4 A Sociocultural Perspective on Opportunity to Learn

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INTRODUCTION

The field of psychometrics has been predominant in work on testing and assessment. For the most part, psychometrics has been strongly influenced by traditional psychological assumptions about the mind and learning. Work that takes a sociocultural perspective has played a much smaller role and has heretofore made little contact with psychometrics. This chapter discusses contributions such a sociocultural perspective has to make to issues of assessment and testing, with a focus on an expanded notion of opportunity to learn (OTL). Ensuring that all learners have had equal OTL is both an ethical prerequisite for fair assessment and a solid basis on which to think about educational reforms that will ensure that all children can succeed at school. It is also a point at which mutually informing discussion can occur between people working in psychometrics and those working on sociocultural approaches to learning.

This section begins with a consideration of the traditional perspective in psychology, one that views knowledge and learning through the lens of mental representations in individuals' heads (Clancey 1997). Even in this traditional view, many of the types of issues that sociocultural perspectives emphasize also arise, although in a more backgrounded way. I will then turn to a more direct consideration of sociocultural perspectives, starting with the relationship between learners and their learning environments. In subsequent sections, I will spell out this relationship in terms of the connections between learning and learners' experiences in the world; how knowledge is distributed across people and their tools; the central importance of people's participation in shared talk and social practices; and the nature of the special varieties of language used in talk and participation when people learn in content areas in school – areas like math, science, social studies, and literature.

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Finally, I will take up the nature of the relationship between culture and participation in school practices.

THE TRADITIONAL VIEW

A traditional way to view knowledge (e.g., Fodor 1975; Newell and Simon 1972; Pylyshyn 1984) is in terms of mental representations stored in the head ("mind/brain"). These representations are the way information from the world is stored and organized in the mind/brain and how it is processed or manipulated. Such a perspective leads to a focus on questions about how information gets into the head, how exactly it is organized in the head, and how it leaves the head when people need to use it. Indeed, these questions have played a central role in much educational research.

This traditional perspective leads rather naturally to a way of looking at the notion of OTL. Learners have had the same OTL if they have been exposed to the same information ("content"). If they have been exposed to the same content, then, according to this view, they have each had the opportunity to store this information in their heads; that is, to "learn it."

Even in this traditional view, complexities arise. For example, there is the problem of "prior knowledge." Most learning theorists agree that the representation of something new in someone's head varies in important ways – important for the material that is learned – on the basis of what is already in the person's head (Bransford, Brown, and Cocking 2000). This is because new information has to be integrated with prior knowledge to make sense, and new knowledge makes sense in different ways according to how it is integrated with such prior knowledge.

New information that cannot be tied to any prior knowledge is not learned well or at all. New information that is well integrated with prior knowledge is more deeply learned than new information that is only superficially integrated with prior knowledge. Thus, even in a traditional view, the notion of OTL would have to consider not just the information to which learners have been exposed, but also what prior knowledge they have brought to the new learning encounter, because this affects the type of learning that takes place or even if any learning occurs at all. Even according to a traditional view, therefore, there is an unavoidable historical dimension to learning and to questions about OTL. Looking at just the here and now will not work, even if traditional assumptions about knowledge and learning are taken into account.

A second complexity is what we might call the "power of representation problem." Some ways of representing information are better for some

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purposes than for others; some forms of representation are more efficient or effective than others. A list is one way to represent information, but a principle from which each member of the list can be deduced and from which new members of the list can be generated is more powerful for many purposes. For example, a list of English words ending in "-ness" (e.g., "goodness," "happiness," "sadness") is less efficient, for many purposes, than a generalization like: "adjective + ness = an abstract noun" coupled with a "blocking principle" in terms of which the generalization does not apply if a non-ness word already exists for the same meaning. Thus, there is no "tallness" because "height" already exists.

However, a learner cannot form a given representation unless he or she has the requisite "mental" representational resources. For example, a learner (or computer) innocent of linguistic ways to represent grammatical generalizations involving morphology would have to settle for a list of "-ness" words. Thus, even in the traditional view, learning and OTL cannot just be a matter of the information to which one was exposed. For true and equal OTL, learners must all have the capacity to form the required representations at the required degree of "power." Two learners exposed to English "-ness" words, one of whom has the grammatical representational resources to represent morphological generalizations and the other of whom does not, have not had the same opportunity to learn the same thing at the same level, even if they have been exposed to the same data. Of course, grammatical representational resources are, in large part, biologically endowed or at least learned in a relatively uniform way across individuals (Chomsky 1986), but no such thing is true in learning literacy, science, or other "content" areas in school, including learning grammar at a conscious level as a "content" area.

The power-of-representation problem shows that, even in the traditional view, we must consider which tools – in this case, tools in the sense of representational resources – the learner has brought to the learning encounter or picked up there along with information (data, content). This is, of course, a different sort of "prior knowledge" issue, in which the required prior knowledge is knowledge of powerful representational schemes. Such schemes are often tied to the disciplinary nature of what is being learned. For example, an academic domain like biology or linguistics has its own special representational resources (such as the one we just reviewed) in terms of which information is more effectively or powerfully dealt with in that domain. Thus, learning these domains – and talking about OTL in these domains – is not a matter of mere exposure to information, but also exposure to and practice with the requisite representational means of these domains.

This last point has obvious implications for testing and assessment. A test made up of a list of facts cannot tell us whether someone has used a list-like representation or a more principled representation to answer the questions on the test. It also cannot tell us whether the student has learned the representational schemes inherent in and partly definitive of the academic domain (in terms of which such facts are generated). It may also be said that a test of such facts puts more burden on those who have simply had to memorize the facts than it does on those who have had the opportunity to master the sorts of representational resources that allow these facts to be generated or inferred. On the other hand, a test that requires knowledge of such representational schemes is not fair if some students have only been exposed to the sorts of facts such schemes generate but not given the opportunity to develop those representational schemes themselves.

Once we grant the points above regarding representational resources, then, even in the traditional view, we have to concede a nonmental aspect to knowledge. In any academic domain, the representational resources it uses – the effective ones that learning the domain entails – are not just mental entities stored in experts' heads. These representational devices are also written down – inscribed – in public ways in terms of words, symbols, graphs, and so forth, on paper, and in machines and various tools the discipline uses. They are also available in the behavior and talk of other people who are experts in the domain. Surely an inability to understand and be able to use these public representational resources does not auger well – even in the traditional view – for the nature and quality of a learner's mental representations in the domain. Even learning the mental representations of a domain, according to the traditional view, must have something to do with learning to use and interact with the public ones.

A third complexity that arises, even within the traditional view, is one that we can see clearly if we consider an analogy with language acquisition. Language acquisition theorists have long pointed out that there is an important difference between "input" and "intake" (Corder 1967; Ellis 1997; Gass 1997). Input is data from the language to be learned to which the learner is exposed. If these data are not processed (not paid attention to and used) by the learner, they obviously have no effect. Intake is input that has been processed in ways that can lead to learning about the language to be acquired.

