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COMMENTARY

Time to Merge Vygotskian and Constructivist Conceptions of Knowledge Acquisition

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The five chapters in this section made an agreeable impression on me, a sympathetic outsider of the North American Vygotskian school. All are based on the authors' long-standing research on knowledge acquisition in the classroom, and they propose some extension or revision of the Vygotskian conception of learning by instruction. More precisely, their proposed extension has been motivated by the need to understand and develop further their target instructional practice. As Moll and his associates (this volume) put it, "practice can exceed as well as inform and elaborate" theoretical notions.

There are several commonalities across the chapters. In short, each chapter is oriented in its own way to a more dynamic (re)interpretation of the Vygotskian conception and suggests a less didactic approach to instruction. Considering that Vygotskians have emphasized almost exclusively the teacher's responsibility for organizing learning for students' acquisition of effective strategies and scientifically correct concepts, and thus supported current forms of instruction heavily controlled by the teacher, these suggested extensions and revisions are especially welcome.

This commentary indicates, first, my subjective appraisal of the current Vygotskian conception of knowledge acquisition and tries to locate needed extensions as the background for reviewing the chapters. Then I examine how much these needed extensions have been achieved by the chapters. Finally, I discuss a few problems still to be solved within the Vygotskian framework.

Needed Extensions and Revisions

Previous Contexts for Interpreting Vygotskian Theories

As the editors of this volume point out in the Preface, many ideas of Vygotsky seem to have been interpreted in a rather narrow fashion. This point is particularly true for his conception of learning or knowledge acquisition and teaching. As a consequence, as Moll et al. aptly put it, the emphasis of Vygotskian approaches to instruction is "usually on the transmission of skills from adult to child, as is the case with traditional classrooms." Though there have

been a few notable exceptions (e.g., Newman, Griffin, & Cole, 1989), Vygotskians have failed to propose alternative ideas to conventional educational practice, which relies heavily on direct teaching of solution routines for test-like problems. Innovations such as converting the conventional classroom into a place for collective search for understanding have seldom been proposed by Vygotskians, though the theory certainly allows for them.

The Vygotskian conception has not been as fertile in educational reform as it could be, partly because it has been interpreted in terms of the empiricism that has dominated American education and educational research. According to the empiricist's view, the core of educational process is the transmission of ready-made knowledge from outside to the individual mind, which is like a blank slate. The Vygotskian conception interpreted within this framework is compatible with conventional didactic teaching, including "rote, drill and practice instruction," which is the reality for disadvantaged children (Moll et al., this volume).

How Vygotskian theory was introduced to educational researchers has also influenced its interpretation by the educational community. That is, the Vygotskian conception was often contrasted to the Piagetian one, which had been attractive to some innovative educators. From the Vygotskian perspective, the Piagetian conception of knowledge acquisition has a number of serious deficiencies and thus was judged unable to serve as a sound basis for educational reform unless properly supplemented. Among others, Piagetians were criticized for emphasizing individual construction of knowledge without paying attention to: (1) the role of more capable members in the society (and their knowledge); (2) cultural artifacts that mediate interactions between individuals and their physical environments; and (3) larger sociohistorical contexts of learning-teaching processes. Therefore Vygotskians have been busy criticizing Piagetians' "romantic child-centered constructivism" without clearly differentiating their conception from transmissionism (Hatano & Newman, 1985).

As a result of these contextual variables, the so-called Vygotskian conception of knowledge acquisition by instruction has been established. In a somewhat caricatured form, it can be expressed as follows.

1. Knowledge to be acquired by the learner (a less mature member of the society) is possessed by the teacher (a more mature member) usually in the form of a set of skills or strategies for solving the target problems; the teacher is assigned by the society the job of transmitting the knowledge.
2. The learner is brought into the instructional situation to solve a few samples of the target problems together with the teacher; the teacher communicates the knowledge in a verbally coded form (as a set of commands or condition-action pairs) and demonstrates how to solve the problems by using this coded form of knowledge.
3. The teacher asks the learner to take over the solution steps she or he can, with other steps being executed by the teacher; the supporting

role of the teacher becomes less and less important as the learner acquires the knowledge.

