

Cognitive Pluralism:

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In this paper, I refer to two notions which are basic to the theory of Cognitive Pluralism. First, there are multiple semiotic means. Language is a primary one, but it is not the only one. Second, semiotic means are based on cultural practices. In the theory of Cognitive Pluralism, as in other pluralistic theories, musical and mathematical notation systems, diagrams, maps, and other semiotic means are examined. The use of diverse cognitive approaches is illustrated by the accounts of experienced thinkers. I discuss analytical and analogue cognitive styles in mathematics in relation to historically shifting emphases in the discipline. The developmental and cultural implications of this theory are illustrated with analyses of narratives as they are retold by children. In closing, a contrast between Howard Gardner's theory of multiple intelligences and the theory of Cognitive Pluralism is presented.

Cognitive Pluralism: A Sociocultural Approach

The amazing variety of our experienced world cannot be represented effectively without some selectivity. This task has become particularly demanding in the closing years of the twentieth century. Human beings are flooded with information; the challenge to notice, to remember, to construct coherence out of this complexity is awesome. The critical role of language in this process has been emphasized by the French philosopher Henri Bergson, the American anthropological linguist, Benjamin Lee Whorf, and by the Russian psychologist, Lev Vygotsky. The enduring impact of Vygotsky's *Thought and Language* has contributed to our understanding of the power and uses of language. Many readers of *Thought and Language* have interpreted Vygotsky's claim that "Words play a central part not only in the development of thought but in the historical growth of consciousness as a whole" to mean that it is language--and only language--that is critical to humans' symbolic endeavors (1962, p. 153).

Psychological Tools

In the work of Wertsch we find a broader formulation of Vygotsky's basic claim. Wertsch's emphasis is on the centrality of semiotic mediation in Vygotskian theory, and the critical role of signs (or psychological tools) in action and in reflection. Wertsch wrote in 1985 that "psychological tools are not auxiliary means that simply facilitate an existing mental function while leaving it qualitatively unaltered. Rather, the emphasis is on their capacity to transform mental functioning" (Wertsch, 1985, p. 79). These transformations are not thought of as embedded in isolated, individual activities. Psychological tools are socially constructed, and individuals appropriate these tools and practice "by virtue of being part of a sociohistorical milieu in which these tools and practices have been and continue to be **culturally transmitted**" (John-Steiner, Panofsky, & Smith, 1994, p. 141).

What are the forms of these psychological tools? One answer to this question is based on this quote from Vygotsky:

The following can serve as examples of psychological tools and their complex systems: language; various systems for counting; mnemonic techniques; algebraic symbol systems; works of art; writing; schemes, diagrams, maps and mechanical drawings; all sorts of conventional signs; and so on (1981, p. 137).

"In all cases" Wertsch writes, "these mediational means are the products of sociocultural evolution and are appropriated by groups or individuals as they carry out mental functioning" (1993, p. 341). I wish to argue for an expansion of these two notions. First, there are a multiplicity of semiotic means of which language is critical but not the only manifestation, and second, these semiotic means are based on cultural practices. I have previously referred to this stance as *cognitive pluralism* (John-Steiner, 1991). The notion that historically developed mediational means constitute an ensemble of psychological tools, and that these may differ in modalities, is different from some of the ways in which Vygotsky's thinking has been interpreted. It also opposes the monist position of some cognitive scientists, who conceive of representations as a propositional code--a language of thought composed of sentence analogues (Pylyshyn, 1984).

Issues of Representation

Thinking about the nature of mental representation reaches back to the Greeks; it is also a hotly debated contemporary concern. Aristotle, perhaps influenced by the importance of vision in Greek speech, suggested that we often think and remember with images. A more recent discussion concerning the role of language in thought can be found in Hannah Arendt's (1977) book entitled *Thinking*. "The sheer naming of things, the creation of words, is the human way of *appropriating and as it were, disalienating* the world into which, after all, each of us is born as a newcomer and a stranger" (1977, p. 100). Her position appears to be a monistic one, ascribing a central role to language in thinking. She writes that "discursive thought is inconceivable without words already meaningful" (1977, p. 99). But then as an interesting twist, Arendt adds:

These observations on the inter-connectedness of language and thought, which makes us suspect that no speechless thought can exist, obviously do not apply to civilizations where the written sign rather than the spoken word is decisive and where, consequently, thinking itself is not soundless speech but mental dealings with images. This is notably true in China ... There the power of words is supported by the power of the written sign, the image (1977, p. 100, and footnote, p. 63).