With any learning, there is an input/intake problem. Even if learners have been exposed to the same information (data, content) – thus, to the same input –it has not necessarily been intake for all of them. There are any number of reasons why input may not actually be intake for various learners. Of course, the "prior knowledge" problem discussed earlier can be one reason

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why, for some learners, certain sorts of input are not intake. Another important variable discussed in the second-language-acquisition literature (see Gee 2008 for a more general discussion) that can cause input not to be intake is that a learner resists using input for social, cultural, or emotional reasons – the learner resists learning because of some perceived threat or insult to his or her individual, social, or cultural sense of self.

In the second-language-acquisition literature, this matter is sometimes viewed this way: Each learner has an "affective filter" (Dulay, Burt, and Krashen 1982; Krashen 1983). When perceived threat is low, the filter is low and input is allowed to get in the head; that is, to become intake. When perceived threat is high, the affective filter is raised and input does not get in or is not properly processed; that is, it does not become intake. Obviously, if the learning situation itself is what is causing the affective filter to rise for some students, we have clear implications for OTL, because these students are not really exposed to the same information as are other students, as the information is now not intake for them.

The input/intake problem tells us, even in the traditional view, that we must go beyond purely cognitive considerations in thinking about learning and the notion of OTL. Learners whose "affective filters" have been raised have not had the same OTL as those learners whose filters have not been raised, despite the fact that they were exposed to the same information, the same input. For the former, the input is not intake – thus, it does not lead to learning. Because the affective filter is tied to social, cultural, and emotional considerations – to learners' views of themselves and their identities in relation to what is to be learned – such sociocultural and effective considerations arise even in traditional views of knowledge and learning.

Our discussion so far has sought to make clear that issues of the historical trajectory of one's learning, of the different public resources available to learners, and the nature of learners' social and cultural identities (and their interpretation of the learning situation in terms of those identities), issues often associated with sociocultural approaches to learning, arise even in the traditional framework that stresses mental representations. Even in the traditional approach, the notion of OTL would have to broaden well beyond mere exposure to the same information, data, or content.

the situated/sociocultural view

We have seen that in the traditional view, knowledge is viewed in terms of mental representations stored in the head ("mind/brain"). We also have seen that complexities arise in this view, although they tend to be backgrounded in favor of studies of cognitive processing. We will turn now to an alternative to the traditional view. This alternative is based on a variety of related, but different, approaches to knowledge and learning stemming from research on situated cognition and sociocultural approaches to language and learning. This alternative emphasizes some of the complexities we discussed with the traditional view and other issues closely related to them.

There is no one accepted situated/sociocultural view, but rather a variety of different perspectives developed in work using different disciplinary lenses from areas like the learning sciences (e.g., Brown 1994), cognitive science (Clark 1997), sociolinguistics (e.g., Gee 1992, 1996, 2004), and cognitive anthropology (Lave and Wenger 1991) – just as there is, in reality, no single accepted formulation of the traditional view. However, to simplify matters, we will develop a perspective on situated/sociocultural work that seeks to capture some of the leading themes in the body of disparate work relevant to a situated/sociocultural viewpoint.

A situated/sociocultural viewpoint looks at knowledge and learning not primarily in terms of representations in the head, although there is no need to deny that such representations exist and play an important role. Rather, it looks at knowledge and learning in terms of a *relationship* between an individual with both a mind and a body and an environment in which the individual thinks, feels, acts, and interacts. Both the body and the environment tend to be backgrounded in traditional views of knowledge and learning.

Any environment in which an individual finds him or herself is filled with *affordances*. The term "affordance" (coined by Gibson 1977, 1979; see also Norman 1988) is used to describe the perceived *action possibilities* posed by objects or features in the environment. The affordances of an individual's environment are what the individual can perceive as feasible to, in, on, with, or about the objects or features in that environment. Of course, an affordance does not exist for an individual who cannot perceive its presence. Even when an affordance is recognized, however, a human actor must also have the capacity to transform the affordance into an actual and effective action. *Effectivities* are the set of capacities for action that the individual has for transforming affordances into action. An effectivity means that a person can take advantage of what is offered by the objects or features in the environment.

Focusing on affordance/effectivity pairs places the focus not on the individual or the environment but on a pairing of the two, a relationship between them. A hammer affords certain actions (e.g., hammering) better than others if one perceives the hammer in properly functional terms. Yet this affordance cannot be transformed into action unless the individual has the capacity to take up the hammer in the right way to transform its affordances into action.

A door that swings out has a set of affordances for movement of a certain sort that can be effected by individuals who have the capacity to push on the door in the way it best affords action.

If we apply this terminology to knowledge and learning in school, we can say that learning involves developing effectivity toward the affordances in specific sorts of environments – for example, in environments in which students are seeking to learn aspects of science, mathematics, social studies, literary criticism, and so forth. Learners must come to be able to perceive fruitful affordances and transform these action possibilities into appropriate actions in thought, word, and deed. In this perspective, studying learning is a matter of studying the relationship between learners and their environments. We have to ask what affordances are available in the environments of particular learners and what effectivities they have or are developing for transforming these affordances into action. We cannot ask only about what is in the learner's head.

Of course, other people (experts and peers) are one special category of "objects" in learners' environments. Different people with different sorts of knowledge and skills afford different learners quite distinctive possibilities of action through talk and shared practices, provided that learners can effect the transformation of these resources into fruitful action and interaction.

This perspective has direct implications for how we view OTL. According to this perspective, learners have not had the same OTL just because they have been exposed to the same information or content. The learning and assessment environment must afford them similar capacities of action. A learner for whom certain objects, people, or features of the environment are not affordances, either because the learner cannot perceive their possibilities for action or cannot effect that action, is not being exposed to the same environment as is a learner for whom these objects, people, or features are true affordances open to the learner's developed or developing effectivity. Notice, too, that there are issues of affordance/effectivity pairings for both learning environments and assessment environments, because both are places where learners have to act.

The affordance/effectivity distinction is only one way to say that thinking and learning are "situated", that is, that we can only understand and define them relevant to the relationships between individuals and specific environments or classes of environments. Yet environment is a complex term in this context. For human beings, the material world and our bodies are part of our environment; human-made tools and artifacts are part of our environment; and other people and their actions and talk are part of our environment. These three categories – each of which interacts and overlaps with the

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others – define three related emphases in work on situated/sociocultural approaches to knowledge and learning: embodiment, distributed cognition, and social practices.

EMBODIMENT

The traditional view of knowledge and learning that we discussed earlier is often connected with a closely related viewpoint that the meaning of a word is some general concept in the head that can be spelled out in something like a definition. For example, the word "bachelor" might be represented by a complex concept in the head that the following definition would capture: "a male who is not married."

However, today there are accounts of language and thinking that are different. Consider, for instance, these two quotes from some recent work in cognitive psychology:

> ... comprehension is grounded in perceptual simulations that prepare agents for situated action. (Barsalou 1999a, 77)

> ... to a particular person, the meaning of an object, event, or sentence is what that person can do with the object, event, or sentence. (Glenberg 1997, 3)

These two quotes are from work that is part of a "family" of related viewpoints which, for want of a better name, we might call the "situated cognition" family, which means that these viewpoints all hold that thinking is connected to and changes across actual situations and is not always or usually a process of applying abstract generalizations, definitions, or rules (e.g., Barsalou 1999a, 1999b; Brown, Collins, and Dugid 1989; Clancey 1997; Clark 1997, 2003; Engeström, Miettinen, and Punamaki 1999; Gee 1992; Glenberg 1997; Glenberg and Robertson 1999; Hutchins 1995; Latour 1999; Lave 1996; Lave and Wenger 1991; Wertsch 1998; Wenger 1998). Although there are differences among the different members of the family, they share the viewpoint that language and thinking are tied to *people's experiences of situated action in the material and social world.* Furthermore, these experiences are stored in the mind/brain not in terms of language ("propositions") but in something like dynamic images tied to perceptions both of the world and of our own bodies, internal states, and feelings. Increasing evidence suggests that perceptual simulation is indeed central to comprehension (Barsalou 1999a, 74).

