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CHAPTER TWO

Implications of Vygotsky's Theory for Peer Learning

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The terms *peer learning* and *cooperative learning* have been used to describe quite different forms of interactions, with different goals, peer arrangements, and types of activities. In this chapter, we focus specifically on peer learning that is related to collaborative problem solving, typically involving two children. The roots of research on this type of peer learning are not in the field of education, but in developmental psychology, with much of the research occurring in university laboratories or in school, rather than involving the study of group processes in the classroom.

In what ways is Vygotsky's theory relevant to a discussion of collaborative peer learning? Vygotsky's theory views human development as a sociogenetic process by which children gain mastery over cultural tools and signs in the course of interacting with others in their environments. These others are often more competent and help children to understand and use in appropriate ways the tools and signs that are important in the cultural group into which they have been born. This process of interaction between the child and a more competent other is said to effect development if the interaction occurs within the child's zone of proximal development.

Although this summary is true to Vygotsky's position, we must not conflate Vygotsky's theory with one small part of the theory; we need to go further if we are to make progress in our understanding of collaboration from a Vygotskian perspective. When scholars study collaboration using a Vygotskian framework, the most commonly cited concept is that of the zone of proximal development,

although this concept is hardly the theory's cornerstone. Our argument is that the application of Vygotsky's theory to collaborative problem solving (as to anything else) requires more than pairing a child with a more competent other and focusing simply on the interactions between them (or, for that matter, on the results of those interactions). Rather, it requires an interweaving of different aspects of development, involving the individual and the cultural-historical as well as the interpersonal, and focusing on the processes of development themselves. Research that dwells solely on interpersonal aspects, relying on the concept of the zone of proximal development, reduces the theory in a way that seriously detracts from its value.

As DeLisi and Golbeck (chap. 1, this volume) and others (Azmitia & Perlmutter, 1989; Chapman & McBride, 1992; Perret-Clermont, 1980; Tudge & Winterhoff, 1993b) make clear, the issue of peer collaboration is also addressed from a Piagetian perspective. Vygotsky-inspired research into peer collaborative problem solving has been less plentiful because Vygotsky, unlike Piaget (especially in his work on moral reasoning), did not emphasize the particular benefits of peer collaboration and focused more on adult-child interaction. Vygotsky's theory, however, has tremendous implications for our understanding of peer collaboration.

We divided the chapter into two major sections. In the first section, we discuss the major aspects of development (cultural-historical, interpersonal, and individual) that characterize Vygotsky's theory. In the second section, we review recent research on peer collaboration that purports to be set within a Vygotskian framework, and examine recent empirical evidence about the conditions under which learning in the course of peer collaboration is most likely to occur.

For the purposes of this discussion, each of these aspects of development (cultural-historical, individual, and interpersonal) will be treated as separate things. This is purely a heuristic device, as they do not operate separately, and Vygotsky's theory requires understanding of their interrelatedness. We cannot understand the interpersonal processes that go on between people (whether child-child or adult-child dyads) without knowing something about the individual characteristics (such as age, gender, motivation, competence) that each participant brings to the relationship. At the same time, we cannot understand the interactions between these individuals without knowing something about the broader context that provides much of the meaning. This context is both micro-systemic (is this collaboration taking place in school or home?) and macrosystemic (the culturally and historically derived meanings and status of collaborations between children, of what is considered appropriate behavior in the home or in the school, and so on). The systemic nature of Vygotsky's theory, as is true of Bronfenbrenner's ecological systems theory (Bronfenbrenner, 1989, 1993; Bronfenbrenner & Ceci, 1994; Tudge, Gray, & Hogan, 1997), should force researchers to analyze the interweaving of these aspects of development.

ASPECTS OF DEVELOPMENT

Culture, History, and Phylogeny

Much of Vygotsky's writing was concerned with evolution, in particular focusing on how humans can be distinguished from other animals, and especially from those closest to humans. Drawing on Darwin, Kohler, Koffka, and others, Vygotsky and Luria (1993, 1994) argued that tool use in apes and chimps constituted the evolutionary link between the animal world and humankind. However, "in spite of the fact that the ape displays an ability to invent and use tools—the prerequisite for all human cultural development—the activity of labor, founded on this ability, has still not even minimally developed in the ape" (Vygotsky & Luria, 1993, p. 74). The use of tools in labor and, yet more important, the use of psychological tools, was critical in the development of human culture, because tools stand as mediating devices between humans and their environments. Just as environments influence people's development, people actively change their environments. This is true whether one designs a stick to be used later for digging and planting (a physical tool), or uses a knot tied in a rope or gives another person a lynx's claw as an aid to memory (examples of psychological tools cited by Vygotsky & Luria, 1993, pp. 102–108). The most powerful psychological tools are signs and symbols, including language, without which neither collaboration nor culture can occur. Culture, Vygotsky (1997) argued,

creates special forms of behavior, it modifies the activity of mental functions, it constructs new superstructures in the developing system of human behavior. . . . In the process of historical development, social man changes the methods and devices of his behavior, transforms natural instincts and functions, and develops and creates new forms of behavior—specifically cultural. (p. 18)

The nature and form of historical developments, in any culture, necessarily have an impact on the thinking, literacy, numeracy, art, and so on, that develops in that culture. These developments, in turn, have a profound effect on the ways in which children's development proceeds in different cultural groups. As Vygotsky (1994a) argued in the first sentence of his 1929 paper titled "The Problem of the Cultural Development of the Child": "In the process of development the child not only masters the items of cultural experience but the habits and forms of cultural behavior, the cultural methods of reasoning" (p. 57).

These developments, of course, have a profound effect on the ways in which children's development proceeds in different cultural groups. The presence or absence of certain types of institutions (e.g., schools), technologies, and semiotic tools (e.g., pens or computers) as well as variations in the values, beliefs, and practices of different cultural groups are interdependent with differences in the ways in which children's development proceeds (Bornstein, 1991; Harkness &

Super, 1996; Hogan, 1996; Rogoff, 1990; Tudge, Shanahan, & Valsiner, 1997; Whiting & Edwards, 1988). The same point is of course true when considering the same cultural group over historical time (Elder, Modell, & Parke, 1993). The study of any aspect of children's development, peer learning included, cannot ignore the cultural and historical context within which that development occurs.

Individual Aspects

It is also critical to bear in mind the dialectical relation between the child and the cultural environment, for although the environment supplies the "habits and forms of cultural behavior" the individual is actively involved in "mastering" those habits and forms (Vygotsky, 1994a, p. 57), and acquiring "as [his or her] personal property, that which originally represented only a form of [his or her] external interaction with the environment" (Vygotsky, 1994b, p. 352). The ways in which this process took place was one of Vygotsky's main areas of interest, including the study of children who were deaf or blind. In his discussion of early development, Vygotsky argued that biological and maturational aspects of development (the "natural line") as well as aspects of the physical, social, and cultural environment (the "cultural line") had to be considered to make sense of development. "Both plans [sic; 'planes'] of development—the natural and the cultural—coincide and merge. Both orders of changes mutually penetrate each other and form in essence a single order of social-biological formation of the child [sic; 'child's'] personality" (Vygotsky, 1997, pp. 19–20).

This set of mutually interpenetrating influences cannot, of course, be separated into specific cultural and natural lines. Nonetheless, individuals bring their own uniqueness to any interaction. Characteristics that contribute to that uniqueness include gender, developmental status (prematurity or full-term birth), pubertal timing, physical or mental attributes, temperament, age, as well as what each individual brings in terms of personal history up to the point at which his or her development is being considered (Valsiner & Litvinovic, 1996). These characteristics are socially rooted, of course, but at the same time are unique to each individual—their own "personal property" (Vygotsky, 1994b). They will be expressed in different ways according to the specifics of the task and of the interacting partner, but any discussion of peer collaboration cannot ignore what each individual brings to the collaborative process.

By way of illustration of what Vygotsky meant by individual differences over time, he described four stages that children pass through in the course of memory development and the understanding of arithmetic (Vygotsky, 1994a). In both cases, what was critical was the development in the child of the use of mediational means, in particular pictures and speech. Vygotsky argued that initially, in the early preschool years, children rely on their natural or "primitive" behavior to try to remember some items. In the second stage, they can use the mediational means (e.g., some type of representation of the items), but only if there

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is a clear connection between the item and the representation. If the link is not obvious, the children are as likely to remember something that was in the representation but had nothing to do with the item to be remembered. The third stage is one in which children start to use the mediating devices more actively, inventing linkages between the item and the representation even when there is no obvious connection. The final stage in the process is one in which the entire process becomes internal, and external mediational means are no longer required.

Vygotsky (1987) clearly stressed the individual's active role in development. Moreover, although he believed that collaboration with others was important, he made clear that its effectiveness has limits, limits that are set by the current developmental state of the individual: "We said that in collaboration the child can always do more than he can do independently. We must add the stipulation that he cannot do infinitely more. What collaboration contributes to the child's performance is restricted to limits which are determined by the state of his development and his intellectual potential" (p. 209).