4. When the learner becomes able to solve the problems without help from the teacher, it is considered that the knowledge has been transmitted successfully.

Needless to say, the above "Vygotskian" conception is only one possible interpretation of Vygotsky's emphasis on the social origin of individual cognition in general and his notion of "the zone of proximal development" in particular—one that approximates cultural transmission. We might explore other possible interpretations. Moreover, although the so-called conception does not make any explicit commitments as to the nature of the learner or of the social interactions that enhance knowledge acquisition, it is often accompanied by a set of hidden empiricist assumptions: (1) the learner is rather passive in nature; (2) he or she does not (have to) understand the meaning of the skills taught or construct knowledge that goes beyond them; (3) only the interaction with the teacher, who is always more capable than the learner, facilitates the acquisition; and (4) the teacher is the only source of information and evaluation.

These hidden assumptions do not seem plausible in the light of an accumulated body of evidence in educational research as well as in cognitive science. Findings in these areas strongly suggest that humans are generally active and competent in their everyday life and can benefit from a variety of interactions with other people and natural and artificial environments. Therefore some revisions are needed, even within the "transmission of skills" framework. This point leads us to a *moderate extension* of the Vygotskian conception of learning by instruction.

A more ambitious attempt is to expand the above conception to include the acquisition of conceptual knowledge, which enables learners to use the acquired skills flexibly and to invent new skills—in other words, to include the process of learners becoming "adaptive experts" (Hatano & Inagaki, 1986). This practice is almost equivalent to a reinterpretation of Vygotsky's theory as exemplifying "realistic constructivism" (Hatano & Newman, 1985), that is, an idea that knowledge is constructed by learners themselves under a variety of sociocultural constraints, which encourages educators to search for alternatives to didactic teaching. This attempt can legitimately be called a *radical extension* of the Vygotskian conception.

Toward Radical Extensions

Presenting in detail a "radically extended" Vygotskian conception of knowledge acquisition is beyond the scope of this short commentary. However, it is possible to discuss what assumptions about the nature of the learner and of supportive environments should replace the above hidden empiricist assumptions. I suggest that the following four points, roughly corresponding to the four points outlined above, constitute the core of the assumptions for

a constructivist Vygotskian conception. These *revising (innovating) assumptions* are generally accepted by the contemporary psychological literature, if not firmly supported by direct evidence.

1. *Learners are active.* It is part of the *zeitgeist* of contemporary cognitive psychology that humans are active agents of information processing and action. Humans often explore tasks beyond the demands or requirements of problem solving, and environments that do not permit active exploration are viewed as unpleasant.

It has also been found in developmental and educational studies that humans, from infancy to old age, enjoy taking initiatives and choosing from among alternatives. They not only explore objects but interact with other persons spontaneously. They tend to be lively and do well when they are allowed to do so.

2. *Learners almost always seek and often achieve understanding.* That people try to find meaning and understanding is a corollary of assumption 1. Our conversation is nearly impossible if participants do not try to interpret given utterances or are satisfied with an interpretation at a shallow level. It is well known from experimental studies that people generate an enriched representation of the presented information and try to interpret a given set of information coherently.

People not only try, but also often succeed, in achieving understanding. In other words, they are competent as well as active. This competence is frequently supported by their prior knowledge because it enables them to process new relevant information effectively. Understanding new information requires some relevant prior knowledge. It is well documented that, prior to instruction, students have acquired a body of fairly rich informal knowledge about a specific topic.

It is possible that learners construct, based on their understanding, knowledge that is in a sense beyond the information given by the teacher or even beyond what the teacher knows. Their invented knowledge is not always correct scientifically but is often plausible.

3. *Learners' construction of knowledge is facilitated by horizontal as well as vertical interactions.* Contributions of horizontal interaction to knowledge acquisition can be substantial, as during peer interaction. In addition to empirical data demonstrating the latter's facilitative effects on learning (e.g., Doise & Mugny, 1984), there are a couple of logical reasons why it is so. First, speaking generally, the less mature member in a vertical interaction is not highly motivated to construct knowledge, because she or he knows that the other member possesses that knowledge. In contrast, during horizontal interaction, members' motivation to disclose their ideas tends to be natural and strong because no authoritative right answers are expected to come immediately (Inagaki, 1981).