Let us use a metaphor to make clear what this viewpoint means, a metaphor drawn from the realm of video games (Gee 2003, 2004; for similar perspectives not built on a video game metaphor see Holland and Quinn 1987; see

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Strauss and Quinn 1997 for a perspective from anthropological psychology; see Barsalou 1999a, b; Glenberg 1997; Glenberg and Robertson 1999; Churchland 1995; Churchland and Sejnowski 1992; Clark 1989, 1997, 2003 for cognitivist perspectives). Video games like *Deus Ex*, *Half-Life*, *Age of Mythology*, *Rise of Nations*, or *Neverwinter Nights* involve a visual and auditory world in which a player manipulates a virtual character. Such games often come with editors or other sorts of software with which the player can make changes to the game world or even build a new game world. The player can make a new landscape, a new set of buildings, or new characters. The player can set up the world so that certain types of actions are allowed or disallowed. The player is building a new world by using, but modifying, the original visual images (really, the code for them) that came with the game.

One simple example of this is the way players can build new skateboard parks in a game like *Tony Hawk's Pro Skater*. Players must place ramps, trees, grass, poles, and other things in space so that they or other players can manipulate their virtual characters to skateboard in the park in a fun and challenging way. In the act, the player can create problems that other players must solve in order to skate the park successfully.

Imagine the mind works in a similar way. We have experiences in the world, including things we have experienced in dialogue with others. Let us use as an example experiences of weddings. These are our raw materials, like the game with which the gamer starts. Based on these experiences, we can build a simulated model of a wedding. We can move around as a character in the model as ourselves, imaging our role in the wedding, or we can "play" other characters at the wedding (e.g., the minister), imaging what it is like to be that person. The model we build is not "neutral"; rather, the model is meant to take a perspective on weddings. It foregrounds certain aspects of weddings that we view as important or salient. It backgrounds other elements that we think are less important or less salient and leaves some things out altogether.

However, we do not build just one wedding-model simulation and store it away once and for all in our minds. Rather, we build different simulations on the spot for different specific contexts we are in. In a given situation or conversation involving weddings, we build a model simulation that fits that context and helps us to make sense of it. Our models are specially built to help us make sense of the specific situations we are in, conversations we are having, or texts we are reading. In one case, we might build a model that emphasizes weddings as fun, blissful, and full of potential for a long and happy future. In another case, we might build a model that emphasizes weddings as complex, stressful, and full of potential for problematic futures.

We build our model simulations to help us make sense of things and prepare for action in the world. We can act in the model and test which consequences follow before we act in the real world. We can role-play other people in the model and try to see what motivates their actions or could follow from those actions before we respond to them in the real world. In fact, human beings tend to want to understand objects and words in terms of their "affordances" for actions. Take something as simple as a glass:

> The meaning of the glass to you, at [a] particular moment, is in terms of the actions available. The meaning of the glass changes when different constraints on action are combined. For example, in a noisy room, the glass may become a mechanism for capturing attention (by tapping it with a spoon), rather than a mechanism for quenching thirst (Glenberg 1997, 41).

Faced with the word "glass" in a text or a glass in a specific situation, the word or object takes on a specific meaning or significance based not just on the model simulation we build, but also on the actions with the glass that we see as salient in the model. In one case, we build a model simulation in which the glass is "for drinking"; in another it is "for ringing like a bell to get attention"; in another it is a precious heirloom in a museum that is "not for touching." Our models stress affordances for action so that they can prepare us to act or not act in given ways in the real world.

We think and prepare for action with and through our model simulations. They are what we use to give meaning to our experiences in the world, and they prepare us for action in the world. They help us give meaning to words and sentences, yet they are not language. Furthermore, because they are representations of experience (including feelings, attitudes, embodied positions, and various sorts of foregroundings and backgroundings of attention), they are not just "information" or "facts." Rather, they are value-laden, perspective-taking "games in the mind."

Of course, talking about simulations in the mind is a metaphor that, like all metaphors, is incorrect if pushed too far (see Barsalou 1999b for how a similar metaphor can be cashed out and corrected by a consideration of a more neurally realistic framework for "perception in the mind"). It should be pointed out, though, for those who find an analogy to games trivializing, that simulations are often used at the cutting edge of the sciences of complex systems to form and test hypotheses, test predictions, and generate analyses. Simulations involving multiple "players" are also widely used for learning in the military and in workplaces where people must learn to coordinate their skills with others.

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Thus, meaning is not about general definitions in the head. It is about building specific models for specific contexts. Even words that seem to have very clear definitions, like the word "bachelor" that we used as an example at the beginning of this section, do not really have such clear definitions. Meaning is not about definitions but about simulations of experience. For example, what model simulation(s) would you bring to a situation in which someone said of a woman, "She's the bachelor of the group?" You might build a simulation in which the woman was attractive, at or a little older than marriageable age, perhaps a bit drawn to the single life and afraid of marriage, but open to the possibilities. You would see yourself as acting in various ways toward the woman and see her responding in various ways. The fact that the woman was not an "unmarried man" would not stop you from giving meaning to this utterance. Someone else, having had different experiences than you, would form a different sort of simulation. Perhaps the differences between your simulation and the other person's would be big, perhaps small. They are small if you and that person have had similar experiences in life and larger if you have not.

If we admit the importance of the ability to simulate experiences in order to comprehend oral and written language, we can see the importance of supplying all children in school with the range of necessary experiences with which they can build good and useful simulations for understanding subjects like science. Nearly everyone will have experiences of weddings and bachelors sufficient for building simulations with which to think and prepare for action. Not all learners have adequate experiences with concepts like reflection and refraction, atoms and molecules, or force and motion that will allow them to build simulations that can serve for thinking and meaning in science.

This is clearly an important issue regarding OTL. If some children have had experiences through which they can build and manipulate appropriate simulations in a domain and others have only interacted with oral and written words, the latter have only general and verbal understandings; they cannot assign the richer and more useful meanings to words and texts that the former can. They have not had the same opportunity to learn the material in as deep and meaningful a way.

One issue that arises when we think of meaning as situated in actual experiences people have had is generality. Of course generality is important, but in a situated viewpoint it is often (and sometimes best) attained, at least initially, bottom up by comparing and contrasting various specific experiences that can then serve as materials for building simulations that apply more generally to a domain. Let's consider a specific example. The science educator diSessa (2000) has successfully taught the algebra behind Galileo's

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principles of motion (principles related to Newton's laws) to children in sixth grade and beyond using a specific computer programming language called Boxer.

