rating out more culturally mediated secondary cognitive abilities, Vygotsky (Rieber & Carton, 1987; Vygotsky, 1989) considered both primary and secondary cognitive abilities as being culturally mediated, and developing in qualitatively different ways and for qualitatively different reasons than the skeletal processes. It is just that the secondary cognitive abilities are the result of more culturally specific complex activity. All cultures that plan any type of complex activity will have language. All cultures that are involved in some type of exchange or distribution of goods will have number systems. They are inherently part of every day activities. But different cultures have special needs in terms of activity, and develop specific knowledge systems to meet those needs (Leontiev, 1981). The primary cognitive abilities, akin to what Vygotsky called every day concepts, are the result of common cultural activity of all the members of the collective. The secondary cognitive abilities, which seem akin to what Vygotsky called scientific concepts, are based on more complex, culturally mediated needs. These scientific concepts come about as a result of some type of more formal instruction (e.g., schooling).

This brings us to the last, and maybe the most important point, which is what is the best form of formal instruction for learning these secondary cognitive abilities. I would suggest that if one followed a Vygotskian notion of the evolution of knowledge, then a form of social constructivism would work far better than drilling. This has to do with a point Geary (1995) himself raised, and that is motivation to engage in a particular activity. Individuals engage in activity within a collective to meet certain needs. In primary cognitive abilities such as language and numbering, the connection between engaging in the activity and meeting needs is relatively obvious. With secondary cognitive abilities the connection has a higher level of mediation, and the connection becomes obscure. The connection between activity and need is made even more cryptic by the way mathematics are taught in school. American culture makes little attempt to connect mathematics education with any motivation for learning mathematics. In my opinion simple drilling would only intensify this problem.

Individuals need to learn primary and secondary cognitive abilities in essentially the same way. The only difference is that with primary cognitive abilities the motivations are obvious. Education in secondary cognitive abilities must incorporate ways for children to understand motivations. Children must be allowed the opportunity to discover the meaning of mathematics in their own lives. They must discover how it resolves tension for them through the solving of problems. In two words: social constructivism.

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The Evolution of Cognition and the Social Construction of Knowledge

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In this comment, I address three issues raised by Glassman (1996, this issue). The first two concern the relation between biologically primary and biologically secondary cognitive abilities and the mechanisms governing their acquisition, respectively. The final issue concerns the alternative model of knowledge acquisition advocated by Glassman, specifically Vygotsky's social constructivism.

First, Glassman (1996) argues that I cast primary and secondary forms of cognition on a continuum, with primary abilities—those directly shaped by evolutionary pressures—at one end and secondary abilities—those constructed to meet highly specific cultural goals—at the other end. I did not argue that primary and secondary abilities formed a continuum. Rather, I stated that cognitive tasks . . . likely vary in the extent to which they draw on biologically primary and biologically secondary abilities and thus might form more of a continuum, rather than discrete classes. However, the neurocognitive systems that support biologically primary abilities appear to be highly specialized and probably evolved to serve a limited number of functions . . . (thus) I prefer to consider biologically primary and biologically secondary abilities distinct. (Geary, 1995, p. 25)

In other words, complex cognitive (and achievement and ability) tests likely tap a mix of primary and secondary abilities. Those tests that rely heavily on primary abilities (e.g., subitizing tasks) might be at one end of a continuum, whereas tests that rely heavily on culturally specific skills (e.g., the Scholastic Aptitude Test) might be toward the other end of the continuum. Nevertheless, at this point, I do not view the underlying primary and secondary abilities as forming a continuum.

The second issue that Glassman (1996) raises concerns the mechanisms that likely govern the acquisition of primary and secondary abilities. Basically, Glassman argues that social activity designed to meet communal goals is the primary factor that leads to the acquisition of all forms of knowledge, primary and secondary. In contrast, I (Geary, 1995) argued that primary forms of knowledge have strong biological foundations. Specifically, the architecture of the neurobiological systems that support primary forms of cognition represents skeletal knowledge or fundamental principles of the associated domain (see also Gelman, 1990). An implicit understanding of the essential features of primary domains is likely realized as the associated neurobiological systems are activated during the processing of domain specific information. These systems also appear to be partially open to environmental input, that is, their architecture might be shaped, in part, by early experiences (e.g., Greenough, Black, & Wallace, 1987).