Second, the more mature member's knowledge cannot necessarily be verbalized in a communicable form (Schön, 1983); and even when it is, some part may be ignored by the less mature. Therefore we cannot always

count on the vertical tutorial interaction. On the other hand, a student can often pick out a useful piece of information from other students who are not generally more capable (Hatano & Inagaki, 1991). Moreover, some members can be more capable than others at some moment during horizontal interaction.

4. *Availability of multiple sources of information enhances knowledge construction.* As understanding is to find coherence among pieces of information, and the construction of conceptual knowledge is often based on understanding, availability of multiple sources of information is expected to enhance the construction. It is especially beneficial for learners to have external sources of information other than the teacher because too much reliance on the authorized answer given by the teacher reduces students' motivation to understand and construct knowledge of their own. Among others, confirmation or disconfirmation of predictions by direct observation or consulting a reference book serves to enhance learning.

These revising assumptions can serve to constrain what the constructivist Vygotskian conception is like. They can also provide us with perspectives for reviewing proposed extensions, as can be seen in the next section.

How Successfully Have These Chapters Extended the Conception?

The five chapters are divided into three groups mainly for convenience of discussion: those proposing moderate extensions (Palincsar et al. and Chang and Wells), radical extensions (Cobb et al. and Moll et al.), and the presentation of analyses of artifacts (Griffin et al.). The grouping or labels attached to the groups should not be taken too seriously because a number of similarity metrics can be applied to the chapters.

Moderate Extensions

Although both Palincsar et al. and Chang and Wells proposed some extensions of the Vygotskian conception of knowledge acquisition, these proposals are moderate, not radical: Both groups of authors are concerned primarily with students' acquisition of strategies under the teacher's guidance and thus stay within the orthodox Vygotskian framework. Palincsar et al. discuss the possibility of creating "communities in which each participant makes significant contributions to the emergent understandings of all members" and thus suggests their willingness to support radical extensions of the Vygotskian conception, but this proposition is not elaborated any further in the chapter.

What Palincsar et al. did was to apply reciprocal teaching to first-graders' lessons on animal survival. A teacher and six children, many of whom were at risk for listening comprehension difficulty, took turns leading the discus-

sion, in which they asked questions about the content of a passage from a text, summarized what had been read, clarified the meaning of expressions in it, and predicted what would follow.

In the process of reciprocal teaching, students were expected to internalize these strategies, which good comprehenders tend to use, as well as to acquire simple biological concepts. The authors claimed that "the most effective social interaction is one in which joint problem solving occurs, guided by an individual who is more skilled" in the use of such intellectual tools as the above strategies. The teacher's role was to ensure that the problem-solving activity would occur within the participants' zones of proximal development, by "providing support that is both temporary and adjustable."

The results indicated that reciprocal teaching in 20 lessons dramatically improved the children's ability to understand text and apply analogically the biological concepts in the text. This finding deserves mention because only a few prior studies in the Vygotskian tradition have yielded such strong and clear effects of social interaction (see also Palincsar & Brown, 1984).

However, reciprocal teaching as formulated by Palincsar et al. does not go far beyond "the transmission of skills from adult to child," though I have never observed myself its process. It should be examined why students acquire these strategies, that is, their motivational basis of the acquisition. If the strategies are acquired because of the teacher's authority or the strategies' usefulness when taking tests, not because they serve to enhance understanding (or search for meaning), reciprocal teaching cannot be taken as being based on the constructivist view and poses no real challenge to the so-called Vygotskian conception.

Chang and Wells also emphasize the role of the teacher in joint activities for developing students' procedural and metacognitive knowledge, though their position seems closer to those proposing radical extensions. Although they admit that "a great deal of the learning . . . takes place as students work together (more or less) collaboratively, without the involvement of the teacher" their chapter is mostly concerned with the teacher's intervention in learner-directed activities in two classrooms. The teachers assigned students an active role in selecting and organizing tasks, though all of them were to achieve the superordinate goals the teachers had established.