The students type into the computer a set of discrete steps in the programming language. For example, the first command in a little program meant to represent uniform motion might tell the computer to set the speed of a moving object at one meter per second. The second step might tell the computer to move the object, and a third step might tell the computer to repeat the second step over and over. Once the program starts running, the student will see a graphical object move one meter each second repeatedly, a form of uniform motion.

Now the student can elaborate the model in various ways. For example, the student might add a fourth step that tells the computer to add a value *a* to the speed of the moving object after each movement the object has taken (let us say, for convenience, that *a* adds one more meter per second at each step). Now, after the first movement on the screen (when the object has moved at the speed of one meter per second), the computer will set the speed of the object at two meters per second (adding one meter), and, then, on the next movement, the object will move at the speed of two meters per second. After this, the computer will add another meter per second to the speed, and on the next movement the object will move at the speed of three meters per second. This will repeat forever, unless the student has added a step that tells the computer when to stop repeating the movements. This process is obviously modeling the concept of acceleration. Of course, you can set *a* to be a negative number instead of a positive one and watch what happens to the moving object over time instead.

The student can keep elaborating the program and watch what happens at every stage. In this process, the student, with the guidance of a good teacher, can discover a good deal about Galileo's principles of motion through his or her actions in writing the program, watching what happens, and changing the program. The student is seeing, in an embodied way, tied to action, how a representational system that is less abstract than algebra or calculus (namely, the computer programming language, which is actually composed of a set of boxes) "cashes out" in terms of motion in a virtual world on the computer screen.

An algebraic representation of Galileo's principles is more general – basically, a set of numbers and variables that does not directly tie to actions or movements as material things. As diSessa points out, algebra doesn't distinguish effectively "among motion ($d = rt$), converting meters to inches ($i = 39.37 \times \mathrm{m}$), defining coordinates of a straight line ($y = mx$), or a host of other conceptually varied situations" (diSessa 2000, 32–33). They all just look alike. He goes on to point out that "[d]istinguishing these contexts is critical in learning, although it is probably nearly irrelevant in fluid, routine work for experts," (diSessa 2000, 33) who, of course, have already had many embodied experiences using algebra for a variety of different purposes of their own.

Once learners have experienced the meanings of Galileo's principles about motion in a situated and embodied way, they have understood one of the situated meanings for the algebraic equations that capture these principles at a more abstract level. Now these equations are beginning to take on a real meaning in terms of embodied understandings. As learners see algebra spelled out in additional specific material situations, they will come to master it in an active and critical way, not just as a set of symbols to be repeated in a passive and rote manner on tests. As diSessa puts it:

> Programming turns analysis into experience and allows a connection between analytic forms and their experiential implications that algebra and even calculus can't touch. (diSessa 2000, 34)

Abstract systems originally got their meanings through such embodied experiences for those who really understand them. Abstraction (at least in many important cases) rises gradually out of the ground of situated meaning and practice and returns there from time to time, or it is meaningless to most human beings.

DISTRIBUTED KNOWLEDGE

In the study of knowledge and learning, a situated/sociocultural perspective takes as its unit of analysis not the person alone, but "person plus mediating device" (Brown, Collins, and Dugid 1989; Wertsch 1998). A mediating device is any object, tool, or technology that a person can use to enhance performance beyond what could be done without the object, tool, or technology. It obviously makes little sense to ask how high a pole vaulter can jump without a pole. Furthermore, poles made of different material enable different types of jumps (Wertsch 1998). What learners can understand and accomplish with diSessa's Boxer program as a mediating device is obviously different than what they can do without it.

When people use mediating devices, knowledge is distributed, some of it existing in their heads, some of it existing in the ways in which they can coordinate themselves (as bodies and in terms of social practices) with the tools they are using, and some of it existing in the tools themselves. Other

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people are also "tools" for learners when and if the learners can interact with them so as to gain and produce mutual knowledge. One problem for the traditional view of knowledge and learning – the view that focuses on mental representations – is that almost all human thought and interaction is mediated by objects, tools, technologies of various sorts, or other people.

In fact, it is clear that a mental representation itself is a mediating device. A learner who has internalized geometry as a form of mental representation can understand and use the laws of the pendulum better and more deeply than one who has not (in fact, using geometry is how Galileo discovered these laws). However, once we concede this fact, it is clear, too, that public representations – like geometry on paper or diSessa's Boxer program – are just as important as mental representations in serving as mediating devices. If we are interested in learning and OTL, we must ask which mediating devices are available, how they are made public, and how they come to be used.

People are smarter when they use smart tools. Better yet, people are smarter when they work in smart environments; that is, environments that contain, integrate, and network a variety of tools, technologies, and other people, all of which store usable knowledge. When we ask where knowledge resides in such smart environments, the answer is that it is distributed across the insides of individuals' heads, their bodies, their tools and technologies; other people; and the ways in which all of these are integrated and linked together in a network. This perspective is common now in businesses and workplaces, less so in schools (Gee, Hull, and Lankshear 1996; Hagel and Brown 2005).

People are always parts of environments, whether they are particularly smart ones or not. They always think and act as part of larger systems that contain more than their own heads do. This perspective has been well captured by work in activity theory. The Russian psychologist Vygotsky (1978) argued that human beings do not react directly to or interact directly with the environment. Rather, human reactions and interactions are mediated by signs (language and other symbol systems) and tools. Vygotsky went on to argue that people learn how to use these mediating devices primarily through social interaction. Through participation in common activities with already adept others, people internalize the workings of their culture, their language, and various symbols, artifacts, norms, values, and ways of acting and interacting. The furniture of the human mind first exits publicly in the world of social interaction and participation.

For activity theorists, the proper unit of analysis in studying activity, certainly including learning, is an *activity system*; that is, a group ("community," though without any connotation of people personally having to feel close to

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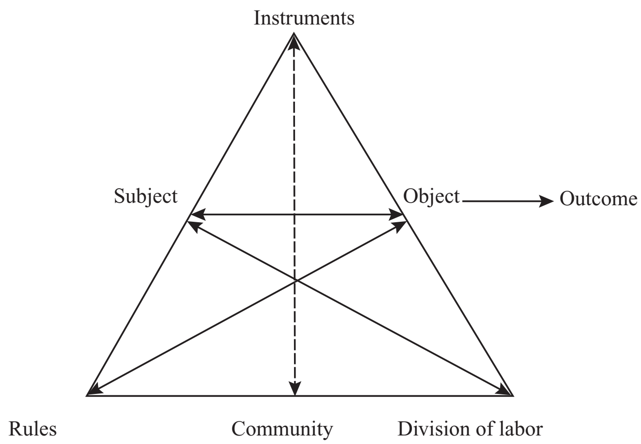

Figure 4.1. Conceptual model of an activity system (Engeström 1987, 78).

each other) of actors who have a common object or goal of activity (Cole and Engeström 1993; Engeström 1987). An activity system as a unit of analysis connects individual, sociocultural, and institutional levels of analysis. The study of activity ceases to be just the psychology of an individual, focusing instead on the interaction of individuals and systems of artifacts in institutional settings that develop across time.