Interpersonal Aspects

The third interrelated aspect of development deals with interactions with others, something that occurs from the moment of birth. As Vygotsky and Luria (1994) argued, the "entire history of the child's psychological development shows us that, from the very first days of development, its adaptation to the environment is achieved by social means, through the people surrounding him. The road from object to child and from child to object lies through another person" (p. 116). Vygotsky's best-known concept, the zone of proximal development, is most relevant in relation to this aspect of development. Contrasting traditional (and, indeed, contemporary) measures of intellectual development (the "actual" level, as determined by tests of what the child can currently do independently) with the proximal level (what the child can do with assistance of someone more competent, whether adult or child), Vygotsky (1987) argued that "the zone of proximal development has more significance for the dynamics of intellectual development and for the success of instruction than does the actual level of development" (p. 209). Instruction, therefore, "*is only useful when it moves ahead of development. When it does, it impels or wakens a whole series of functions that are in a stage of maturation lying in the zone of proximal development*" (p. 212). The zone is not, therefore, some clear-cut space that exists independently of the process of joint activity itself. Rather, it is *created* in the course of collaboration: "We propose that an essential feature of learning is that it creates the zone of proximal development; that is, learning awakens a variety of developmental processes that are able to operate only when the child is interacting with people in his environment and in collaboration with his peers" (Vygotsky, 1978, p. 90).

The specific mechanisms that allow the child to construct higher psychological structures, according to Vygotsky, are internalization and externalization.

Children internalize or interiorize the processes occurring in the course of the interaction with the more competent member of the culture—they “grow into the intellectual life of those around them” (Vygotsky, 1978, p. 88). Internalization is not a matter of mere copying and is “far from being a purely mechanical operation” (Vygotsky & Luria, 1994, p. 153), because this would preclude the emergence of novelty. Rather, children transform the internalized interaction on the basis of their own characteristics, experiences, and existing knowledge. Development is thus a process of reorganization of mental structures in relation to one another (Vygotsky, 1994a). In subsequent interactions with the social world, the transformed knowledge-structures contribute to its reconstruction. Those who have already aided the child may assist in this process by encouraging externalization: “The teacher, working with the school child on a given question, explains, informs, inquires, corrects, and *forces the child himself to explain*” (Vygotsky, 1987a pp. 215–216, italics added).

Vygotsky did not distinguish between social and cognitive development as contemporary Western psychologists do. In Western societies, cognitive processes are seen as internal and individual, and social processes as external and mutual (Forman, 1992). Vygotsky, by contrast, distinguished between interpsychological (or intermental) and intrapsychological (or intramental) processes. Interpsychological processes are socially regulated and mediated. Intrapsychological processes (e.g., voluntary memory, selective attention, logical reasoning) begin as interpsychological, so they are always in some sense social, as they are based on social interaction. But both intra- and interpsychological processes are cognitive when they are engaged in problem-solving activities. Therefore social and cognitive processes are not separate entities but rather are interdependent. Although Vygotsky focused a great deal of attention on cognitive development, and it is primarily in this sphere that research based on his ideas has been conducted, he cautioned against ignoring socioemotional dimensions of development:

Among the most basic defects of traditional approaches to the study of psychology has been the isolation of the intellectual from the volitional and affective aspects of consciousness. The inevitable consequence of the isolation of these functions has been the transformation of thinking into an autonomous stream. Thinking itself became the thinker of thoughts. Thinking was divorced from the full vitality of life, from the motives, interests, and inclinations of the thinking individual. (Vygotsky, 1987, p. 50)

Vygotsky did not explain the nature of specific psychological mechanisms. An example of such a mechanism is the kind of mental representation of social interactions that form in the internalization process. Vygotsky, however, saw this as essentially a mediated process. The social process passes through a link, a psychological tool. One such tool is a sign, and for Vygotsky the most important type of sign in the transformation of thinking from other- to self-regulation was language.

This focus on these processes of development was clearly important to Vygotsky, but he did not restrict them to discussions of instruction (Nicolopoulou, 1993). In a 1933 lecture, Vygotsky (1978) argued that play is highly important in young children's development, not least because it helps them in the use of symbolic forms: “In play thought is separated from objects and action arises from ideas rather than from things: a piece of wood begins to be a doll and a stick becomes a horse” (p. 97). Meanings of things are thus detached from their typical appearance and serve as mediating devices between objects and ideas, in just the same way that the written word will come to have that function for literate children. Vygotsky (1987) concluded that “play creates a zone of proximal development of the child. In play a child always behaves beyond his average age, above his daily behavior” (p. 102).

It is at this level of analysis that attention can be focused on the actual processes of interaction between the developing individual and his or her environment. That environment is of course a social environment, for although it can be thought of as purely physical (in the case of solitary play), the social is nonetheless present in the provision of play materials, space or time for play, prior knowledge of what are considered appropriate and inappropriate ways in which to play with the materials, and so on. Interpersonal interactions are necessarily key to understanding peer learning, for although we need to know about individual characteristics of the two or more individuals involved, the interactions between them are crucial.

We now turn from a purely theoretical discussion to an examination of empirical research on peer collaborative problem solving, focusing largely (although not exclusively) on research that has been placed within a Vygotskian framework. We then discuss the implications of this work for both peer learning and the theory itself.

RESEARCH ON CHILDREN'S COLLABORATIVE PROBLEM SOLVING

Vygotsky concentrated more on the cultural-historical aspects of development and had relatively little to say about microgenetic problem-solving scenarios that characterize much of the research on social interaction and problem solving (van der Veer & Valsiner, 1994). Nonetheless, the concept of the zone of proximal development and the notion that a potential level of development could be achieved by the child under guidance of adults or peers has inspired research on social interaction and problem solving with important implications for his theory. Although there has been relatively little research on peer collaboration from a Vygotskian perspective, substantial evidence has accumulated that social interaction can be beneficial to children's learning, as Vygotsky hypothesized. Research inspired by both Vygotskian and Piagetian theory has shown

that peer collaboration can facilitate better performance when one child is more advanced (Ames & Murray, 1982; Bearison, Magzamen, & Filardo, 1986; Chapman & McBride, 1992; Doise & Mugny, 1984; Light, 1983, 1986; Mackie, 1983; Murray, 1972, 1983b; Perret-Clermont, 1980; Perret-Clermont & Schubauer-Leoni, 1981; Tudge, 1989, 1992; Tudge & Winterhoff, 1993b; Tudge, Winterhoff, & Hogan, 1996).

It thus appears that children's problem-solving ability can improve when they work together. There are, however, some discrepancies in the literature as to the conditions under which such benefits are likely to be seen (Chapman & McBride, 1992; Tudge et al., 1996). Social interaction does not have uniform effects and the assumption that all social interaction has beneficial effects and none that are detrimental may be untenable. Several studies have found that children have not improved during collaborative problem solving (Doise & Mugny, 1984; Mugny & Doise, 1978; Perret-Clermont, 1980; Russell, 1982). In addition, evidence has accumulated indicating that under some conditions collaboration may in fact have detrimental effects (Levin & Druyan, 1993; Rosenthal & Zimmerman, 1972, 1978; Tudge, 1989, 1992; Tudge & Winterhoff, 1993a; Zimmerman & Lanaro, 1974). The findings suggest that benefits may depend on a complex set of factors. Such factors may include the particular age and ability level of the children and of their partner, the children's motivation to collaborate, and the extent to which they are exposed to more sophisticated reasoning by a partner and are willing to accept and use that reasoning independently. The nature of the task will also have an influence, as the situations and activities will pose challenges to the ways in which children had previously used certain cognitive operations. The institutional and cultural supports for collaboration will also interact with the other factors. Under what conditions is cognitive growth most likely to be fostered when children collaborate? In the discussion that follows, we focus on individual, interpersonal, and cultural-historical factors separately, although we wish to be quite clear that this organization is for heuristic purposes only.

INDIVIDUAL FACTORS

Individual factors differentiate individuals from one another and include age, gender, and personality and socioemotional factors. It is critical, from the point of view of Vygotsky's dialectical approach, to consider what the individual brings to the learning situation. Although the emphasis is clearly on sociocultural context in Vygotsky's theory, dialectical models stress the interrelatedness of person and environment. Thus, it is not the case that the social or cultural context determines the process or outcome of collaborative learning. Rather, individual and contextual factors interact and mutually affect each other. Age and gender are two factors that are typically viewed as individual characteristics by

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scholars who have focused on peer collaboration. Perceptions of what can be achieved, either individually or collaboratively, by children of different ages or gender, however, are more than "individual" characteristics, but clearly of interpersonal and sociocultural relevance. Nonetheless, they are usually treated as individual factors.

Age

Research on peer collaboration is typically conducted using school-aged children, but the extent to which younger children can benefit from peer collaboration has been debated in the literature (Azmitia & Perlmutter, 1989). The issue arises out of apparent differences between Piagetian and Vygotskian theory. Piaget argued that the greatest benefits of peer collaboration would be achieved when children had reached the concrete operational stage, whereas Vygotsky, by contrast, believed that social interaction was important for children's development from birth, when adults first begin to encourage children to communicate, plan, and remember. However, he did not state that this would necessarily be the case for interaction with peers (Tudge & Winterhoff, 1993b).