Arendt's discussion of variations in the internal aspects of thought as linked to cultural practices (i.e., literacy), raises important issues for a theory of semiotic mediation. By including images in her conception she differs from monists such as Fodor and Pylyshyn, who developed a computational

model of cognition. In addition, she proposes a link between external forms of symbol systems--alphabetical or hieroglyphic writing systems--and internal codes.

A variety of scholars reject the notion of language as the sole basis of re-presenting, of re-constructing, or remembering a lived experience through mediated activity. Rudolf Arnheim takes the monistic position in favor of visual models. His perspective in *Visual Thinking* is that thought and sight are dynamically interconnected, and that language plays a limited, secondary role. "Visual thinking calls, more broadly, for the ability to see visual shapes as images of the patterns of forces that underlie our existence--the functioning of minds, of bodies, or machines, the structure of societies or ideas" (Arnheim, 1969, p. 315). He also discusses the multiple roles that images can play as pictures, sign or symbols.

There are also pluralistic theories, for instance, Kosslyn's (1980) model, which includes images, verbal propositions, musical and mathematical notational systems as part of semiotic mediation, or representation. When I discuss such a pluralistic concept as a teacher, I rely upon the following demonstration: I ask these students to pretend that they need a telephone number which they get from "information," and they do not have a pencil with them. They must remember the number by some mnemonic device. When they report the devices they used, in a class of twenty adults, there are at least four different strategies. One is repeating the number and relying on an auditory image while dialing. Another is a chunking strategy, where the first three digits are recalled unmediated, and the other four numbers are associated with a historical date, or with a personally significant number like a birth date. Others report a kinesthetic strategy, during which the auditorily received numbers are re-coded on the imaged surface of a touch-phone. An interesting, rare strategy is musical: numbers are recalled as musical notes. Some people with mathematical training find arithmetical patterns or relationships among the digits. Participants in the exercise are usually surprised by the diversity of strategies reported by their peers, as each individual tends to universalize his/her way of recalling information.

In thinking about this exercise one is faced with the issue of re-presentation. How, where, and in what way was the number held on to by the participants? The concept of representation is a critical part of contemporary cognitive science. Jerome Bruner wrote: "Representation, or a system of representations is a set of rules in terms of which one conserves one's encounters with events" (1973, p. 316). Howard Gardner writes in *The Mind's New Science*, "a scientist traffics in such representational entities as symbols, rules, images" (1985, p. 38). Some sociocultural theorists are uncomfortable with representation and the concomitant notions of internalization. Lave and Wenger have written,

Conventional explanations view learning as a process by which a learner internalizes knowledge, whether "discovered," "transmitted" for others, or "experienced in interaction" with others. This focus on internalization does not just leave the nature of the learner, the world, and of their relations unexplored; it can only reflect far Teaching assumptions concerning these issues. It establishes a sharp dichotomy between inside and outside, suggests that knowledge is largely cerebral, and takes the individual as an unproblematic unit of analysis (1991, p. 47).

They contrast the cognitivist account of knowledge acquisition and the implicit notion of representation with their own emphasis on "learning as increasing participation in communities of practice" (1991, p. 39). Their participatory view is akin to that of Barbara Rogoff, Jacquelyn Baker-Sennet, and Eugene Matusov (1993) who also reject what they call the "cranial storage metaphor" (p. 3). In contrast to a static storage metaphor they suggest a better focus to be one of conceptualizing mental representation *as an activity*. They suggest that "activity involves active and dynamic contributions

from individuals, their social partners, and historical traditions and materials and their transformations, in mutually defining relations" (p. 11).