Figure 4.1 (from Engeström 1987) models the integrated elements of an activity system. The whole system has certain intended and unintended "outcomes." The outer triangle contains the integration of "instruments" (various tools and technologies), "rules" (norms of use), and "division of labor" (the differential expertise of different actors in the system). Various other relationships in the model capture the diverse ways in which "subjects" (actors), the "object" (goal) of the activity system, and the "community" (various types of actors in the system) interrelate with each other and with the instruments, rules, and division of labor.

To see the model at work, consider the example of a doctor working at a clinic (example taken from Center for Activity Theory and Developmental Work Research 2003). The object (goal) of the doctor's work is the health problems of his or her patients. The outcomes include both intended ones like improvements in health and unintended ones like patients getting lost in the midst of overcrowding in the clinic. The instruments include tools like x-rays, laboratory tests, and medical records as well as medical knowledge that is partly internalized and partly stored in books and tools. The community consists of the various actors who constitute the staff of the clinic and its

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patients. The division of labor determines the tasks and powers of the doctors, nurses, aides, patients, and other actors in the system. Finally, various rules and norms regulate how, when, and where various actions and interactions take place, as well as the use of time, how outcomes are measured and assessed, and the criteria for rewards.

The same activity system will look different if we take the point of view of another subject (actor) in the system; for example, a nurse. Both the doctor and the nurse share the same overall object (goal), the health care of the patients, but they do not necessarily construe it in the same way. Different actors, because of their different histories and different positions in the division of labor, may very well construe the object and the other components of the activity system in different – sometimes quite different – ways. Yet they still must coordinate their different interpretations of the object (goal) and the activity system as a whole to ensure that the system operates, however well or poorly. This coordination requires continual overt and tacit negotiation, carried out in word and deed, among the various actors in the system.

An activity system does not exist by itself; it interacts within a network of other activity systems. For example, our clinic may receive various rules and instruments from management, another activity system, and in turn, the clinic produces outcomes for other activity systems, such as insurance companies.

If we take an activity-system view of students in a classroom, we cannot ask only about the individual student. We have to ask what sort of activity system the student is in, what his or her role is in it, what the system looks like from his or her perspective, what it looks like from the perspective of other actors (e.g., the teacher, other students) in the system, and what other systems interact with the one the student is in. From an opportunity-to-learn perspective, we must consider more than the information to which the learner has been exposed. All of the other elements in the system need to count as well, including the ways in which all of these elements mediate the learner's knowledge and performance.

PARTICIPATION

In situated/sociocultural work, activity systems have often been analyzed in terms of the notion of a "community of practice" (Lave and Wenger 1991; Wenger 1998). In communities of practice, people share a set of practices, often carried out collaboratively, related to carrying out a common endeavor. Newcomers pick up both overt and tacit knowledge through a process of

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guided and scaffolded participation in the community of practice, a process that has been compared to apprenticeship.

The term "community of practice" – which is now common in the business literature as a way to reform work (Gee, Hull, and Lankshear 1996; Wenger 1998; Wenger, McDermott, and Snyder 2002) – has been used to cover a variety of different social configurations in which shared practices and participation are central (for a critique of the notion of "community of practice," see Gee 2004 and Barton and Tusting 2005). Not all of these fit the sometimes "warm" connotations of the word "community." Nonetheless, the central ideas are that people learn new practices through participation with others, that they are networked with others and with various tools and technologies in ways that allow them to accomplish more than they could by themselves, and that knowledge is stored as much in the network and the practices of the group as it is in any one person's head.

Communities of practice – in workplaces and in some educational instantiations – are beginning to take on a distinctive shape. Some salient features are listed below. These features have commonly been mentioned in literature seeking to reform modern workplaces to make them smarter, but they have all been applied to reform in schools as well and are found in one form or another in classrooms that place a premium on students generating knowledge through participation in authentic practices in areas like science and mathemetics (DuFour and Eaker 1998; Fink and Resnick 2001; Fullan and Hargreaves 1991):

(1) Members of the community of practice are affiliated with each other primarily through a common endeavor and shared practices and only secondarily through ties rooted in shared culture, race, class, gender, or ability. These latter ties – as well as other forms of diversity – are not seen as dividers but are leveraged as differential resources for the whole group in carrying out its common endeavors and practices.

(2) The common endeavor is organized around a whole process (involving multiple but integrated functions), not single, discrete, or decontextualized tasks carried out outside of or without knowledge of the wider contexts that give them meaning.

(3) Members of the community of practice must all share extensive knowledge. By "extensive knowledge," I mean that members must be involved with many or all stages of the endeavor; able to carry out multiple, partly overlapping, functions; and able to reflect on the endeavor as a whole system, not just their part in it. This shared extensive knowledge also involves shared norms, values, and ways of acting

and interacting that allow the community of practice to carry out its endeavors.

(4) Members of the community of practice also each have intensive knowledge; that is, specialized and deep knowledge that goes beyond the group's shared extensive knowledge, which they have built up and can supply to others who do not share it when they need aspects of it for their own work.

(5) Much of the knowledge in the community of practice is *tacit* (embodied in members' mental, social, and physical coordinations with other members, and with various tools and technologies) and *distributed* (spread across various members, their shared sociotechnical practices, and their tools and technologies) and *dispersed* (available offsite from a variety of different sources).

(6) The role of leaders is to design communities of practice, continually resource them, and help members turn their tacit knowledge into explicit knowledge to be used to further develop the community of practice, while realizing that much knowledge will always remain tacit and situated in practice.

In such communities of practice, people are committed through their immersion in practice, because it is the practice itself that gives them their identity. Diverse individual skills and cultures are recruited as resources for the community, not as identities that transcend the community of practice itself.

It is clear that an activity-system perspective, with its links to the notion of a community of practice, treats people, including learners in school, as actors and not just as passive recipients of information (Greeno and Gresalfi, this volume). What people do in an activity system or a community of practice is not entirely a result of what is going on inside their heads but is contingent on interactions among all the elements of the system in which they are acting and interacting. As Greeno (1997, 8) has stated, "just presenting hypotheses about the knowledge someone has acquired, considered as structures in the person's mind, is unacceptably incomplete, because it does not specify how other systems in the environment contribute to the interaction."

It is also clear from our discussion of activity systems and communities of practice that the notion of *participation* in social interaction is foundational. This is so for several reasons. First, according to this perspective, following Vygotsky's (1978) ideas about the Zone of Proximal Development, learning starts when learners are first able to accomplish with others through participation in interaction what they cannot yet accomplish on their own. Such

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skills are said to be in the learner's Zone of Proximal Development, and these are the skills that will soon become individual accomplishments. By the time they become individual accomplishments, learners will have internalized these skills in terms of the schemes they have seen publicly at work in their social interactions with others using various sign systems and tools. These skills, in this sense, retain a social element.

Second, we have seen earlier that the meanings of words and signs, if they are to be truly useful, must be situated in experiences that learners have had that they can simulate in their minds and from which they can eventually build simulations that are more generally applicable. Yet learners can only come to see how words and signs fit particular patterns of experience if they see these words used in specific situations in ways that make clear how they apply. Thus, models of language in use in specific situations from masters and more expert peers is crucial for learning how to situate the meanings of words and signs in specific ways – otherwise, learners have only general verbal definitions as meanings that are hard to apply in specific situations.