Research has been inconclusive on this issue. Cooper (1980) found that 5-year-olds were more likely to get involved in discussion and collaboration than 3-year-olds on a balance scale task, and Azmitia (1988) found little evidence that discussion helped 5-year-olds learn a model copying task. Tudge and Winterhoff (1993a), on the other hand, using a mathematical balance beam task, found that 5- to 6-year-old children performed better when they worked with a more competent partner than when working alone or with a less competent partner. In related research, 5-year-olds were as likely to benefit from collaboration as 8- to 9-year-olds (Tudge, 1992). Most commentators concur that further research is needed to ascertain age-related constraints on the benefits of social interaction (Azmitia & Perlmutter, 1989; Forman, 1992; Tudge & Rogoff, 1989). The discrepant results outlined here point to the need for studies that vary age levels and that incorporate preschool children. Vygotsky believed that biological factors would place limitations on children's development of higher psychological functions. He was very unclear, however, about how these factors operate and did not specify how the organically based elementary processes relate to the development of the higher functions (Wertsch & Tulviste, 1992). This is an area that warrants further research and theory development.

Gender

Gender is generally underexplored as a potential factor influencing children's collaborative efforts apart from work reported by Bearison and his colleagues, conducted from a Piagetian perspective (Bearison et al., 1986). Gender differences have been found in the way in which children use language in interaction

in other areas of research (Ellis & Gauvain, 1992). In two studies of peer collaboration set within a Vygotskian framework, gender differences were reported. Ellis and Gauvain found sex differences in the way boys and girls exchange information in same-sex pairs. Tudge (1992) reported that although, on average, girls and boys did not differ in their overall initial level of reasoning (rule use) in a balance beam task, there were differences in performance following collaboration. Specifically, girls were more likely to regress, following collaboration with other girls, than were boys who had worked with boys, in part because the girls seemed more interested in preserving good relations with their partners than in arguing with one another. The findings of these studies indicate that gender is an area deserving greater attention.

Further work is also necessary to identify other individual factors that may influence the success or failure of collaborative learning among peers, the most obvious of which is individual motivation to collaborate and learn. This issue is discussed further here, as well as in other chapters in this volume (e.g., Palincsar & Herrenkohl, chap. 6, and Webb & Farivar, chap. 5).

INTERPERSONAL FACTORS

Interpersonal factors are processes taking place between individuals. Vygotsky argued that social interaction is the forum in which change in individuals and contexts occurs. Much of the research on peer collaboration set within a Vygotskian framework targets interpersonal factors and has led both to advancement of Vygotsky's theory and to greater understanding of the conditions under which social interaction is most likely to lead to developmental advance in children's thinking. The interpersonal factors discussed here include the nature of the pairing, including a contrast of adult-child with child-child pairing (because this has important implications for collaborative learning and for Vygotsky's theory), and the implications of pairing children of different competency levels, both when independent feedback is provided and not provided. The role of interpersonal socioemotional factors, including motivation and relative confidence of the partners, is also discussed. Finally, we discuss the findings regarding achievement of joint understanding of the problem.

Adult-Child and Child-Child Pairing

Vygotsky's theory that higher mental functions originate in shared problem solving, during which children learn more skilled approaches in interaction with a more competent partner, has received most attention as it relates to adult-child rather than peer interaction. This may be because it is frequently viewed as the opposite to Piagetian approaches to cognitive development. Piaget believed that social interaction was likely to be most beneficial when the rela-

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tionship between partners was socially symmetrical. Children would be more likely to enter into a true negotiation of reasoning with partners who are not seen as holding positions of authority, or as experts (see, e.g., DeLisi & Golbeck, chap. 1, this volume; DeVries, 1997; Tudge & Rogoff, 1989; Tudge & Winterhoff, 1993b). Vygotsky did not address the issue of social hierarchy, but stressed the importance for development of collaborating with a more competent partner (asymmetry in knowledge rather than in social relations), and in his own work referred more to adults in his discussions of the zone of proximal development. Is social interaction only valuable when children are paired with adults, or can interaction with peers also be valuable? Research set within both Piagetian and Vygotskian frameworks indicates that collaboration both with adults and peers can have positive effects on children's cognitive development in the course of collaboration, yet research comparing adult-child and child-child pairing has had somewhat mixed results.

In a study conducted by Radziszewska and Rogoff (1988), target children were 9 to 10 years old. In the peer dyads children were class friends and adult-child dyads were mother-daughter and father-son pairs. The dyads were given maps of an imaginary town, with a school and 23 stores, and two lists of errands. The task was to devise the optimal route for one car from school and back to retrieve the items on the two lists. To produce this route, the pair had to consider relative distances for locations they had to visit, as well as for alternatives (on every list there were two items that could be bought at either one of two stores). Pairs were told that they would later be asked to plan a trip alone, and collaboration rather than instruction was stressed. At individual posttests, target children who had collaborated with adults performed significantly better than those who had worked with peers. Results indicated that adult-child pairs were more likely to use sophisticated planning strategies—they planned sequences, whereas peer dyads used more one-step moves (similar to those used by younger children working alone), and this proved more effective.

A study by Gauvain and Rogoff (1989) looked at the effects of sharing responsibility during joint planning with a peer or with an adult partner on later individual performance. The participants were 5-year-olds, and the study was of a similar design to the study just described, except that participants were not aware that they would receive a posttest. During planning, adult-child dyads produced slightly more efficient routes than did peers or solitary children and showed more concern with definition of task and efficiency. However, when they later planned routes alone, there was no difference in efficiency, indicating that the children had not made their parents' more efficient strategies their own.

Studies conducted by Ellis and Rogoff (1982, 1986) focus on peer versus adult tutoring (the authors argued that these can be viewed as instances of collaborative problem solving). Differences were found in the way in which adults and children teach: Children's teaching depended more on demonstration and modeling and their verbal instruction was less complex. Children were less effective

as teachers on complex laboratory classification tasks, seeming to have difficulty coordinating the multiple demands involved in managing the instructional task. The strategies used by the two kinds of dyads were compared in a task involving classification of either grocery items or photos of common objects on kitchen shelves in colored boxes (Ellis & Rogoff, 1986). The task of the more advanced partner was to prepare child learners to perform the task independently for a later test. Child teachers tended to focus more on the immediate task of putting the items in the right locations and seldom explained the categorization rationale, whereas adult teachers placed more emphasis on the long-term goal of having the child learn the categorization scheme for a later memory test. It was concluded that the benefits of having an adult partner were greater than those associated with having a peer partner.

As a whole, this research provides support for the theory that a zone of proximal development can be constructed with either an adult or peer, but indicates that pairing with an adult has different consequences (often more beneficial) for children's learning. This has important implications for Vygotsky's theory, because in his discussion of the zone of proximal development, he did not differentiate between the potential effects of either type of partnership. Although the focus of this chapter is on peer interaction, we return to the issue of the relative benefits of adult-child and child-child pairing in our discussion of the processes occurring in social interaction that are most likely to foster cognitive growth.

Competency Levels Between Peers

Vygotsky's (1978) theory suggests that cognitive growth may occur not only when children are assisted by an adult but also when children collaborate with a more competent peer. There has been considerable support for this idea in research inspired by both Vygotsky's and Piaget's theories. Some research shows that interaction between children of the same cognitive level can be beneficial, as long as interpersonal conflict is engendered (Ames & Murray, 1982), but that collaboration is more effective when a child is paired with a more advanced partner.

The findings are somewhat mixed, however. Although the majority of research indicates that children who work with a more competent partner improve more than those who have an equally or less competent partner, recent work by Tudge and his colleagues (Tudge et al., 1996) demonstrates an exception. Children were pretested individually and classified according to the level of "rule" they used to predict the movements of a mathematical balance beam when different combinations of weights were placed at varying distances from the fulcrum. The rules (of which there are six levels) correspond to children's increasing ability to take into account weight and distance to solve the problems. Children either worked alone or were paired with same-sex partners who used the same rule, a higher rule, or a lower rule at pretest. Some children received

feedback from the materials and some did not. In the collaborative sessions, they were asked to predict the workings of the beam (whether it would fall to either side or stay balanced when blocks holding it in place were removed) and provide justification for their predictions. When children disagreed, the experimenter asked them to discuss the problem until they reached agreement. After agreement had been reached, they were again asked to provide justification. Tudge and his colleagues reported that although working with a partner was somewhat more effective than working alone, this was only true under conditions of no feedback. Working with a more competent partner was not more effective than working with an equally competent partner or working alone—especially when the child did not receive feedback from the materials.

The concept of the *zone of proximal development* has generally been taken to imply that neither the task difficulty nor the guidance given to children should be too far in advance of their current level of ability. Tudge et al. (1996) tailored the problems given to target children in each dyad so that the most difficult problem could be solved by using the rule one higher than they had used at pretest. Their partners had used a rule no more than two higher than that of the target children. This kind of pairing was more effective in bringing about cognitive growth than was the case in previous studies (Tudge, 1989, 1992), when the problems were not tailored in this way. In the earlier studies, children's improvements were not as pronounced. Results obtained to date are generally supportive of Vygotsky's belief that learning is most likely to occur when help is "proximal" to the current level of the child. In research currently underway by Tudge and his colleagues, both competency level and difficulty task are varied to investigate the limits of proximity to current level for cognitive growth to occur.

