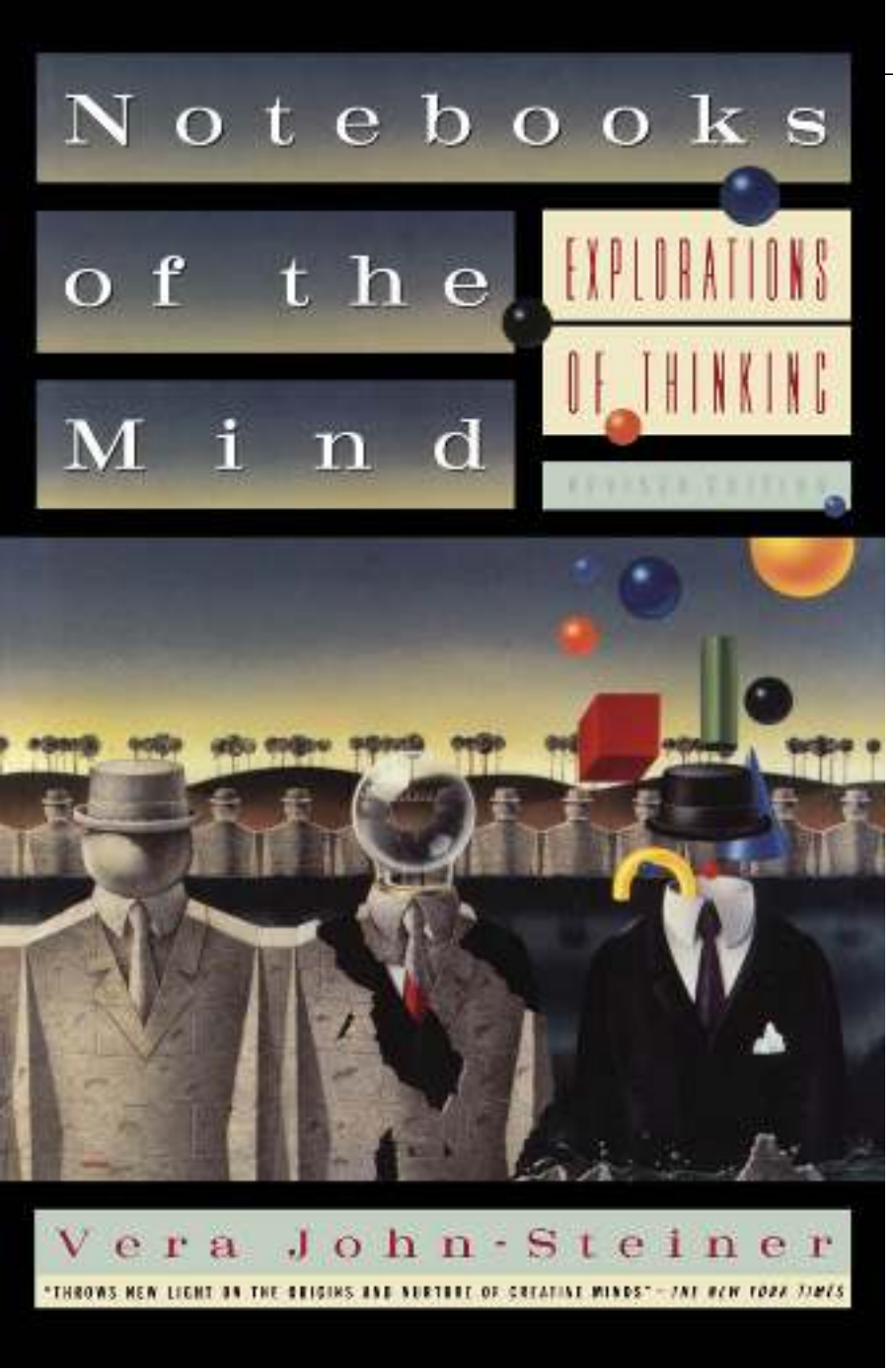
Notebooks
of the
Mind
EXPLORATIONS
OF THINKING
Vera John-Steiner
"THROWS NEW LIGHT ON THE ORIGINS AND NURTURE OF CREATIVE MINDS" — THE NEW YORK TIMES

Notebooks of the Mind

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Notebooks of the Mind

Explorations of Thinking

REVISED EDITION

Vera John-Steiner

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To Sophie Polgar and Stan Steiner,
for they have built the houses of my thought.

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Foreword

Reading *Notebook of the Mind* recalled an incident, a powerful moment in World War II. During a long voyage on a troopship, a few people who liked poetry somehow met each other and found in the ship's library Edna St. Vincent Millay's *Conversation at Midnight*. We read it aloud, taking turns with the different voices. The long poem presents a fascinating and varied array of people gathered in Millay's mind to reflect upon the great questions of life.

This memory was awakened by Vera John-Steiner's book. For she has assembled a company of "experienced thinkers" (to use her wise and modest phrase) as conversationalists in a quiet and comfortable, yet disciplined reflection on the creative process. Of course, these conversationalists, remembering over fifty, do not ever gather together in the flesh. These are dialogues orchestrated by the author of the book, bringing out certain features of the creative process, the long apprenticeships, the continuous interaction of person and society, the varied languages or modalities of creative thought, and the importance of character in sustaining patient, disciplined hard work.