Third, participation in social practices not only makes meanings public, but it also allows us to ask how we can position learners in the interaction so as to allow them to be active generators of knowledge (Greeno 1997, 1998; Greeno and Gresalfi, this volume). We saw, at the outset of this chapter, that even with the traditional "in the head" approach to knowledge and learning, there is the problem that some representations are much more powerful than others. When learners must generate knowledge as part and parcel of social practice, they must use more powerful representational systems in their heads and on paper – the sorts of representations that yield new results and do not just store already-provided information. However, to produce such knowledge, learners must be given both the authority for and the resources with which to build knowledge (tools and interactions with masters and more expert peers). In turn, placing participation in talk and other social practices at the center of learning allows us to investigate the affordances and constraints of different forms of participation, a crucial question that hardly arises in the traditional view. To the extent that different forms of talk and social interaction lead to different affordances and constraints for different learners, we confront, once again, a key concern for thinking about equitable opportunities to learn.

Fourth, one of the most important tools for learning in the content areas like mathematics and science is mastery of the specialist varieties of language these areas use, varieties that, as a family, are often referred to as (forms of) "academic language" (Schleppegrell 2004). Specialist varieties of language are crucial tools (mediating devices) for creating meanings in the academic

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content areas. In this sense, learning in the content areas is a form of language development, and like all forms of language development, it is for the most part dependent on specific forms of social interaction with masters (people who know the form of language) and peers (Halliday and Matthiessen 1999). In fact, we know a good deal about how varieties of language are acquired, knowledge that can be applied to learning in the content areas in a situated/sociocultural perspective (Gee 2004; Schleppegrell and Colombi 2002). Let us turn, then, to the issue of language and learning.

ACADEMIC REGISTERS

Although people tend to think of a language like English as one entity, actually it's not one but many entities (Gee 2004, 2005). There are many different varieties of English. Some of these are different dialects spoken in different regions of the country or by different sociocultural groups. Some are different varieties of language used by different occupations or for different specific purposes; for example, the languages of carpenters, lawyers, or video game players.

Every human being, early in life, acquires a vernacular variety of his or her native language. This form is used for face-to-face conversation and for "everyday" purposes. Different groups of people speak different dialects of the vernacular, connected to their family and community. Thus, a person's vernacular dialect is closely connected to his or her initial sense of self and belonging in life.

After the acquisition of their vernacular variety has begun, people often also go on to acquire various nonvernacular specialist varieties of language used for special purposes and activities. For example, they may acquire a way of talking (and writing) about fundamentalist Christian theology, video games, or bird watching. Specialist varieties of language are different – sometimes in small ways, sometimes in large ways – from people's vernacular variety of language. Linguists often refer to these specialist varieties of language, tied to specific tasks and identities, as "registers" (Halliday and Martin 1993).

One category of specialist varieties of language is what we can call academic varieties of language; that is, the varieties of language connected to learning and using information from academic or school-based content areas (Gee 2002; Halliday and Matthiessen 1999; Schleppegrell 2004; Schleppegrell and Colombi 2002) The varieties of language used in (different branches) of biology, physics, law, or literary criticism fall into this category.

Some texts are, of course, written in vernacular varieties of language; for example, some letters, e-mail, and children's books. The vast majority of texts

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in the modern world, though, are not written in the vernacular but in some specialist variety of language. People who learn to read the vernacular often have great trouble reading texts written in specialist varieties of language. Of course, there are some texts written in specialist varieties of language (e.g., nuclear physics) that many very good readers cannot read.

Specialist varieties of language, whether academic or not, often have both spoken forms and written ones, and these may themselves differ from each other. For example, a physicist or computer scientist can write in the language of physics or computer science and speak a version of it, too (e.g., in a lecture).

It is obvious that once we talk about learning to read and speak specialist varieties of language, it is hard to separate learning to read and speak this way from learning the sorts of content or information that the specialist language is typically used to convey. That content is accessible through the specialist variety of language and, in turn, that content is what gives meaning to that form of language. The two – content and language – are married (Halliday and Matthiessen 1999).

Of course, one key area where specialist varieties of language differ from vernacular ones is vocabulary. Yet they also often differ in syntax and discourse features as well ("syntax" means the internal structure of sentences; "discourse" in this context means how sentences are related to each other across a text and what sorts of things can or cannot be said in a particular type of text). For example, suppose someone is studying the development of hornworms (cute green caterpillars with yellow horns). Contrast the vernacular sentence "Hornworms sure vary a lot in how well they grow" with the (academic) specialist sentence "Hornworm growth exhibits a significant amount of variation."

The specialist version differs in vocabulary (e.g., "exhibits"), but it also differs in syntactic structure. Verbs naming dynamic processes in the vernacular version (e.g., "vary," "grow") show up as nouns naming abstract things in the specialist version ("variation," "growth"). The vernacular sentence makes the hornworms (cute little caterpillars) the subject/topic of the sentence, but the specialist sentence makes hornworm growth (a measurable trait for hornworms) the subject/topic. A verb–adverb pair in the vernacular version ("vary a lot") turns into a verb plus a complex noun phrase in the specialist version ("exhibits a significant amount of variation").

Although we do not have space to pursue the matter fully here, specialist varieties of language also differ from vernacular varieties at the discourse level. We can see this even with our two sentences. Note that the specialist version does not allow an emotional word like "sure" that occurs in the vernacular version. We would not usually write or say, "Hornworm growth sure exhibits a significant amount of variation." There is nothing wrong with this sentence syntactically. We just don't normally speak or write this way in this variety of language. It doesn't "go with" the other things we say or write in this variety. At the cross-sentential level, specialist languages use many devices to connect, contrast, and integrate sentences across stretches of text that are not used as frequently, or exactly in the same way, in vernacular varieties of language (like the phrase "at the cross-sentential level" at the beginning of this sentence).

Specialist languages draw, of course, on grammatical resources that exist also in vernacular varieties of language. For example, any vernacular variety of English can make a noun (like "growth") from a verb (like "grow"). Yet to know the specialist language, you have to know that this is done regularly in such a variety; you have to know why (its function in the specialist language); and you have to know how and why doing this goes together with a host of other related processes (for example, using a subject like "hornworm growth" rather than "hornworms" or avoiding emotive words like "sure"). Any variety of a language uses certain patterns of resources, and to know the language, you have to be able to recognize and use these patterns (Halliday 1973, 1985a, 1985b; Halliday and Martin 1993; Halliday and Matthiessen 1999). This is much like recognizing that the pattern of clothing "sun hat, swimsuit, and thongs" means someone is going to the beach.

Earlier we stressed the close connections between meaning and experience. Yet our experiences of talk, dialogue, and social interaction with other people are a large part of what teaches us how words and other signs apply to reality. Let us consider for a moment how people learn the meaningful functional features of their everyday language. Note, however, that we are not talking about the acquisition of "core grammar" (the basic design features that all languages share at least parameters for), an innate competence for human beings (Chomsky 1986). We are talking about how people learn which discourse and pragmatic functions words and syntactic structures can carry out within the social groups of which they are members. Consider, in this regard, the following quote from Michael Tomasello (1999):

> . . . the perspectival nature of linguistic symbols, and the use of linguistic symbols in discourse interaction in which different perspectives are explicitly contrasted and shared, provide the raw material out of which the children of all cultures construct the flexible and multi-perspectival – perhaps even dialogical – cognitive representations that give human cognition much of its awesome and unique power. (p. 163)

Let's briefly explore what this means. From the point of view of the theory Tomasello is developing, the words and grammar of a human language exist to allow people to take and communicate alternative perspectives on experience (see also Hanks 1996). That is, words and grammar exist to give people alternative ways to view one and the same state of affairs. Language is not about conveying neutral information; rather, it is about communicating perspectives on experience and action in the world, often in contrast to alternative and competing perspectives: "We may then say that linguistic symbols are social conventions for inducing others to construe, or take a perspective on, some experiential situation" (Tomasello 1999, 118). This is not to say, by the way, that some perspectives are not better or worse than others, only that language allows its users to state and debate different perspectives or interpretations of the world about them.