Vygotsky's theory of development (particularly his concept of the zone of proximal development) is typically taken to mean that the effects of social interaction will always be positive and never detrimental to cognitive functioning (van der Veer & Valsiner, 1994), although Vygotsky (1934, cited in Wertsch, 1985) stated that instruction should be in *advance* of the child's current level for learning to occur. The work of Tudge (1989, 1992), and of Levin and Druyan (1993) indicates that when children are exposed to reasoning that is *below* their own current level, the effects of collaboration can be detrimental. When children were paired with a less competent partner in Tudge's balance beam experiment (but when feedback was not a condition), some children regressed in their reasoning. Specifically, if a child could be persuaded by a less competent partner to accept reasoning that was less advanced, regression was likely to occur. Tudge suggests that functions that are not fully formed (those that Vygotsky referred to as *embryonic*) may be more malleable, so that development can be either in the direction of progression or regression. In Tudge's rule system, some rules allow children to consistently predict the workings of the beam (i.e., how it will behave when weights are added in certain configurations and at certain distances from the fulcrum). Other rules do not allow for such consistent predic-

tion. Tudge (1989, 1992) found that children who used rules on the pretest that were least open to consistent predictability of the working of the balance beam were most likely to develop—but development could be either in the direction of advance or decline, depending on whether they were paired with a more or less competent partner.

Levin and Druyan (1993) found that children regressed on a task involving a misconception about movement and speed. The experiment was based on the belief in *single object–single motion*. The misconception is that two parts of a single object cannot move at different speeds. Children were shown video simulations of dogs moving on a screen. In one simulation, two dogs run on a track and are unattached (*autonomous carrier*); on the other, the two dogs are carried by a rotating carousel (*common carrier*). The problem is to work out whether the dogs are moving at the same speed in each scenario and, if not, which is moving faster. Children who gave discrepant responses to the second problem at pretest were paired (one child offering the misconception as a solution, the other giving the scientific solution). On the autonomous carrier problem, children who were paired with a more competent partner were likely to improve. On the second problem (common carrier), involving the misconception, the more competent children (those who had originally given the scientific [correct] solution) were likely to regress as a result of collaboration.

These studies suggest that regression is not only possible but also likely, depending on the level of competency of a partner as well as on the nature of the task. The findings have important implications for Vygotsky's concept of the zone of proximal development and its functioning, broadening it in a manner that is compatible with Vygotsky's thinking to include the possibility of developmental decline as a consequence of interaction in the zone of proximal development. Tudge (1992) suggested that it may be possible to construct a zone of proximal development either in front of or behind the child's current level of reasoning. The question remaining unexplored is whether there are limits on the degree to which children will decline. For example, when children decline to a level that is not malleable, or to a fully matured (lower) level of reasoning, will developmental decline stop? This can be tested by varying the degree to which the partner is less competent than the target child.

Interpersonal Socioemotional Factors

Vygotsky assumed that children would be motivated to learn from their more competent partners, and there is some empirical evidence to support this. Ellis & Rogoff (1982) found that children will initiate their own involvement in problem-solving activities when their partners are ignoring their presence or doing little to encourage joint participation. But what compels children to accept the reasoning of another once collaboration has begun? Why do children internalize knowledge at higher (and lower) levels? Although his primary concern was

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with the processes of development and particularly the transformation from intermental to intramental functioning, Vygotsky's theory did not deal adequately with this question beyond specifying a process of internalization and externalization. The lack of attention paid to this question by researchers interested in peer collaboration may be due to the difficulty associated with its investigation (Ellis & Gauvain, 1992). One way in which the issue has been explored is in terms of the relative confidence of collaborating partners, that is, as an interpersonal issue. Another important factor may be children's prior relationships, but this question has received little empirical attention to date.

Tudge (1989, 1992) raised the issue of whether researchers have confounded competence and confidence in children, particularly in Piagetian studies that involved pairing conservers with nonconservers. Results of these studies invariably report improvement of nonconservers. This can be explained, Tudge argued, by the fact that conservers (according to Piaget) are necessarily more confident, because they see the logical necessity of their position. As a result, their less confident partners accept their reasoning. The nature of the rules children used to predict the working of the balance beam in Tudge's own studies (1989, 1992; Tudge et al., 1996) may be associated with differences in the confidence of children's reasoning. As discussed earlier, three of the rules necessarily involve some inconsistency in prediction, whereas three others allow consistent prediction. Children using rules involving some inconsistency at pretest were more likely to improve when paired with a child using a higher, consistent rule and to regress when paired with a partner using a lower, consistent rule. About twice the number of children who had used a rule allowing consistent prediction at pretest continued to use that same rule than did children who used a rule that involved uncertainty. In short, less confident children were likely to accept the reasoning of their partner, even when it was at a lower level than they began with, and these developmental regressions were stable.

Levin and Druyan (1993) came to a similar conclusion regarding their finding that children who held the scientifically correct solution to a problem about movement and speed were likely to regress when paired with a child who held a misconception about movement and speed. Misconceptions are intuitive concepts that are resistant to change even in the face of scientific evidence to the contrary, perhaps because the solutions are (apparently) self-evident. Children who held the scientific misconception at pretest were likely to have been more confident of their position and children who offered the scientific solution, having little evidence from everyday life to reinforce their thinking, were less confident.

These studies clearly point to the relevance of affective factors in children's learning. Work by Forman and her colleagues (Forman, 1992, Forman & McPhail, 1993) may point the way to more fine-grained analysis of such emotional factors as children's task goals and the processes by which they come to reach intersubjectivity. This group of researchers analyzed children's verbal commu-

nication to try to understand the process by which intersubjectivity is achieved. Forman (1992) analyzed discourse between peers, basing her definition of discourse on Ochs' (1990) view that whereas language (explicit verbal arguments) may reduce our understanding of context, discourse, by contrast, relates language to the norms, preferences, expectations, and so forth, that are implicit in communication. Discourse is the more appropriate form of analysis, Forman argued, from a Vygotskian perspective, because it implies a social process that takes context-based factors into account, and because its focus is on speech as a mediational tool. Forman (1992) argued that intersubjectivity is built on the interpsychological activity of discourse:

What children learn from discourse is a set of implicit principles of cooperative interaction and procedures for making inferences about what people mean by what they say. These conversational influences are different from the inferences employed in formal deductive arguments. Conversational inferences are the means by which children take an active role in the co-construction of knowledge. (p. 148)

Thus, analysis of discourse can lead us to a better understanding of how intersubjectivity is achieved. We can learn, for example, how children gain the ability to combine the conversational discourse used outside the context of school with the kind of logical argument necessary to successfully solve an academic problem as a team. Forman's work indicates that successful achievement of intersubjectivity requires that children coordinate their interpersonal wishes to dominate or to please their partner with the need of the dyad to work together to solve the problem. Forman and McPhail's (1993) analysis of speech registers enabled them to see how children reflect on and modify their initial task goals so that they can come to a shared understanding of the task and collaborate. This is clearly a promising avenue for further research that may help to tease out the process by which knowledge comes to be jointly constructed.

Joint Understanding

Several studies, including those conducted with peer dyads only and those in which peer pairing has been compared with child-adult pairing, indicate that having a more competent partner is not a sufficient condition for cognitive growth to occur. It is also important that children be exposed to a higher level of reasoning than that which they exhibited at pretest, and that they accept that reasoning. In Tudge's (1989) study, children were asked to provide justification for their predictions during the experiment (no feedback was given). Reasoning could be provided at the same level as the partner's, or at a higher or lower level. The effects of the quality of this reasoning were substantial. When children were exposed to reasoning at a higher level, they were likely to start to use a higher rule themselves, although not in all cases. In some instances, children accepted their partner's more sophisticated reasoning during the collaborative ses-

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sion, but did not proceed to use (adopt) it at subsequent individual posttests. Similar results were reported in a later study (Tudge, 1992). For advances to occur, the more competent partner had to verbalize his or her reasoning and the less advanced child had to accept it.

Ellis and Rogoff (1986) found that peers communicated their reasoning poorly to their partners in comparison to adults in the course of a joint planning task. In subsequent individual posttests, children who had worked with a peer showed more of a tendency to use less effective, step-by-step approaches to the planning task than did those paired with an adult. Radziszewska and Rogoff (1988, 1991) reported a similar phenomenon. The greater success of the adult-child pairs than the child-child pairs could be explained by the fact that children in the former type of dyad were exposed to more sophisticated reasoning than was the case in the peer dyads, if only because adults were much more likely to verbalize their thinking about potential strategies (98% of adults did so). Indeed, these were virtually the only children who heard strategy statements. These findings suggest a strong role for verbalization of reasoning by partners as a condition under which cognitive growth is more likely to occur during peer collaboration. Although Vygotsky did not explicitly state that this should be a condition for social interaction to be beneficial, it is quite compatible with his thinking about the importance of language as a mediating mechanism inherent in the process of social interaction and internalization. The research just outlined supports and further clarifies this thinking, underscoring the importance for children of hearing verbalized reasoning at a higher level. It indicates that simply hearing another's more advanced thinking does not necessarily lead to learning; there must also be a process of negotiation, through which children reach a joint understanding of both the task at hand and the solution, for children's thinking to advance.