This, then, is the sense in which the notion of *representing* is used in this paper; as an activity, embedded in social practice, and relying on socially developed semiotic means. Implicit in such an approach is the assumption that what Bruner calls "events," for instance, literacy events, are patterned in certain ways. Ecology, history, culture, and family organization may play roles in the patterning of events and experience. Arendt's example of ideographic writing argues that a socially developed code, and its attendant forms, has implications for the prevalence of visual modes of representing.

Examples from Mathematics

In further exploring the notion of cognitive pluralism—that of the multiplicity of semiotic means and their formation through cultural practices—we have looked at different kinds of data. These include psychometric studies, self-reports, and cross-cultural inquiries. Ann Roe's (1970) study of scientists found that social scientists favor verbal cognitive strategies while physical scientists **rely** on visual approaches. In addition to group differences in representational activities, one can **find** varying strategies among members of a single profession. An interesting distinction is made by Davis and Hersh (1981) in *The Mathematical Experience* between analytical and analogue approaches to mathematics. In the former, symbolic and verbal processes predominate, while in the latter, geometric and visual intuitions play an important role. They give the following example:

Some years ago I (one of the authors) spent considerable time working in the theory of functions of a complex variable. This theory has a considerable geometric underlay. In fact, it can be developed independently from a geometric (Riemannian) or from an analytic (Weierstrassian) point of view. The geometrical illustrations in textbooks often feature spheres, maps, surfaces of an unusual kind, configurations within circles, overlapping chains of circles, etc. As I was working along with the analytical material, I found that it was accompanied by the recollection or the mixed debris of dozens of pictures of this type that I had seen in various books, together with inchoate but repetitious nonmathematical thought and musical themes.

I worked out, more or less, a body of material which I set down in an abbreviated form. Something then came up in my calendar which prevented me from pursuing this material for several years. I hardly looked at it in the interval. At the end of this period, time again became available, and I decided to go back to the material and see whether I could work it into a book.

At the beginning I was completely cold. It required several weeks of work and review to warm up the material. After that time I found to my surprise that what appeared to be the original mathematical imagery and melody returned, and I pursued the task to a successful completion (pp. 310-311).

There are several interesting issues raised by this account. First, the mathematician-author writes of setting down his ideas in an abbreviated form, a process akin to what Vygotsky has called "semantic shorthand." Such notations frequently have the "extreme, elliptical economy of inner speech, changing the speech pattern almost beyond

recognition" (Vygotsky, 1962, p. 45). I have called this process "inner speech writing" as it captures a certain rapidity of newly developed ideas. These written thoughts which have not been reshaped for an audience are messages for the self and may take the form of writing, noting, and calculating. In the report above, the author expands our notions by illustrating how symbols other than language, such as geometrical illustrations, can perform similar roles in intense cognitive labor. The socially constructed nature of these symbols (that they are textbook illustrations) highlight this phenomenon even further.

This report also adds to our exploration of cognitive pluralism as the author emphasizes how his visual-geometric (or analogic) symbols assisted him in recalling his earlier work on a complex function problem. This process strikes me as akin to Vygotsky's analysis of the "sense" of symbols. "In inner speech," he wrote, "a single word is so saturated with sense that many words would be required to explain it in external speech" (p. 47). Davis and Hersh (1981) describe such a notion of sense in mathematics when they write: "Just what constitutes the 'straightness' of the straight line? There is undoubtedly more in this notion than we know and more than we can state in words and formulas" (p. 159). They further write "mathematical concepts evolve, develop, and are *incompletely* determined at any particular historical period" (p. 162). It is in exploring at the boundaries of this indeterminacy—the saturation of sense—that new discoveries are frequently made.