According to Chang and Wells, both children and adults are meaning makers; that is, they try to make sense of new information and thus are involved in the process of hypothesis formation, testing, and modification. Children, however, do not possess a rich repertory of strategies (e.g., how to start a project, how to deal with differences of opinion). Teachers certainly know these strategies but presenting them in a propositionally coded form is not enough for students to acquire them. There must be "extended opportunity for discussion and problem solving in the context of shared activities, in which meaning and action are collaboratively constructed and negotiated." Learning occurs at points of negotiation of meaning in conversation.

Thus although Chang and Wells' major concern is the transmission of

strategies from the teacher to students, their assumptions about the learner and social interaction have aptly been updated in the constructivist direction. Moreover, instruction organized by Chang and Wells, different from reciprocal teaching, had a clear goal set for students' activities and teachers' interventions, that is, to make the presentation informative and enjoyable to the audience. Therefore the chapter can be taken as an appeal for creating a "functional learning environment" (Newman, 1985).

Chang and Wells pay due attention to the affective aspects of conversation. Their protocols clearly reveal that interactions are far from "purely cognitive." Children seemed to try to be academic winners, save face, avoid being looked down upon, and so on, especially during interactions with peers. In this sense, a school class is certainly different from a mother-child dyad in terms of its structural and motivational complexities.

Radical Extensions

Proposed extensions by Cobb et al. and Moll et al. are so radical that some readers may doubt that the authors are still Vygotskians. Cobb et al. demonstrate how researchers could become Vygotskians without giving up being constructivists. Through a long-term observational study of the "inquiry mathematics" classes of second-graders, the authors have come to realize that, in order to understand the process of students' construction of mathematical knowledge some Vygotskian ideas must be incorporated.

Among others, they have accepted a Vygotskian idea that doing mathematics is a social activity as well as an individual construction activity because what counts as a problem or as a solution has normative aspects. In other words, social norms of the classroom constrain students' mathematical actions and constructions. Therefore the teacher has an important role to play in establishing classroom norms that encourage active construction of mathematical knowledge. According to Cobb et al., this job can be achieved by "talking about talking about mathematics." Interestingly, the teacher's reactions tended to be direct and imposing at this metacognitive level. He or she may have grasped intuitively that students' cognitive activities can develop without frequent teacher intervention after the students have acquired the metacognitive beliefs necessary for monitoring their activities.

Another Vygotsky-inspired idea Cobb and his associates incorporated is that instructional processes are institutionally constrained. For example, what occurs in the mathematics class is strongly influenced by the role our society assigns to schooling or mathematics, though, as the authors emphasize, innovative mathematics instruction may alter some institutional constraints.

However, the authors' approaches to instruction as well as theoretical interpretations are still constructivist. They view learning as "active construction to resolve experientially based problems." This view is in contrast to the conventional characterization of learning as the transfer or transmis-

sion of culturally developed modes or products of thinking from those who know to those who do not. More specifically, their instructional procedure was "small group work followed by a teacher-orchestrated whole class discussion of the children's problems, interpretations, and solutions." and thus involved numerous horizontal interactions. The teacher took her lead from the students' contributions and encouraged them to build on each other's explanations as she guided conversations about mathematics. There was no grading and no individual pencil-and-paper seat work.

More importantly, the students were not expected to make certain pre-determined mathematical constructions because it might force the students to learn how to act in accord with the teacher's expectation only. Cobb et al. take it as the goal of mathematics instruction for students to articulate their own understandings. The authors also indicate that the teacher did not act as the sole validator of knowledge in her classroom.

Students are described as active and spontaneous learners also by Moll et al. The third-grade bilingual classroom they studied from the Vygotskian point of view seems close to Cobb et al.'s inquiry mathematics classes that got started with the Piaget-inspired constructivist framework and incorporated a few Vygotskian ideas later.