Scholars in the Vygotskian tradition have stressed the need for children to come to joint understanding of a problem on the basis of having taken each other's perspective into account. The concept has been related to the linguistic concept of intersubjectivity as used by Rommetveit (1975) in work by scholars such as Gauvain and Rogoff (1989) and Wertsch (1985). The less advanced child is assumed to be interested in learning from the more competent partner, and the expert is viewed as having responsibility for adjusting to the level of support or guidance to fit within the child's zone of proximal development (Tudge & Rogoff, 1989).

Research by Ellis and Rogoff (1982, 1986) indicated that it is important that the more competent partner understands what the less advanced partner needs and is able to adjust the degree of support they give to match that. Adults were found to be more skilled at doing this with children than were peers. Gauvain and Rogoff (1989) found that those children who shared responsibility for the task and made joint decisions with their partner were most likely to improve. In later solitary trials, having had a partner per se was not related to improved plan-

effectiveness or use of foresight; those who had shared responsibility during collaborative sessions were more likely to use advanced scanning and more efficient routes than children who had not, and these children were also more likely to be responsible for decision making. This was true for adult-child and peer dyads. These findings are consistent with Vygotsky's position that knowledge is first social and later individual, in the sense that knowledge is created in the course of interaction with another, rather than simply preexisting in the environment.

In research that has focused solely on peer collaboration, Forman and Cazden (1985) looked at the joint problem-solving activities of 9- to 14-year-olds, using Piaget's chemical task and a projection of shadows problem. The authors were interested in how peers came to a shared understanding of the task. They found that it was more important for partners to coordinate their perspectives and coconstruct a joint answer (*interpsychological regulation*) than it was for them to have a different perspective to start off with for peer collaboration to be beneficial.

Interaction Style

What influences the process of coming to a joint agreement on a problem? One factor may be the way in which children interact with one another. Styles of interaction will significantly affect the experience of *guided participation*—the idea that negotiation of a problem is most likely to be beneficial when the more competent partner has the skills and motivation to tailor the help given (the kind of reasoning provided) to a level appropriate for the less advanced partner (Rogoff, 1990; Wertsch, 1985). However, it is also important for the less advanced partner to be motivated and actively involved in the process, as exemplified by research reported elsewhere in this volume (Palincsar & Herrenkohl, chap. 6; Webb & Farivar, chap. 5).

In the literature on collaborative problem solving, the issue of the role of interaction style for cognitive growth has largely centered around whether cooperative styles are the most likely to produce growth (Azmitia & Perlmutter, 1989). Most studies of elementary school children seem to indicate that cooperation is more conducive to learning than domination by one child. Children can benefit from an activity if they are jointly involved in the problem solving, although it has also been shown that children can improve from simply copying a model (Azmitia & Perlmutter, 1989). Dominant styles may be preferable at the early stages of interaction if the child is a novice, but when the child's competence is increased, a more cooperative style may be better. Forman and Cazden (1985), in their work with peer dyads, found a correlation between the level of social interaction children used (the degree to which both children were involved with each other) and learning. Three styles of interaction were discerned as the children worked on problem-solving tasks. The first was a parallel form,

in which there was no exchange. The second was an associative form, in which children tried to exchange information but did not attempt to coordinate their roles. Finally, there was a cooperative form, in which both children constantly monitored each other's work and played coordinated roles in carrying out the task. Cooperative interaction was associated with the most advanced cognitive operations in reaching solutions to the task.

Research also suggests that the capability of more advanced partners to provide support at an appropriate level is an important feature of interactional style. As discussed previously, Vygotsky's view was that development of cognitive abilities is facilitated by help from a partner that is targeted to somewhat in advance of the child's current level. This sensitive support facilitates the transition from shared to self-regulated cognitive processes as the child is supported in taking on an increasingly active role, or in what Rogoff (1990) termed *guided participation*. This shift in responsibility has been explored somewhat in comparison studies of adult-child versus peer pairings but very little in research on peer interaction. In one such study, Ellis and Rogoff (1986) found that peers were not as good as adults in scaffolding the performance of another. In Ellis and Rogoff's comparison of adult-child and child-child dyads, the child teachers tended to give learners too much responsibility and not enough guidance. Adult teachers played a dominant role early on, but then gradually withdrew their support on the basis of what the child appeared to need. Child teachers tended to allow insufficient participation by learners but did seem to be aware of the learner's need for more information and guidance and to become gradually more effective in imparting this over time. Gauvain and Rogoff (1989) concluded that child teachers (e.g., trained peers) may not be sensitive to the appropriate level for learning in the less advanced child. Child teachers "did not involve the learners at a comfortable level allowing the learner some degree of participation without requiring the learner to do much alone prematurely" (p. 303). These findings provide support for the Vygotskian emphasis on joint construction of solutions to problems as the means through which advances in children's psychological functioning comes about. At the same time, it calls into question the extent to which peers can be expected to be able to successfully coconstruct a zone of proximal development in interaction with less advanced peers, because even if a peer knows what the less advanced child needs, he or she may have difficulty adjusting to an appropriate level and adjusting as the child improves over time. The findings of Ellis and Rogoff (1982, 1986) and Gauvain and Rogoff (1989) are consistent with the emphasis of Vygotskian scholars on the importance of partners' achieving joint understanding and definition of goals (intersubjectivity; Tudge & Rogoff, 1989). They serve to illustrate the important role of sensitivity to the level and needs of the less advanced child and of ability to adjust guidance to the appropriate level.

What influences interaction styles? Ellis and Rogoff (1986), in their work involving classification tasks, found one factor to be the nature of the task. Part-

ners who were acting as tutors in this study tended to be more dominant in their style of interaction on tasks that resembled activities in the home than on tasks that resembled school activities. However, research on peer collaboration has not yet found satisfactory answers to the question of how children come to collaborate and, as a result, to learn. Overall, knowledge about the process that brings children together to work out a joint solution is limited, although other chapters in this volume (e.g., those by King, chap. 4; Palincsar & Herrenkohl, chap. 6; and Webb & Farivar, chap. 5) are very helpful. We still know comparatively little, however, about children's initial task goals, about how they modify or redirect their individual and interpersonal goals and preferences to meet the task of negotiating as part of a dyad. We know that it is important for children to accept a higher level of reasoning but do not know what compels them to do so. We know that guided participation facilitates learning, but we do not understand what motivates a more advanced partner to provide continuous, progressive support as the less advanced child moves toward greater responsibility. These are questions about socioemotional factors, an area that has received little attention in the literature.

Feedback

Another area that has received limited attention is that of feedback that comes not simply from the collaborating partners, but from the materials themselves. For a child to receive confirmatory feedback that the proposed solution is correct presumably provides a boost to his or her confidence, and no doubt helps a dyad achieve joint understanding. In studies of social interaction, feedback has sometimes been available, sometimes not. What is striking about the majority of the research is that the potential effects of feedback separate from those of the interaction process have not been examined. In some studies in the tradition of Vygotskian theory, for example, when model copying is used (e.g., Wertsch, 1979; Wertsch & Hickmann, 1987) and feedback is inherent in the task, it is not possible to determine whether it is the effects of the social interaction process or of feedback that underlie the results observed. In one study involving social interaction between 3- to 5-year-old children and their mothers (Freund, 1990), the separate effects of feedback or social interaction were examined. One group of children interacted with their mothers in the course of the problem-solving task and received no feedback from the experimenter as to whether their solutions were correct; another group did not interact with their mothers but did receive feedback at the end of the task. Children who collaborated with mothers improved more than those who got feedback. However, because mothers typically regulated their children's problem solving, it can be seen as a kind of feedback in itself, and because Freund did not control simultaneously for feedback and social interaction, the separate effects of each on children's performance were unclear.

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Two studies questioned the nature of the separate effects of feedback from the materials and social interaction among peers. Ellis and Siegler (1994) studied fifth graders' mathematical problem solving with decimal fractions, alone and in dyads, with some children receiving feedback as to the correctness of their responses and some not. None of the children who did not receive feedback gave correct responses at the posttest, irrespective of whether they worked alone or with a partner, whereas a significant number of those who received feedback answered correctly. The most successful problem solvers were children who received feedback and worked with a partner—they were more than twice as likely to answer correctly at posttest than singletons who received feedback. Tudge et al. (1996) studied children engaged in a problem-solving task using a mathematical balance beam. Children were in three groups: 6-year-olds, 7-year-olds, and 8- to 9-year-olds. Some of the children worked in pairs and some alone, some received feedback from the materials and some did not. Children who received feedback from the balance beam improved significantly more than those who did not. Those who worked with a partner performed better than those who worked as singletons, but only when they did not receive feedback; children working as singletons with feedback did better than children who worked with a partner, a finding that contrasted with most previous research on the effects of peer collaboration. Tudge and his colleagues speculated that having a partner may serve as a distraction, encouraging social interaction that is not related to the task, and that when singletons got feedback they used it. When no feedback was provided to singletons, most continued at the same level or declined. Just receiving feedback was not enough to help a child advance in the level of reasoning they used to solve the balance beam problems, however. The children most likely to improve were those who were exposed to, and accepted, a higher level of reasoning. These findings suggest that a partner may not be necessary, if the problems given are tailored to the level of the child and contingent feedback is given. But when no feedback is given, having a partner may be more conducive to learning. It appears that our understanding of the impact of competency levels and task difficulty on children's collaborative problem solving can be enhanced greatly by taking feedback into account.