Notational systems can be converted from analogue to analytical forms, and their use may show variability during different historical periods. There are periods when a particular notational system becomes predominant within a domain, with the result that cognitive pluralism—reliance upon multiple codes—may be narrowed among its members. Such may have been the case in mathematics at the middle of the 20th century. For years the French Bourbaki group were unchallenged intellectual leaders in their field. They were committed to a thorough formalization of mathematics, accepting only the analytic approach. A concomitant rejection of analog, kinesthetic and geometric approaches took place. But now there is an interesting reversal, chronicled by the geometer Robert Osserman (1981):

The recent rise to prominence of such unabashed geometrists as Thurston and Yau is a sign that the low ebb in the fortunes of geometry has passed. (These geometers use highly visual approaches to complex problems, such as the fourth dimension.) I would predict that with no effort on our parts, we will witness a rebirth of geometry in the coming years, as the pendulum swings back from extreme devotion to structure, abstraction, and generality (p.244).

Mathematics and Language

The shifting importance of analytical versus analogue approaches in mathematics reflects domain specific concerns—preferences voiced within the discipline—as well as developments in related disciplines. Chaos theory with its strong visual representations is an example of such broader trends. Part of the appeal of analytical approaches is that they assist in schematizing the complexity of experience. But while simplification is useful in cognitive activity as reflected in symbol use and the development of notational systems, it is only part of cognitive dynamics. Together with simplification, we use mathematical and lexical devices which contribute to the distinctiveness of represented experience. In analytical approaches, systematic use of mathematical symbols contribute to efficiency, while analogue approaches and reliance on mathematical imagery, frequently contributes to discovery.

There is a parallel between the contrasting and complementary roles of analogue and analytical approaches in mathematics and in certain language dynamics. In language, simplification is frequently achieved by habitual, grammaticized categories: Svorou (1986) explained how the historical development of the meaning of the English locative expression *in front* evolved from a nominal source. Ffis account provides an interesting example of the emergence of grammaticized categories from nouns.

The Oxford English Dictionary tells that the noun *front* was borrowed from Latin into English in the 13th century. It denoted a specific object *forehead*. By the 14th century, it was found in an

abstract metaphorical extension, a possessive construction, *thefront of* to denote the foremost part of objects, such as the entrance side of a building. Later it was used to denote any side of the building, depending solely on the perspective of the viewer. That is, it reveals a new step in the process of abstraction. By the 17th century, it had grammaticized to the locative expressions *thefront of*, which denoted a location in contact with a specific part of an object. Later, by the 18th century, the process developed further from the concrete noun *forehead* to the contemporary grammaticized use of *infrent of*, a locative expression denoting position in a wide variety of contexts. Once the noun *forehead* had been metaphorically extended into the locative expression *infrent of*, it is no longer limited to referring to the body part *forehead*. Now in its grammaticized form, it is used widely in any relevant context to denote a spatial relationship. This illustrates an efficient creative language dynamic.

The dynamics between *efficiency*, as achieved by simplification and generalization in language, and *salience*, the result of careful lexical choice, contributes to what is noted, communicated, or remembered. These interactions are similar to the relationships between precision in symbol use and the reliance on mathematical or physical imagery in scientific discovery.

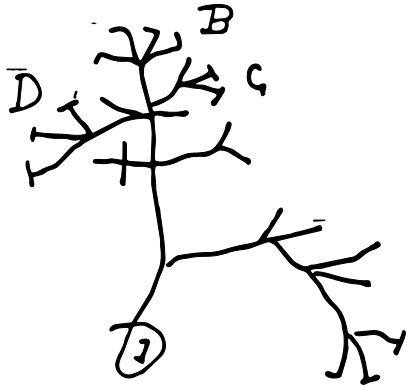
Notations of Thinking

The use of multiple cognitive approaches---varying in sense modalities, formality, and style---is illustrated by the accounts of experienced thinkers drawn from a variety of domains. I use these extensively in *Notebooks of the Mind*. One of the most interesting of these was provided by the British writer, Margaret Drabble. She is a writer of great verbal fluency. "Thinking about things and translating them into words is a continuous and instinctual activity with me," she said. "I can hear all my sentences being said, I can hear them to a marked extent" (quoted in John-Steiner, 1987, p.32). While aware of this strong presence of words in her writing, Drabble also reported on selected use of imagery in her work. When a change is needed in her narrative, she tries to visualize an event in her developing plot.