Moll et al. explicitly point out the necessity of interpreting Vygotsky's notion of zone of proximal development in a more dynamic and encompassing way than is conventionally understood. Providing assisted performance for a task that is a bit difficult for students to solve by themselves and evaluating their independent performance later do not guarantee good instruction. Assistance may just be awful: Rote, drill and practice instruction is often offered to the less privileged population in our modern society.

Based on Vygotsky's own writings as well as their classroom observations, Moll et al. claim that the unique form of cooperation between the child and the adult that is central in the educational process is mutually and actively created by the teacher and students. Thus they admit that students' initiative, interaction with peers, and adult guidance are all indispensable. They also claim that children's search for meaning and significance, which plays a prominent role in Vygotsky's general theorizing, should be incorporated as a critical component in creating the zone of proximal development. Their protocols suggest that joint activities can "help children express and obtain meaning in ways that will enable them to make knowledge of their own."

In their classroom, students were allowed to choose topics that interested them. They could even generate their research questions and negotiate their learning tasks with their teacher. Thus in this classroom, individual students' initiative and the teacher's guidance coexisted. Learning was not an individual achievement but a joint accomplishment between adults and children. In other words, the teacher provided a safety net for children who would engage in diverse classroom activities.

Books and other materials are considered important resources for learning by Moll et al. By pointing out that these artifacts constitute part of the

collective zone, the authors endorse a view that having multiple sources of information is desirable.

It will be interesting to examine similarities and differences among Cobb et al., Moll et al., and Itakura's (1962) hypothesis-experiment-instruction (HEI), which also capitalizes on students' dialogical (polilogical) interaction guided by the teacher. The following procedure is usually adopted in this Japanese science-education method: (1) Pupils are presented with a question with three or four alternative answers. (2) They are asked to choose one by themselves. (3) Pupils' responses, counted by a show of hands, are tabulated on the blackboard. (4) They are encouraged to explain and discuss their choices with one another. (5) They are asked to choose an alternative once again. They may change their choices. (6) Pupils are allowed to test their predictions by observing an experiment or reading a given passage.

The teacher in HEI, after presenting the problem, is a chairperson or moderator who tries to stay as neutral as possible during students' discussion. Thus although the teacher has control over the kinds of activities in which students are engaged, none of the members in the discussion group is taken as more capable by status than any other. In step 4, above, students often engage in lively discussions in a large group ($n = 40$ to 45). Several students may express their opinions often, but most of them tend to participate vicariously in the discussion, nodding or shaking their heads, or making brief remarks. There is empirical confirmation in step 6 that demonstrates clearly which answer alternative is correct. Itakura claims that students' predictions must be tested by observation or consultation independent from the teacher. Teachers in HEI seem to intervene directly least often but organize students' activities by providing the appropriate artifacts, that is, a well thought out series of problems.

Students in HEI are not explicitly asked to achieve understanding as a final task outcome. They are encouraged only to discuss which alternative is correct, and enduring comprehension activity is initiated primarily by their being presented a problem, the answer alternatives of which include plausible yet erroneous ideas. However, a few experimental studies (reviewed by Hatano & Inagaki, 1987) have revealed that Itakura's procedure enhances students' understanding of the scientific concepts and rules involved as well as their interest in confirming their predictions. It has also been suggested that students acquire metacognitive beliefs that evaluate understanding more highly than giving the correct answer through repeated participation in HEI.

Analyses of Artifacts

Griffin et al. deal with an apparently different topic, that is, critique and revisions of an educational software program, though it is part of a larger study on how computers might be used to promote development through a series of formative experiments. We generally assume that a context is constituted, not given beforehand, by participants' words and actions. Because software

is static, it does not seem to contribute greatly to the constitution of context. However, as the authors put it, it embodies its programmer's "voice." In a sense, the programmer is a hidden member of the communicative interactions in which teachers and students are involved when they use the software. In fact, the authors have observed occasions where the software was "blamed" for not allowing smooth interactions.