Our final point relating to interpersonal factors in collaborative problem solving is that most studies involving contrasts between dyads (or small groups) and individuals assume that individuals are working alone, simply because they have no partner. In fact, of course, the social world is always present, sometimes in the person of the researcher, who is there ostensibly simply to observe but in fact provides a high degree of regulation. Even if the researcher is "present" only by virtue of a camera, the social world is clearly present. It is present in the materials provided, the way in which the child is asked to attempt the experimental problem, the unusual circumstances in which the setting is arranged (from a university laboratory to a relatively secluded area in the child's school), and in so many other ways.

CULTURAL-HISTORICAL CONTEXTUAL FACTORS

Discussion of cultural-historical or sociocultural factors is rare in the Vygotsky-based literature on peer collaboration (far less common than studies that examine adult-child collaboration), but even more rare are studies that incorporate analysis of cultural-historical or sociocultural factors into the design. We identified three such studies, one conducted by Tudge (1989) comparing children from the (now former) Soviet Union and the United States on a problem-solving task, a second conducted by Ellis (1987) comparing Navajo and Euro-American children on instructional strategies, and a third by Tudge and Winterhoff (1993b). In each case, the researchers attempted to explain differences in collaborative problem solving by invoking knowledge of historically formed features of the cultures involved.

Tudge (1989) used a mathematical balance beam with 5- to 7-year-old same-sex pairs. The findings were virtually identical across the two cultural groups: when children who used an "unconfident rule" were paired with a higher level partner, they were likely to improve with a confident partner but likely to regress if the more confident partner's rule was lower than their own. In the United States, however, boys made greater pretest to posttest improvements than girls, and the latter were more likely to regress. In the Soviet Union, there were no gender differences. Tudge argued that cultural norms about gender could explain these findings. In the United States, boys tend to be socialized to think of themselves as being good at mathematics and scientific thinking relative to girls. In the Soviet Union, by contrast, girls were not raised to see themselves as inferior in this area. Girls in the United States may also be more ready to agree in order to preserve friendship or to please, although this may mean declining in the sophistication of their reasoning.

In a second study that addressed sociohistorical factors, Ellis (1987) compared Navajo and Euro-American children's instructional strategies. Using a three-dimensional battery-operated maze game called "The Way to the Store," pairs of 9-year-olds were asked to teach individual 7-year-olds (i.e., these were groups of three children). Cultural differences were found in the manner in which instruction was carried out, with Euro-American children relying more on verbal instruction than Navajo children. However, the proportion of useful task information to overall information conveyed was greater for Navajo groups. There were also differences in degree of involvement in the task and division of instruction. Overall, Navajo children appeared to be more supportive partners and to collaborate more effectively. The authors related these findings to differences in cultural values for talking and for collective rather than individual achievement.

A third study did not incorporate analysis of cultural-historical factors into the initial design but discussed findings with reference to sociohistorical factors.

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In his discussions of sociohistorical development, Vygotsky emphasized the importance that changes in the sociopolitical landscape and its associated institutions could have for children's development. One such institution is formal schooling, which Vygotsky expected to have implications for the development of higher mental processes. Tudge and Winterhoff (1993a) argued that school experience is sometimes confounded with age. They studied 5-year-olds collaborating on a problem-solving task. Their results suggested that children who were longer in school were more familiar with expectations and requirements of school and with interacting with peers and teachers. Specifically, children who were longer in school (not older children) used a significantly higher rule at individual pretest than peers with less school experience. In addition, there were differences in the degree to which children benefited from receipt of feedback, depending on amount of experience with formal schooling; those with more experience benefited more.

SUMMARY OF RESEARCH FINDINGS AND IMPLICATIONS FOR VYGOTSKY'S THEORY

As a whole, research on peer collaboration in the past decade has led to greater specification of the conditions under which collaboration is most likely to foster cognitive growth. It is now clear that social interaction cannot be assumed to have blanket effects and certainly cannot be assumed to be always beneficial. For example, competency has a complex relation with feedback, such that when children receive contingent feedback from the materials, it may even be preferable to work as a singleton. Other conditions that affect the degree to which social interaction among peers can be expected to lead to developmental advance are the age of partners (although the findings are mixed), and the relative competence of partners; being paired with a more competent partner is generally preferable, whereas pairing with a less competent partner may lead to regression. In addition, there is evidence that cognitive growth is most likely to occur when tailoring occurs at three levels; tailoring of the level of reasoning to which children are exposed (competency level of partner), of the difficulty of the task, and of the support given by the social partner. Further research is needed to investigate optimal adjustment of these three features of social interaction to the child's current level. It also appears critical that more competent partners verbalize their reasoning and that less advanced children accept reasoning at a higher level than they started out with. Furthermore, the greater the extent to which partners are involved in the task, treat it as a joint endeavor, and come to a shared understanding, the more likely it seems to be that children will learn. Finally, the children's perception of their partner's reasoning (perhaps because he or she is more confident) may be conducive to development, but whether this is developmental advance or decline depends on whether the more confident

partner is also the more competent. These findings can only be taken as suggestive of conditions under which development may be fostered, and not to represent optimal conditions for learning. There are no optimal conditions that have universal application irrespective of context.

Strengths and Weaknesses of the Research and Implications for Vygotsky's Theory

The studies discussed here generally provide support for Vygotsky's theory that children's development can be fostered both by adults and by more competent peers. It also extends and clarifies that theory in important ways but fails to address it in others. One of the greatest strengths of this body of literature is that process has received at least as much attention as outcomes, in keeping with Vygotsky's own interests. Although many researchers look at pretest and posttest differences in attempting to specify the optimal conditions for development to occur, attention has been paid to the question of how shared knowledge is created and how more competent partners facilitate the internalization of this knowledge.

The studies reviewed here generally support Vygotsky's theory. Indeed they provide evidence that knowledge can be constructed socially—it can exist as a social interactional process prior to being internalized and used independently by children (a basic premise of Vygotsky's work). It provides support also for the concept of the zone of proximal development. A number of studies indicate that less advanced children can move to a higher level of thinking with the help of a more competent partner. Several important conditions are attached to this however. Whereas Vygotsky (1978) loosely grouped adults and more competent peers together in his discussion of the zone of proximal development, several of the studies outlined here indicate that there may be differences in the consequences of working with an adult and working with another child, arising perhaps from adults' greater skills at tailoring their support to a level that is conducive to learning. There may also be age constraints on the potential for social interaction to help foster cognitive growth, but this is an area that needs further research. Vygotsky believed that there were limits on the extent to which constructing the zone of proximal development could result in higher levels of thinking, and this has also found support. One notable extension to Vygotsky's formulation of the concept of the zone of proximal development is the finding that social interaction with a less competent peer can lead to regression. Although this is not incompatible with Vygotsky's views (he specified that help should be provided in advance of the child's current level), it makes explicit the possibility that development can proceed either in the direction of advance or decline, and therefore that a zone of proximal development can be constructed ahead of or behind the child's current level of cognitive ability. The limits to which this can occur have not yet been investigated. Research outlined here also

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suggests that development is likely to occur (as Vygotsky hypothesized) when children's thinking is at an immature stage. One reason why thinking that is not yet fully formed is more open to development (in either direction) appears to be that children at such stages behave less confidently than those who hold greater conviction about the correctness of their thinking. Children's social partners need not necessarily be more competent to be more self-assured. These findings both support and extend Vygotsky's conceptualization of the zone of proximal development. Research also indicates that when feedback is provided, the relation between relative competency of partners and the likelihood of cognitive growth is complicated. As mentioned earlier, when feedback is available, it may actually be preferable to work as a singleton than with a partner. This issue was not discussed by Vygotsky, but has implications for real-life settings. If children are paired at school to work collaboratively, then it is necessary to understand the potential benefits when feedback will also be provided.

The studies discussed here also help to clarify and extend our understanding of the processes of constructing joint understanding and of the transition from shared to self-regulated thinking. The findings are consistent with Vygotsky's beliefs. For example, Vygotsky believed that the joint construction of knowledge is mediated by psychological tools, and particularly by language. Research discussed previously indicates that verbalization of a more sophisticated level of reasoning by the more advanced partner is strongly related to cognitive advance. Vygotsky also believed that children were actively involved in this process—one study reviewed here found that children will initiate their own involvement in a task when the more competent partner does nothing to involve them. In addition, several studies found that improvement in performance was related to the degree to which children were actively involved in the task—it must be a joint, rather than a parallel, effort. Vygotsky did not explain the conditions under which internalization of shared knowledge is most likely to occur, other than saying that construction of a zone of proximal development facilitates this. Research reviewed here suggests that children are most likely to adopt the higher level of thinking and use it independently when the more competent partner helps to guide and support the less advanced partner to take progressively more responsibility, monitoring change and gradually withdrawing support as appropriate. Another important contribution, as mentioned earlier, is the finding that not every partner is equally able to adjust their help in an appropriate manner.