One of the ways the researcher can have access to generative, creative activity is by studying the jottings, diagrams, and rapid flow of ideas of engaged, experienced thinkers. One rich source for accessing these rapid, planning notes is in the journals and diaries of writers. This example is from Virginia Woolf-

Suppose I make a break after H's death (madness). A separate paragraph quoting what R. himself said. Then a break. Then begin definitely with the first meeting. That is the first impression: a man of the world, not professor, or Bohemian ... Love. How to say he never was in love? Give the prewar atmosphere. Ott. Duncan. France. Letter to Bridges about beauty and sensuality. His exactingness. Logic. (A *Writer's Diary*, 1953, p. 292-293).

Such notes exemplify the packed, telegrammatic features of inner speech described by Vygotsky, who wrote that "Inner speech is to a large extent thinking in pure meanings. It is a dynamic, shifting, unstable thing" (Vygotsky, 1986, p. 249). Examples of condensed, planning notes are not limited to writers. One of the claims that I made in my book *Notebooks of the Mind* is that condensation occurs across modalities. The first example is from Darwin's notebooks (Gruber, 1980). It is an image he drew frequently.



"Over the years, Darwin drew a number of tree diagrams **both** trying to perfect **it** and penetrate it- to learn what his own imagery would tell him" (Gruber, 1980, p. 318). Tchaikovsky reported similar

activities. IEs brother, Modesto, tells us that he often took walks when he needed a break from the task at hand. During these walks, most of the time ... was spent in composition. He thought out the leading ideas, pondered over the construction of the work, and jotted down fundamental themes. In Klin there are carefully preserved many little exercise books, which he has used for this purpose. If in absence of mind Tchaikovsky had left his notebook at home, he noted down his passing thoughts on any scrap of paper, letter, envelope ... which he chanced to have with him (*Life and Letters of Tchaikovsky*, 1973, p. 20).

These jottings are a particular form of semiotic means. They are based on socially developed psychological tool&-words, drawings, maps, musical notes, or scientific diagrams. They are used by experienced thinkers, who telescope a cluster of ideas into a symbolic form, only to **find** that unpacking these symbols is a demanding task as well as a promising one.

Such rapid, condensed notes and diagrams are also used in communicative exchanges among collaborators and partners in dialogue. Physicists grab napkins to diagram their thoughts while eating; many of them also carry notebooks during walks. It is difficult to interpret these quick jottings unless the reader is familiar with the ongoing work of the person whose notes he or she may be studying. These generative notes exemplify Vygotsky's notions of psychological tools turned inwards, as they **fit** his description of condensed inner speech. What I have added to his analysis is the notion that the characteristics of inner speech are not limited to language. Condensed thinking and planning occur across modalities and can be shared with collaborators. When these jottings are unpacked and made communicable to those unfamiliar with the thinkers' new work, they achieve clarity. There is a continuing interaction between *generative* thinking, which is often condensed, fluctuating, and unstable, and *expanded*, fully shared thinking which is organized and refined for maximum, communicative impact. The diversity of semiotic means is greatest in their externalized, fully communicative forms, but they share important features and functions in their generative forms.

I have discussed some issues related to what I call "cognitive pluralism in a sociocultural context." My focus has been on the use of diverse semiotic means on **the** part of adult"-particularly those individuals who are engaged in intellectual labor. This theory also has some interesting implications for children raised in varied cultural settings.

Cross-Cultural Studies of Childrens' Narratives

In the diverse communities of the American Southwest, children hear winter tmes, coyote stories, and other traditional narratives from their parents and grandparents. Stories form a significant part of their socialization. Our own work has focused on story retelling and story construction among diverse groups in the United States and in Europe (John-Steiner & Panofsky, 1992).

In order to present children with a story with wide appeal, we chose a narrative of an older brother and his younger sister and their dream adventures. *One of these Days*, a story specifically written by Charolette Pomerantz for our work, is a long and complex tale. Most 5-year-olds can only retell one third of its plot. But the story is engaging, and it is accompanied by large color illustrations. The pictures evoke a Native American and Southwestern milieu which are engaging to children from many backgrounds, including the European children with whom we have worked.