Software involves programmers' tacit assumptions that, like "presuppositions" during discourse, are powerful in controlling other participants' behavior. However, because of their having options, negotiation between the programmer's voice and the voices of the other participants is possible to some extent. The authors report several interesting cases in which they succeeded in modifying the target software so it allowed more flexible negotiations, as well as unsuccessful cases where the software could not be changed because of technological limitations.

The authors' findings have important general implications for education as well as for educational research. Although artifacts are static products of human behavior, they function as if they had intentions, for example, creating contexts for activity and constraining live participants' actions and constructions. This point is also emphasized by Chang and Wells and Moll et al. Moreover, artifacts represent some people's voices, usually voices of people who have power. In other words, unless live participants consciously and intentionally try to avoid it, their educational activities are controlled to some extent by those who have power to produce and provide relevant artifacts. Textbooks and tests, among others, must be such artifacts (Apple, 1986). It is an important challenge for educational researchers to find ways to make these artifacts less directive.

Future of the Vygotskian Conception of Knowledge Acquisition

Summarizing Achieved Extensions

How can we summarize the findings and interpretations of the above five sets of Vygotskian studies? How much of the needed extensions and revisions have been achieved by them? Let me present a summary in terms of the four revising assumptions listed in the first section.

First, the active nature of learners is now taken for granted by most, if not all, of the authors. That students seek and often achieve understanding has also been accepted. Thus Revising Assumptions 1 and 2 seem to have replaced the empiricistic ones. These revising assumptions being accepted, the Vygotskians in this section are clearly different from empiricists, and some of them belong to the constructivist camp: Knowledge, at least in part, is constructed by individual students. It has also been made clear that the teacher's guidance affects students' knowledge acquisition in varied ways. The teacher not only transmits strategies through joint problem solving; through conversation, the teacher expands and elaborates "spontaneous"

ideas by students and develops their metacognitive beliefs so the construction of relevant knowledge can be enhanced.

Second, all the authors have well recognized that peer interactions, especially when monitored by the teacher, can contribute to knowledge construction. Revising Assumption 3 has thus been accepted. A student may try to build his or her understanding on an idea presented by another through dialogue; and two or more students may try to negotiate and co-construct integrated ideas in joint activities. Although the teacher's feedback plays an important role, he or she is not the sole evaluator. The presence of peers is never considered to be a distraction from learning. Even heterogeneity of students' ideas and backgrounds is evaluated positively. When one of the editors of this volume wrote a chapter focusing on peer interaction some 5 years ago (Forman & Cazden, 1985), its theme was considered outside the Vygotskian mainstream. Now, however, it is legitimate to address peer interaction so long as the need for adult guidance is not ignored.

Third, it is unanimously agreed that, in addition to the teacher, other artifacts, embodying the voices of people who made them, can help students construct relevant and plausible knowledge. Among others, textbooks, other books, and software are important. They not only provide information but create a collective zone of proximal development. Revising Assumption 4 has firmly occupied its place.

In sum, as stated at the beginning of the commentary, there is a recognizable tendency across the five chapters to move away from transmissionism and toward constructivism at the theoretical level and to encourage students' active participation in joint activities more than passive attentiveness to what is presented verbally or demonstrated by the teacher at the level of instructional practice. Can we conclude that the Vygotskian conception of knowledge acquisition is being extended successfully? Generally speaking, does this tendency to extend and revise itself indicate a "healthy" state of Vygotskian theory?

My answers are affirmative to both questions, because I believe, in a Lakatosian manner, that (1) extending or revising its assumptions in the light of research findings and practical serviceability is needed for the Vygotskian research program to continue "progressing"; and (2) Vygotskian key notions constituting the "hard core" of the program can be kept intact, even when its peripheral, empirically falsifiable assumptions are updated. Some Vygotskian purists may be fearful of their losing theoretical identity if the active and competent nature of individual learners is emphasized, but this fear has no rational ground. As Chang and Wells correctly point out, to argue that knowledge is individually constructed is not to ignore the role of other people in the process of construction. Similarly, emphasizing the role played by interactions with peers and artifacts in students' construction of knowledge does not mean that guidance by the teacher is not critical.