The weakness of this body of literature, to return to the argument we made at the outset of this chapter, lies in the insufficient attention paid to elements of Vygotsky's thinking that are critical tenets of cultural-historical theory. The most important of these is perhaps sociocultural factors which, for Vygotsky, gave meaning to microgenetic and ontogenetic development. Indeed, interpreting development in terms of historically formed contexts lies at the heart of cultural-historical theory. The majority of recent research cannot be generalized beyond the White middle-class Western populations on which it was conducted. The

cognitive tools, approaches to problem solving, and interaction styles may differ greatly across cultural contexts both outside and within the United States (Ellis & Gauvain, 1992), leading to potentially quite different interpretations of results.

The second missing element is related to the first, which is that apart from Forman's work, studies of peer collaboration have not given very much attention to semiotic mediation. Whereas most research focused on identifying the optimal conditions for development to occur, Forman and her colleagues (Forman & Cazden, 1985; Forman & McPhail, 1993) directed their attention to analysis of children's use of language (speech registers and discourse) in social interaction. This work may help to further our understanding of the process by which intersubjectivity is constructed. Forman's research has perhaps come closest to taking the broader context into account, because her focus is on discourse (which implies looking not merely at verbal arguments but at the implicit message about the context-based norms, expectations, etc., in communication) rather than language.

Finally, although Vygotsky believed that it was critical to our understanding of developmental processes, the issue of mediation of effective peer learning by socioemotional factors has been explored very little. It appears that researchers are just beginning to recognize their potential influences (Ellis & Gauvain, 1992). One area that could be explored in further research is children's prior relationship with their partner. From an early age, peer interactions among children occur mainly between friends (Azmitia & Perlmutter, 1989). It may make a difference to the nature of the interaction whether partners have previously (and positively) spent time together. In a few studies, friends performed better than non-friends, perhaps because friends' conversations have more mutuality and involvement than those between non-friends (Berndt, 1987). This might mean that they understand each others' needs more, and so could give better guidance. Friends are more likely to resolve conflicts equitably than are non-friends (Hartup, 1992), and this might have implications for the degree to which children are able to achieve shared understanding of the task. In addition, friends are more likely to give explanations for their actions (Nelson & Aboud, 1985). This is a factor that may be of extreme importance, because a key process identified in whether children improve in the course of interaction is whether they are exposed to and accept the reasoning of their partner (Tudge, 1989, 1992; Tudge et al., 1996). Finally, friends are more likely to try to get their partner to change their mind—to challenge the position of the other and advance their own (Nelson & Aboud, 1985), a factor that may also be important for the processes involved in convincing the other to accept their reasoning.

Conclusions

The small number of research studies that investigated Vygotsky's theory that children's learning can be fostered by their interaction with more competent

peers resulted in several important clarifications and extensions of Vygotsky's theory. Our understanding of the effects of social interaction among peers, and of the mechanisms leading to those effects, has progressed from a general acceptance that all social interaction necessarily leads to cognitive growth to a growing awareness of the complexity of factors that can serve to facilitate or hinder developmental advance, and even to lead to decline. Many questions remain unanswered regarding the processes by which children can influence each other's cognitive development. This research has not uncovered the specific mechanism that brings about the collaborative process or what motivates children to change their current way of thinking in favor of new (or perhaps old) knowledge. We are coming closer to understanding the conditions under which children in collaborative situations are likely to reach a joint situational definition that provides the foundation for self-regulation of cognitive processes, but we do not understand the nature of the transformation process as children internalize social relations. Neither do we understand the findings in terms of the sociohistorical contexts that give them meaning. Because research has typically focused on peer collaboration in middle-class Western cultures, we know little about the sociocultural factors that may influence cognitive interaction.

If socioemotional factors remain an understudied phenomenon, and individual and interpersonal participant characteristics remain an unknown, we will be left with the unappealing scenario envisioned by Vygotsky, where "thinking is inevitably transformed into an autonomous flow of thoughts thinking themselves" (1934, in Wertsch, 1985, p. 89). If research on peer collaboration continues to overlook sociohistorical contexts, we will be left with the untenable assumption, from a Vygotskian perspective, that context is irrelevant to children's development.

References

- Ames, G. J., & Murray, F. B. (1982). when two wrongs make a right: Promoting cognitive change by social conflict. Developmental Psychology, 18, 894-897.
- Azmitia, M. (1988). Peer interaction and problem-solving: When are two heads better than one? Child Development, 59, 87-96.
- Azmitia, M., & Perlmutter, M. (1989). Social influences on children's cognition: State of the art and future directions. In H. W. Reese (Ed.), Advances in Child Development and Behavior, (Vol. 22, pp. 89-144. New York: Academic Press.
- Bearison, D. J., Magzamen, S., & Filardo, E. K. (1986). Socio-cognitive conflict and cognitive growth in young children. Merrill Palmer Quarterly, 32, 51-72.
- Berndt, T. (1987). The distinctive features of conversations between friends: Theories, research, and implications for socio-moral development. In W.M. Kurtines & J. L. Gewirtz (Eds.), Moral development through social interaction (pp.281-300). New York: Wiley.
- Bornstein, M. H. (Ed.) (1991). Cultural approaches to parenting. Hillsdale, NJ: Erlbaum.
- Bronfenbrenner, U. (1989). Ecological systems theory. In R. Vasta (Ed.), Annals of child development, Vol 6 (pp. 187-249). Greenwich, CT: JAI Press.
- Bronfenbrenner, U. (1993). The ecology of cognitive development: Research models and fugitive findings. In R. Wozniak & K. Fischer (Eds.), Development in context: Acting and thinking in specific environments (pp. 3-44). Hillsdale, NJ: Erlbaum.
- Bronfenbrenner, U., & Ceci, S. (1994). Nature-nurture reconceptualized in developmental perspective: A bioecological model, Psychological Review, 101, 568-586.
- Chapman, M., & McBride, M. L. (1992). The education of reason: Cognitive conflict and its role in intellectual development. In C. U. Shantz & W. W. Hartup (Eds.), Conflict in child and adolescent development (pp. 36-69). Cambridge: Cambridge University Press.
- Cooper, C. R. (1980). Development of collaborative problem-solving among preschool children. Developmental Psychology, 16, 433-440.
- Damon, W., & Phelps, E. (1987, June). Peer collaboration as a context for cognitive growth. Paper presented at Tel Aviv University School of Education.
- DeVries, R. (1997). Piaget's social theory. Educational Researcher, March, 4-17.
- Doise, W., & Mugny, G. (1984). The social development of the intellect. Oxford: Pergamon Press.
- Elder, G. H., Jr., Modell, J., & Parke, R. D. (1993). Children in time and place: Developmental and historical insights. New York: Cambridge University Press.
- Ellis, S. (1987). The effects of collaboration on children's instruction: Observations of a Navajo sample. Unpublished dissertation, University of Utah.
- Ellis, S., & Gauvain, M. (1992). Social and cultural influences on children's collaborative interactions. In Winegar, L. T., & Valsiner, J. (Eds.), Children's development within social context: Research and methodology. (Vol. 1, pp. 155-180). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Ellis, S., & Rogoff, B. (1982). The strategies and efficacy of child vs. adult teachers. Child Development, 53, 730-735.
- Ellis, S., & Rogoff, B. (1986). Problem solving in children's management of instruction. In E. C. Mueller & C. R. Cooper (Eds.), Process and outcome in peer relationships (pp. 301-325). Orlando, FL: Academic Press.
- Ellis, S., & Siegler, R. S. (1994). Development of problem solving. In R. J. Sternberg (Ed.), E. C. Carterette & M. P. Friedman (Series Eds.), Handbook of perception and cognition, Vol 12, Thinking and problem solving (pp. 333-367). Academic Press.