This is not surprising, because we have argued already that people give meaning to language by running simulations of our previous experiences. We see that language is already built to convey perspectives on experience, not to offer neutral viewpoints detached from how people actually see things. Human language is built to support human thinking, both of which are perspectival.

Let's give some examples of what it means to say that words and grammar are not primarily about giving and getting information, but rather about giving and getting different perspectives on experience. You open Microsoft's Web site: Are products you can download from the site without paying a price for them "free," or are they being "exchanged" for prior Microsoft purchases (e.g., Windows)? Saying "the download was free because I already owned Windows" is a different perspective on the same sort of experience than "the download was paid for when I bought Windows." If I use the grammatical construction "Microsoft's new operating system is loaded with bugs," I take a perspective in which Microsoft is less agentive and responsible than if I use the grammatical construction, "Microsoft has loaded its new operating system with bugs."

These are all examples from daily life. However, such perspective taking is equally important for the specialist varieties of language used in the content areas in school – a type of language development that occurs after children's early socialization into their native vernacular dialects. Earlier we discussed diSessa's programming language for capturing some specific applications of Galileo's laws of motion. These laws, and diSessa's specific symbolic instantiation of them, take a perspective on the material world that is quite different from the perspectives we tend to use everyday language for to take on that same world. Furthermore, other symbolic forms take yet a different perspective on much the same phenomena (e.g., geometrical expression of the laws of motion). Learners don't really understand any of these symbolic expressions unless they see what perspective they are designed to take on reality; that is, how they imply the world *is* and what the symbolic forms allow us

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to do to/with the world. The best way to see this is to participate in social interactions and activities in which these symbolic forms are used in ways that make clear what they mean and how they apply.

How do children learn how words and grammar line up to express particular perspectives on experience? Here, interactive, intersubjective dialogue with more advanced peers and masters appears to be crucial. In such dialogue, children come to see, from time to time, that others have taken a different perspective on what is being talked about than they have. At a certain developmental level, children have the capacity to distance themselves from their own perspectives and (internally) simulate the perspectives the other person is taking, thereby coming to see how words and grammar come to express those perspectives (in contrast to the way in which different words and grammatical constructions express competing perspectives).

Later, in other interactions or when thinking, the child can rerun such simulations and imitate the perspective-taking the more advanced peer or adult has done by using certain sorts of words and grammar. Through such simulations and imitative learning, children learn to use the symbolic means that other persons have used to share attention with them:

> In imitatively learning a linguistic symbol from other persons in this way, I internalize not only their communicative intention (their intention to get me to share their attention) but also the specific perspective they have taken. (Tomasello 1999, 128)

Tomasello also points out (1999, 129–30) that children come to use objects in the world as symbols at the same time (or with just a bit of a time lag) as they come to use linguistic symbols as perspective-taking devices on the world. Furthermore, they learn to use objects as symbols (to assign them different meanings encoding specific perspectives in different contexts) in the same way they learn to use linguistic symbols. In both cases, the child simulates in his or her head and later imitates in his or her words and deeds the perspectives his or her interlocutor must be taking on a given situation by using certain words and certain forms of grammar or by treating certain objects in certain ways. Thus, meaning for words, grammar, and objects comes out of intersubjective dialogue and interaction: " . . . human symbols [are] inherently social, intersubjective, and perspectival" (Tomasello 1999, 131).

The same dialogic, socially interactive process of language acquisition that shapes children's early understanding of the meaningful functions of their everyday language applies to their learning later specialist varieties of language that are crucial for school success. Learners need to participate in social interactions and activities in which they can make good guesses about what perspectives on reality the language and other symbol systems they see in use are being used to take. They need to be able to simulate these in their minds and try them out in interactions, hopefully in contexts that do not punish them for initially unsuccessful or partially flawed attempts.

If students fail to know the languages of the content areas, no really deep learning can occur, although they memorize and recite facts they don't fully understand and cannot themselves use in proactive ways. If children do not start early on the acquisition of academic forms of language, they are swamped by the later grades and high school and beyond, where language demands in the content areas become intense and complex. Again, we face a crucial opportunity-to-learn issue: Have all children in a given learning environment had equal opportunity to learn the specialist forms of language vital for thought and action in the domain they are seeking to learn?

CULTURE

A sociocultural approach places a premium on learner's experiences, social participation, use of mediating devices (tools and technologies), and position within various activity systems or communities of practice. The word "culture" has taken on a wide variety of different meanings in different disciplines. Nonetheless, it is clear that, as part and parcel of our early socialization in life, we each learn ways of being in the world, of acting and interacting, thinking and valuing, and using language, objects, and tools that crucially shape our early sense of self. A situated/sociocultural perspective amounts to an argument that students learn new academic "cultures" at school (new ways of acting, interacting, valuing, and using language, objects, and tools) and, as in the case of acquiring any new culture, the acquisition of these new cultures interacts formidably with the learners' initial cultures (in Gee 1996, 2005, I use the term "Discourse" – with a capital "D" – instead of "culture").

So far we have discussed the kinds of specialized experiences, tools, forms of participation, and varieties of oral and written language that are found in school and elsewhere in public settings like academics, workplaces, and institutions for which schools are meant to prepare people. Our early socialization in life gives us what we might call our "vernacular" culture; that is, the ways of being, doing, acting, interacting, and using language, objects, and tools that we associate with being an "everyday" ("nonspecialized") person belonging to specific social groups. Each of us has a culturally different way of being an "everyday" person, and it is this identity that we bring to school when we start the process of learning the specialized ways associated with formal schooling and academic content areas.

As we saw earlier, linguists have long made a distinction between a person's "vernacular" dialect (which is different for different geographical and social groups) and the specialized varieties of language ("registers") like those used in the content areas in school and in academic disciplines (Labov 1972; Milroy and Milroy 1985). We can broaden this distinction to consider not only people's vernacular dialects but also their vernacular cultural ways as a whole (Barton 1994). Just as one's vernacular dialect is the core basis on which new varieties of language are learned, so, too, one's vernacular culture is the core basis on which new cultures at school are learned.

We argued earlier that we humans give meanings to things and plan for action by building perspectival simulations in our minds based on the sorts of experiences we have had. Yet each of us has had different experiences – and learned different perspectives on those experiences – in our early enculturation. These home- and community-based ways of building meaning interact with and form the initial base for the child's new experiences at school and in academic content areas, the experiences with which the child will learn to build school-based models of the world.