From this view, it is very unlikely that the early experience of the child is random or solely driven by socially mediated goals. Rather, the sensory and perceptual systems that constitute primary abilities are selectively activated by specific types of information: social and environmental. The activation of these systems, in turn, likely motivates continued attention to the associated social or environmental inputs. In support of this view is the finding that the looking patterns of human infants are not random but show a selective preference for specific forms of social (e.g., faces) and environmental (e.g., three-dimensional shapes) inputs (e.g., McGuinness & Pribram, 1979). I argued further that the development of the neurocognitive systems that support primary abilities was likely facilitated by children's play. Children's play ensures that these systems are provided with a continuing and increasingly complex pattern of experiences. These experiences, in turn, are needed for the development of the underly-
ing neurobiological systems and to flesh out primary knowledge. Children’s play is inherently fun; this affective component likely motivates engagement in the requisite activities. The acquisition of secondary abilities, I argued (Geary, 1995), requires more deliberate teaching that typically occurs in formal school settings, as contrasted with play. Glassman (1996) incorrectly implies that I argued for drill-and-practice as the primary school-based teaching technique. In fact, for mathematics I argued that drill-and-practice is necessary for the acquisition of procedural knowledge, but that the child’s conceptual understanding of the material is just as important and requires teaching activities other than drill-and-practice. Moreover, drill-and-practice can be done more or less intelligently. Intelligent drill, which characterizes Chinese mathematics workbooks, involves presenting the items so that a variety of procedures are needed to solve the associated problems and sequencing the items so that children can make inferences about the underlying concepts. Unintelligent drill, which characterizes many American mathematics textbooks, involves randomly sequencing items that all require the same procedure. The final, and most important, issue that Glassman (1996) raises involves his argument that Vygotsky’s social constructivism is the model that should be used in our attempts to understand children’s cognitive and academic development. The basic assumption is that all knowledge is culturally mediated and is constructed through the activities that are associated with achieving socially important goals. For instance, mathematical knowledge, both primary and secondary, is constructed as needed to meet needs that arise in the social community, such as commerce. Of primary importance in the construction of this knowledge is language and social discourse. Although several features of Vygotsky’s model are useful and likely represent one mode of knowledge transmission (e.g., the zone of proximal development), the position that all forms of knowledge are constructed during social discourse is almost certainly wrong. There is little reason to believe, for instance, that the cognitive systems that enable us to navigate in the world have been socially constructed, given that these basic systems are evident in many species (Shepard, 1994). This is not to say that the social environment does not have an important impact on children’s cognitive development—it almost certainly does. In fact, there are several models that propose that social relationships are an important pressure in the evolution of many forms of cognition, such as language (e.g., Dunbar, 1993; Geary, in press). Thus, understanding how the social community influences the evolution of human cognition will add to our understanding of children’s cognition. For instance, one associated skill is the ability to make inferences about the intentions of other people. Siegler (1995) recently demonstrated that asking children to explain an experimenter’s reasoning greatly enhanced their conceptual understanding of a number-conservation task. One explanation for this result is that this manipulation capitalized on an evolved ability and motivation to understand other people’s thinking. Either way, there is much to be learned about how evolved cognitive biases interact with culturally specific goals. The general mechanisms advocated by Vygotsky likely represent just one of many factors that influence children’s cognition. In fact, the general appeal of Vygotsky’s model may be understood from an evolutionary perspective. There is good reason to believe that human beings have evolved to attempt to exert some type of control over their social and physical environment. Heckhausen and Schulz (1995) argued that when actual, or primary, control cannot be achieved, secondary control mechanisms (e.g., fantasy) become activated. The activation of these mechanisms, in turn, supports attempts to gain some level of primary control by, for instance, motivating continued goal-directed behavior in the face of failure. The appeal of Vygotsky’s model (and many postmodern arguments) may be understood from this perspective. Language is an important secondary control mechanism (sometimes a primary mechanism when it actually influences the behavior of others) and a central feature of Vygotsky’s model. By casting all of cognition and cognitive development in terms of language and social discourse, one can create the illusion that many aspects of our lives that are beyond our control (e.g., evolved social and cognitive biases) are in fact controllable. Such models are attractive because they are psychologically comforting; however, this does not mean that they are scientifically valid.

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On Erik Erikson’s Berkeley Resignation

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Hopkins’s obituary of Erik Erikson (1995, September) noted that Erikson “resigned his position at Berkeley” (p. 797) in 1950. However, Hopkins gave no information as to the reason for Erikson’s resignation. This is unfortunate, because the circumstances surrounding Erikson’s action give insight into his actualization of one of the “virtues” he posited in his life-cycle theory: fidelity. Erikson’s resignation came during the era of Senator Joe McCarthy’s political persecutions, and many states forced their teachers and professors to sign “loyalty oaths” as a condition of their further employment. Erikson refused to comply, choosing instead to resign. Those who are not familiar with the McCarthy years may not realize the ramifications of such a choice, which opened the possibility that Erikson might be “blacklisted” within the academic community, rendering him unable to secure another university position. Indeed, as Hopkins noted, Erikson’s next appointment, to Austen Riggs, was clinical, with no academic affiliation.

REFERENCE