- Forman, E. A. (1987). Learning through peer interaction: A Vygotskian perspective. The Genetic Epistemologist, 15, 6-15.
- Forman, E. A. (1992). Discourse, intersubjectivity, and the development of peer collaboration: A Vygotskian approach. In Winegar, L. T., & Valsiner, J. (Eds.), Children's development within social context: Metatheory and theory (Vol. 1, pp 143-160). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Forman, E. A., & Cazden, C. B. (1985). Exploring Vygotskian perspectives in education: The cognitive value of peer interaction. In J. V. Wertsch (Ed.), Culture, communication, and cognition: Vygotskian perspectives (pp. 323-347). Cambridge: Cambridge University Press.
- Forman, E. A., & McPhail, J. (1993). A Vygotskian perspective on children's collaborative problem-solving activities. In E. A. Forman, N. Minick, & C. A. Stone (Eds.), Education and mind: The integration of institutional, social, and developmental processes. New York: Oxford University Press.
- Freund, L. S. (1990). Maternal regulation of children's problem-solving behavior and its impact on children's performance. Child Development, 61, 113-126.
- Gauvain, M., & Rogoff, B. (1989). Collaborative problem solving and children's planning skills. Developmental Psychology, 25, 139-151.
- Harkness, S., & Super, C. M. (1996). Parents' cultural belief systems: Their origins, expressions, and consequences. In S. Harkness & C. M. Super (Eds.), Parents' cultural belief systems. New York: Guilford Press.
- Hartup, W. W. (1992). Conflict and friendship relations. In C. U. Shantz & W. W. Hartup (Eds.), Conflict in child and adolescent development (pp. 186-215). Cambridge: Cambridge University Press.
- Hogan, D. M. (1966). The co-construction of social development: A longitudinal study of the relations among social class, parenting, and children's activities. Unpublished dissertation, The University of North Carolina at Greensboro.
- Knox, J. E. (1993). Translator's introduction. In L. S. Vygotsky & A. R. Luria, Studies on the history of behavior: Ape, primitive, and child (pp. 1-35). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Kozulin, A. (1990). Vygotsky's psychology: A biography of ideas. Cambridge, MA: Harvard University Press.
- Levin, I., & Druyan, S. (1993). When sociocognitive transaction among peers fails: The case of misconceptions in science. Child Development, 64, 1571-1591.
- Light, P. (1983). Social interaction and cognitive development: A review of post-Piagetian research. In S. Meadows (Ed.), Developing thinking: Approaches to children's cognitive development (pp. 67-88). London: Meuthen.
- Light P. (1986). Context, conservation and conversation. In M. Richards & P. Light (Eds.), Children of social worlds: Development in social context (pp. 170-190). Cambridge: Harvard University Press.
- Luria, A. R. (1976). Cognitive development: Its cultural and social foundations. Cambridge, MA: Harvard University Press.
- Mackie, D. (1983). The effect of social interaction on conservation of spatial relations. Journal of Cross-Cultural Psychology, 14, 131-151.
- Mugny, G., & Doise, W. (1978). Socio-cognitive conflict and structure of individual and collective performances. European Journal of Social Psychology, 8, 181-192.
- Murray, F. B. (1982). Teaching through social conflict. Contemporary Educational Psychology, 7, 257-271.
- Murray, F. B. (1983). Learning and development through social interaction and conflict: A challenge to social learning theory. In L. S. Liben (Ed.), Piaget and the foundations of knowledge (pp.231-247). Hillsdale, NJ: Erlbaum.

- Nelson, J., & Aboud, F. (1985). The resolution of social conflict between friends. Child Development, *56*, 1009-1017.
- Nicolopoulou, A. (1993). Play, cognitive development, and the social world: Piaget, Vygotsky, and beyond. Human Development, *36*, 1-23.
- Perret-Clermont, A. N. (1980). Social interaction and cognitive development in children. London: Academic Press.
- Perret-Clermont, A. N., & Schubauer-Leoni, M. L. (1981). Conflict and cooperation as opportunities for learning. In P. Robinson (Ed.), Communication in development (pp. 203-233). London: Academic Press.
- Ochs, E. (1990). Indexicality and socialization. In J. W. Stigler, R. A. Shweder, & G. Gerdt (Eds.), Cultural psychology: Essays on comparative human development (pp. 387-308). New York: Cambridge University Press.
- Radziszewska, B., & Rogoff, B. (1988). Influence of adult and peer collaborators on children's planning skills. Developmental Psychology, *24*, 840-848.
- Radziszewska, B., & Rogoff, B. (1991). Children's guided participation in planning imaginary errands with skilled adult or peer partners. Developmental Psychology, *27*, 381-389.
- Rogoff, B. (1990). Apprenticeship in thinking: Cognitive development in social context. Oxford: Oxford University Press.
- Rommetveit, R. (1975). On the architecture of intersubjectivity. In R. Rommetveit & R. M. Blakar (Eds.), Studies of language, thought and verbal communication (pp. 93-107). London: Academic Press.
- Rosenthal, T. L., & Zimmerman, B. J. (1972). Modeling by exemplification and instruction in training conservation. Developmental Psychology, *6*, 392-401.
- Rosenthal, T. L., & Zimmerman, B. J. (1978). Social learning and cognition. New York: Academic Press.
- Russell, J. (1982). Cognitive conflict, transmission and justification: Conservation attainment through dyadic interaction. Journal of Genetic Psychology, *142*, 283-297.
- Tudge, J. R. H. (1989). When collaboration leads to regression: Some negative consequences of socio-cognitive conflict. European Journal of Social Psychology, *19*, 123-138.
- Tudge, J. R. H. (1992). Processes and consequences of peer collaboration: A Vygotskian analysis. Child Development, *63*, 1364-1379.
- Tudge, J., Gray, J., & Hogan, D. (1997). Ecological perspectives in human development: A comparison of Gibson and Bronfenbrenner. In J. Tudge, M. Shanahan, & J. Valsiner (Eds.), Comparisons in human development: Understanding time and context (pp. 72-105). New York: Cambridge University Press.
- Tudge, J. R. H., Putnam, S. A., & Valsiner, J. (1996). Culture and cognition in developmental perspective. In B. Cairns, G. H. Elder, Jr., & Costello, E. J (Eds), Developmental science (pp. 190-222). New York: Cambridge University Press.
- Tudge, J. R. H., & Rogoff, B. (1989). Peer influences on cognitive development: Piagetian and Vygotskian perspectives. In M. H. Bornstein & J. S. Bruner, (Eds.), Interaction in human development (pp. 17-40). Hillsdale, NJ: Erlbaum.
- Tudge, J., Shanahan, M., & Valsiner, J. (1997). Comparisons in human development: Understanding time and context. New York: Cambridge University Press.
- Tudge, J. R. H., & Winterhoff, P. A. (1993a). Can young children benefit from collaborative problem solving? Tracing the effects of partner competence and feedback. Social Development, *2*, 242-259.

- Tudge, J. R. H., & Winterhoff, P. A. (1993b). Vygotsky, Piaget, and Bandura: Perspectives on the relations between the social world and cognitive development. Human Development, *36*, 61-81.
- Tudge, J. R. H., Winterhoff, P. A., & Hogan, D. M. (1996). The cognitive consequences of collaboration and feedback. Child Development, *67*, 2892-2909.
- Tulviste, P. (1991). Cultural-historical development of verbal thinking: A psychological study. Commack, NY: Nova.
- Van der Veer, R. & Valsiner, J. (1991). A quest for synthesis: Life and work of Lev Vygotsky. London: Routledge.
- Van der Veer, R. & Valsiner, J. (Eds.) (1994). The Vygotsky Reader, Cambridge, MA: Basil Blackwell Ltd.
- Valsiner, J. (1988). Developmental Psychology in the Soviet Union, Indiana: Indiana University Press.
- Valsiner, J. (1989). Human development and culture: The social nature of personality and its study. Lexington: D.C. Heath & Company.
- Vygotsky, L. S. (1978). Mind in Society. Cambridge, MA: Harvard University Press.
- Vygotsky, L. S. (1987). The collected works of L. S. Vygotsky: Vol. 1, Problems of general psychology. New York: Plenum.
- Vygotsky, L. S. (1994a). The problem of the cultural development of the child. In R. van der Veer & J. Valsiner (Eds.), The Vygotsky reader (pp. 57-72). Cambridge, MA: Basil Blackwell.
- Vygotsky, L. S. (1994b). The problem of the environment. In R. van der Veer & J. Valsiner (Eds.), The Vygotsky reader (pp. 338-354). Cambridge, MA: Basil Blackwell.
- Vygotsky, L. S. (1997). The collected works of L. S. Vygotsky, Vol. 4: The history of the development of higher mental functions. New York: Plenum Press.
- Vygotsky, L. S., & Luria, A. R. (1993). Studies on the history of behavior: Ape, primitive, and child, V. I. Golod & J. E. Knox (Trans. and Eds.). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Vygotsky, L. S., & Luria, A. R. (1994). Tool and symbol in child development. In R. van der Veer & J. Valsiner (Eds.), The Vygotsky reader (pp. 99-174). Oxford: Blackwell.
- Welsh, M. C. (1991). Rule-guided behavior and self-monitoring on the Tower of Hanoi disk-transfer task. Cognitive development, *6*, 59-76.
- Wertsch, J. (1979). From social interaction to higher psychological processes: A clarification and application of Vygotsky's theory. Human Development, *22*, 1-22.
- Wertsch, J. (1985). Vygotsky and the social formation of mind. Cambridge: MA: Harvard University Press.
- Wertsch, J. V. (1991). Voices of the mind: A sociocultural approach to mediated action. Cambridge: Harvard University Press.
- Wertsch, J. V., & Hickmann, M. (1987). A microgenetic analysis of problem-solving in social interaction. In M. Hickmann (Ed.), Social and functional approaches to language and thought (pp. 241-266). Orlando, FL: Academic Press.
- Whiting, B. B. & Edwards C. P. (1988). Children of different worlds: The formation of social behavior. Cambridge: Harvard University Press.
- Zimmerman, B. J., & Lanaro, P. (1974). Acquiring and retaining conservation through modeling and reversibility cues. Merrill Palmer Quarterly, *20*, 145-161.

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1999

LAWRENCE ERLBAUM ASSOCIATES, PUBLISHERS
Mahwah, New Jersey
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