The same is true in the other areas we have discussed. Children come to school with culturally specific, favored methods of participating in interactions and activities and using language and mediating devices (objects, tools, and technologies) of various sorts (Lee, this volume). These methods also interact with the new, school-based methods the child must learn.

The specialized forms of language and interaction that the child finds at school can resonate with and bridge to the child's vernacular cultural ways and thereby enhance learning. Alternately, they can lack such resonance or fail to create such bridges, thereby raising the child's affective filter and ensuring that school-based input is not actually intake. A great deal of the literature in the sociocultural area is devoted to this topic (e.g., Delpit 1995; Heath 1983; Scollon and Scollon 1981; Taylor 1983; Taylor and Dorsey-Gaines 1987). It has been shown, for instance, that the home-based practices of many middle-class families involve actions, interactions, and ways with words that resonate with practices that occur at school (e.g., Delpit 1995; Gee 1996; Heath 1983; Ochs et al. 1992). For example, practices in which children engage in early pretend readings of books or give scaffolded reports at dinnertime to their parents about some activity they have done that day have been shown to facilitate early success with early school literacy practices. Allowing children to develop "islands of expertise" with regard to subjects like trains or dinosaurs, for which they tend to give and hear school-related explanatory language, is another practice that appears to facilitate early school success (Crowley and Jacobs 2002).

In all of these cases and many others like them, children are not only practicing early versions of school-based practices but are doing so as part and parcel of being socialized into their vernacular culture. These children come to associate school and school-based ways with their home and community-based identities, thanks to the initial overlap between home and school practices. This is a powerful form of affiliation.

There is also ample literature demonstrating that children from groups that have tended to fare less well in school also engage in complex and sophisticated language and interactional practices at home. For example, the complex and often poetic verbal practices of many African American children have been well documented (e.g., Delpit 1995; Gee 1996; Labov 1972, 1974; Rickford and Rickford 2000; Smitherman 1977). However, too few schools make use of early school-based practices that resonate with these vernacular practices and build on them, thereby failing to build the initial strong sense of affiliation with school that often occurs for other children.

The same issues that arise for children's entry into school continue to apply throughout the school years. However, young people bring to school not only their vernacular language and culture but also their peer-based cultures (Shuman 1986). Some of these themselves involve specialist varieties of language and culture ("discourses") connected not to school "content" but to their own peer-based and community identities – for example, if they have become adept at hip-hop or anime. The language and practices associated with hip-hop or *Yu-Gi-Oh* (an anime card game, video game, and television series) are quite complex – indeed, "specialist" and often "technical." However, they are not school based. Schools, therefore, face the issue of how to bridge – and not denigrate – not just children's home-based cultures but their peer-based and "popular cultural" cultures as well.

Schools can make use of students' cultural knowledge and practices and link to their cultural senses of self or they can ignore – or worse, denigrate – these and risk raising the learner's affective filter. Work like that of Lee (1993, 1995, 1997, 2001, this volume) has amply demonstrated that such resonance and links can be made and can make for real school success, even in high school. Lee has built a curriculum that allows African American students to use and research their own vernacular dialects (dialects well studied by professional linguists) and vernacular verbal practices of using metaphor and other tropes. The students also study specialized practices in domains like rap, which have integral links to their vernacular culture. These studies, which are academic in their own right, serve, too, as a mediating device for the students' later studies of standard school-based fare involving, for example, literary critical studies of African American and other novelists.

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Lee has also demonstrated that classroom interaction, talk, and participation can be enacted in ways that resonate with some African American students' home- and community-based discourse practices (i.e., ways of making sense through language in social interaction). At the same time, these classroom practices involve deep learning of school-based content via the types of situated and participatory learning we have discussed earlier in this chapter and, together with Lee's overall curriculum, eventually lead as well to the acquisition of more specialized registers and school-based ways with words. What Lee is doing is, of course, no more than what schools do often at an unconscious level for more privileged children from other cultural groups – those more often associated with so-called "mainstream" middle-class children's homes.

Surely two children have not had the same opportunity to learn if schooling or a given assessment is built on resonances with one child's vernacular culture and not on the other's. Worse yet, two children have not had the same OTL if, however unconsciously, schooling or assessment ignores, dismisses, or demeans the one child's home- and community-based sense of self and ways with words, deeds, and interactions.

CONCLUSIONS: ASSESSMENT

Current assessments often don't mean what we often think they do. For example, the well-known phenomenon of the "fourth-grade slump" – the common situation in which children who have passed early reading tests cannot "read to learn" by the time more complex language demands, connected with academic content areas, are made in the fourth grade – shows that early reading tests do not mean children are learning to read in any academically useful way (Chall, Jacobs, and Baldwin 1990; see also the Research Round-Up section of the Spring 2003 issue of *American Educator*).

If we think of learners in terms of developmental trajectories (Greeno and Gresalfi, this volume) in the space of academic content learning and the learning of the complex forms of academic language associated with different content areas, teachers and policy makers alike need assessments that tell them where learners are in their trajectories and whether they are on course for successful progress in the future. Even certain forms of "failure" may be indicative of progress (e.g., when young children start saying "goed" instead of "went," demonstrating that they are catching on to the existence of an underlying rule system rather than just memorizing forms), and certain forms of "success" may not really portend success, as is so well shown by the fourth-grade slump.

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Assessing the development of learners rather than static stores of skills and information that may not be meaningful in terms of the course of development means that we must ensure that all learners are given the resources and environments necessary for development in school. Americans believe that schooling is a right for all children. Thus, it makes sense to argue that children have certain rights with regard to learning and assessment; that is, rights to conditions that if unmet mean assessment is meaningless or unfair and full development impossible. This chapter, while overemphasizing certain sociocultural approaches to learning, has discussed a number of these "rights," each couched in terms of the notion of OTL.

In summary, we can state the following rights we would argue each child has with regard to OTL. When these rights are not honored, assessments are meaningless and unfair, unless their point is to tell us that the learners' rights were not honored.

1. Classrooms must offer learners not just the same "content" but also equal affordances for action, participation, and learning.
2. Because comprehension requires the ability to simulate relevant experiences in the mind, all learners must be offered the range of necessary experiences with which they can build good and useful simulations for understanding in the content areas (e.g., science, mathematics, social studies, history).
3. Learning for humans is mediated by "smart tools"; that is, representations, technologies, and other people networked into knowledge systems. Thus, learners must be offered equal access to such smart tools.
4. Learning takes place within activity systems, systems that, in school, should be a form of a community of practice. Thus, we must consider more than the information to which the learner has been exposed. All the other elements in the system need to count as well, including access to the forms of participations and social interaction that make one an agent and knower in the system.
5. Content learning in school requires learning new forms of language and the identities, values, content, and characteristic activities connected with these forms of language (e.g., the language of literary criticism or of experimental biology). Every learner has the right for these "new cultures" to be introduced in ways that respect and build on the learner's other cultures and indigenous knowledge, including his or her home-based vernacular culture and peer-based and "popular culture" cultures ("Discourses").

There are, of course, other such rights connected to authentic OTL. Yet caring about these rights means caring – in research, teaching, and assessment – about the trajectories of learners as they develop within content areas in school as part of communities of practice, engaged in mind, body, and culture, and not just as repositories of skills, facts, and information.

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