I also believe that if we want to establish a generally acceptable conception or theory of knowledge acquisition there should be much more dialogue (or polilogue) among theories or research programs. This practice may lead

us to attempt to strengthen one theory by incorporating insights from another, which is sometimes considered “problematic” (See Introduction of the October 1988 issue of *The Quarterly Newsletter of the Laboratory of Comparative Human Cognition*). In fact, Vygotskian theory has provided insights to supporters of other theories, among others, Piagetian theory (e.g., Brown, 1988; Cobb et al., this volume) and the cognitive science of instruction (e.g., Brown, Collins, & Duguid, 1989). Some Vygotskians want to provide insights to the “nativist/modularist” theory (e.g., Di Bello & Orlich, 1987). There is no reason why Vygotskians cannot incorporate insights from other schools. Even when attempted extensions and revisions are based on such insights (e.g., from information-processing psychology or genetic epistemology), it may not be problematic if those insights are harmoniously integrated into the whole of Vygotskian theory.

Problems Yet To Be Solved

Although I am willing to give my assent to many of the revisions and extensions by the five chapters, I am not fully satisfied with the resultant Vygotskian conception of knowledge acquisition. As the conception shifts from transmissionism to constructivism, two problems appear, or at least become more serious; and solution of them is urgently needed to make the conception more or less complete.

One problem is how to explain the sociogenesis of individual cognition from the constructivist view. The so-called Vygotskian conception, though too narrow in its scope, once offered a good explanation as to where students’ skills come from and how they are “transmitted.” In contrast, what a constructivist can offer now is too global and unspecified. In her attempt to offer a constructivist explanation for sociogenesis, Resnick (1987, p. 47) argued that “the environment and the culture provide the ‘material’ upon which constructive mental processes will work.” This argument can be a good starting point for further discussion, if we can specify in more detail the nature of “material” and how it is worked on by an active mind.

Putting together the interpretations offered in these chapters, I would like to propose, though tentatively, the following four specifications regarding the nature of “the material provided by the environment and culture” or “sociocultural constraints.”

1. Knowledge is often constructed when the learner interacts with the teacher (or a more capable member), peers, or artifacts embodying voices of others, creating jointly with them the context for interaction.
2. Through interaction something collective is produced; in other words, something is shared among its participants. This “something” can be a cooperative system for solving problems, discussed and negotiated meanings or understandings, common sense and social

norms defining situations and regulating behaviors, and so on. This process involves socioemotional components as well.

3. The learner incorporates (or assimilates, using Piagetian terminology) this “something” for generating, elaborating, and revising his or her knowledge.
4. The above (smaller) system of face-to-face interaction is embedded in a larger system, such as an institution or a community. The larger system may officially set a limit on the kinds of interactions that can occur within the smaller system. The larger system also influences interaction in the smaller system and thus the learner’s construction of knowledge indirectly through a mediating individual (who is both a participant in the interaction within the smaller system and a member of the larger system) and an artifact.

The other problem is how to characterize spontaneous or everyday concepts (or conceptions) and scientific concepts, as well as the relations between the two. A solution of this problem is urgently needed because everyday concepts serve as the basis for interaction, negotiation, and sharing; and scientific concepts represent the best possible products of such joint activities. Better characterization of these beginning- and end-states of change induced by instruction would enhance our understanding of the process of socioculturally constrained construction of knowledge (Glaser & Bassok, 1989). Vygotsky’s discussion of these types of concepts has often been ignored in Vygotskian instructional research because the so-called Vygotskian conception enabled them to start with the knowledge possessed by a more mature member, neglecting what the less mature member has already acquired.

An adequate solution of this problem probably requires Vygotskians to incorporate notions such as innate constraints and modularity. Harris (1990) suggested that there are certain widespread, accurate schemas in each discipline of everyday science, whereas other insights are much less accessible. The Vygotskian notion of sociogenesis does not mean that humans can acquire any piece of knowledge if they are socially supported. However, how and how much the process of social construction of knowledge is constrained by innate and early cognitive competence in each domain requires special consideration.

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INTERPERSONAL RELATIONS IN FORMAL AND INFORMAL EDUCATION