One of the questions we asked was related to the role of picture cuing in the retelling of the core story. Are there differences between children of different ages, and from different cultural backgrounds in their reliance on visually depicted story features? We found that younger children and Native American children of all ages relied on picture cuing to the greatest extent. Older children and many children from urban communities developed more verbal strategies for remembering. These findings are of particular interest in light of Vygotsky and Leont'ev's memory experiments (Vygotsky, 1978). They, too, gave tasks to young learners which were beyond their current levels of functioning and found visual memory aids contributed to the children's recall. Although our work was not explicitly based upon their experiments, the similarities are of interest.

In the story-retelling research with diverse populations of learners (John-Steiner & Panofsky, 1992), we found that culturally specific schemata governed the recall of *One of These Days*. None of the children at this age retold the entire story, and what they chose to retell is representative of their culturally patterned experiences and traditions. The majority of the young children included the most dramatic action sequences. What they added to this core retelling is most easily revealed by examining a comparison between two Native American groups, the Sioux and the Navajo. The stories of these children differed little in length, but the content uncovered two distinct cultural patterns. The Plains Indian Sioux children, whose cultural tradition includes a strong emphasis on activities which exhibit bravery, retold stories stressing action. The Navajo children, whose tradition emphasizes nature, beauty, and harmony, retold stories which included many more verbalized visual elements, and their versions were quieter and more contemplative.

John-Steiner and Panofsky (1992) reported a later study comparing two groups of Southwestern Indians, the Navajo and the Pueblo. In this study, interesting differences were identified in the children's inclusion of family members in their retold stories. The primary characters in *One of these Days* are a 6-year-old boy and his younger sister. The secondary characters are the parents, whose roles are limited in the story. The primary characters are included by all the children in their retelling. But the inclusion of additional characters seemed to be governed by the family organizations of the

communities from which the children were drawn. Navajos traditionally live on family compounds, frequently at some distance from other members of their clan, and the children have little contact with non-Native Americans during their early years. In contrast, Pueblo children live in village communities surrounded by cities and towns of Anglo Americans. In the Pueblo communities, they spend time with individuals who are not members of their immediate families, and they often have contact with non-Pueblo children and adults. It appears that for Navajo children, family connections become a primary focus in narratives. In their retold stories, they frequently included references to members of the main characters' family. In contrast, Pueblo children did not seem to focus on family memberships to the same extent, and secondary characters were not salient for them in their retelling. Thus the analysis of their retold stories reveals that the concept of community is more closely bound to family membership for the Navajo children than it is for the Pueblo children.

In brief, when these studies are viewed through a sociocultural lens, they reveal two interesting trends. First, the youngest children and the majority of the Native American children relied upon two categories of semiotic means—visual and verbal as a basis for their retelling. The older children were able to use more sophisticated verbal strategies, including note taking in constructing a longer and more accurate story. Second, the patterns in the children's selective retelling provide further evidence of the power of cultural schemata in the ordering and recall of experience.

Conclusions

The development of cognitive pluralism as presented in this paper does show some common features with Howard Gardner's theory of multiple intelligences (Gardner, 1983). In both theories, language constitutes one of several semiotic systems as part of human representational activities. The difference, and it is a crucial difference, is that Gardner ascribes a central role to biology; he views intelligences as built upon certain raw "computational mechanisms" and argues for a possible, biological basis for different kinds of intelligences. In contrast, my interests are in examining the cultural, technological and disciplinary aspects of the development and appropriation of diverse symbol systems and semiotic means. It is in this endeavor that sociocultural theory provides nurture and challenge for the study of cognitive diversity in a pluralistic world.

Notes

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'An earlier version of this paper titled, "Cognitive pluralism: A Whorfian analysis" was published in B. Spolsky and R. Cooper (Eds.), (1991). *Festschrift in honor of Joshua Fishman's 65th birthday*. The Hague: Mouton.

I wish to thank Carolyn Kennedy, Teresa Meehan, Carolyn Panofsky, and the reviewers for **their** varied contributions to this paper.

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