The author's idea of uniting these reflections differs from anthologies on creativity in which each contributor takes his or her turn and disappears, a rapidly fading memory quickly outshone by the next luminary. In *Notebooks of the Mind*, speakers appear and reappear as the author reorganizes their reflections into a serious and many-sided examination of a set of unifying themes. It becomes clear that being creative is a self-reflective process. This is almost self-evident in the case of science, for creativity, because scientific thought must justify itself and

explain its origins. Recent research has shown that older conceptions of the scientific method blight the innovative, imaginative side of creative thought and unduly curtail consideration of the processes through which it is carried forward. *Notebooks of the Mind* is valuable in illuminating these points and in showing that they apply not only in the sciences but in all the arts.

Implicit in the book is a respect for the interplay of creative process and creative product. The person at work may use private languages and modes of thought, but these must then be translated into forms others can comprehend. Public and private are distinct, but they must be commensurate and transposable. Among the many examples Jerry Stocker uses to illustrate this point, I particularly liked her account of the playwright-turned-actor-turned-playwright. From the deep immersion in the actor's craft comes the knowledge of what the playwright must do. Similar examples can be found in the sciences: we think of Newton as a theoretician, but he was also a great maker of scientific instruments.

From a number of recent studies we have come to understand how a long and well-worked-through apprenticeship is vital to the development of a creative life. Teachers and mentors may be imposed upon the young person, or sought out, or discovered in a lucky accident. They may be physically present or far away, living or long dead models. But models and mentors there must be, as well as the disciplined work necessary to profit from them. This point emerges in my work on Darwin, in David Feldman's studies of prodigies, and repeatedly in the present volume.

In a refreshing reversal of more customary formulations, John Steiner treats the skills and languages of thought of the creative person as ways of being, permeating one's life. But in addition the creative person preserves a set of "invisible tools," which are matters of character—courage, discipline, openness to collaboration, ability to go it alone—without which the skills would come to naught. The key point is that creative aspiration must capture the *whole* life: thus it is that the skills, the languages, and the character are each indispensable.

In modern cognitive psychology, a continuing battle rages between the proponents of propositional thought and those who favor imagistic thought, each side aiming to show that the other can be "translated" out of existence. Johnstone enters the fray with three important points to make. First, the set of alternatives numbers more than two. In addition to her examination of visual and verbal modes of thought, she gives a particularly rich and thorough presentation of the languages of emotion and of the body—music, dance, and theater. Second, the product must not be confused with the process. Among choreographers, for example,

she shows how George Balanchine's thought is fundamentally visual, Merce Cunningham's spatial and geometric, and Martha Graham's poetic and mythic. Yet all produce dance, all appear on the same public stage, all contribute to and learn from the same world of dance. Finally, the fact that one language of thought can be translated into another by no means develops either one. Indeed, this work of translation is a large part of the creative process.

Nowhere is this idea more clearly brought out than in the exchanges between the physicist Richard Feynman and the mathematician Freeman Dyson—two characters who do not appear in this book's mighty cast, but who might well be waiting in the wings. A point came when Feynman had already worked out his system for representing quantum electrodynamic processes (now known as "Feynman diagrams"), but his colleagues could not understand him. Dyson's students told him that Feynman really had something. So the two men set to work, the distinguished mathematician to learn from the pioneering physicist. After months of collaboration they understood each other, and Feynman had an exponent who could teach the world. This all we'll ever going to say that Feynman just already had the basic insight. But without the hard work of collaboration, translation, and public rendering, the job is not done. So both parts are indispensable to the creative process, and arguing indispensables more must yield to another in trying for importance.

In common discussions of the modalities of thought, too much emphasis has been placed on the choice between visual and verbal thinking. Now we can see how this Hobson's choice is unnecessary and almost beside the point. There are many modalities available, each person must struggle to develop his or her own patterns of thought, and the movement from modality to modality is the central issue on which we should be focusing our attention, rather than the choice of one or the other dominant "language of thought." Moreover, a vital, ever-loose coupling exists between the forms of thought involved in the creative process and those displayed in the final public product. In Frames of Mind, Howard Gardner has recently revivified our knowledge of the multiplicity of these modes of thought. It remains now for us to work out in some detail the complex arrangements that evolve among different modes in different phases of the creative process.

Professor John-Steiner has made a wise choice of the term "experienced thinkers" to characterize the figures in her book. It permits her to introduce into this many-sided dialogue all sorts of people who might not qualify for a place in the Pantheon of creativity—lesser known

artists, social scientists will something to say about the creative process, people from the media world of television, and so on. Depending on one's criterion level, they might or might not qualify as creative individuals—but they do each have something to say about the subject, something born of their own struggles and experiences. This enlargement of the cast of characters in the conversation makes it possible to introduce findings from experimental and developmental psychology into the discussion of creative work. By the same token, we can see how workers in these branches of knowledge can learn from reviewing the notebooks of the mind.

In "One Word More," Robert Browning wrote

> Does he paint? he fain would write a poem,—
> Does he write? he fain would paint a picture.

These incessant dialectical movements—between process and product, person and society, one modality and another, intention and expression—are the core of the creative process. When you march, music captures your feet; when you sing it captures your heart. *Notebooks of the Mind* is like conversations; not at midnight, but say at a civilized hour of the morning, when each of the participants has already made good progress in the day's work, and wants to stop to reflect on it.

Howard E. Gruber
University of Geneva
and Rutgers University

Acknowledgments

Some books are part of one's life for many, many years. This is such an enterprise, and its slow but steady growth was helped by my family, my friends, and my students. I owe a special debt to Professor Howard Gruber, who shared his vast knowledge of cognition and creativity with me during many talks, and to the later writer Anaïs Nin, who read an early chapter and provided much needed encouragement. My colleagues in New York, California, and New Mexico arranged introductions to potential interviewees, and discussed ideas with me. Many of them are listed in the back of this book among the names of those interviewed.

The staff of the University of New Mexico press has been supportive and committed to this work, and my editor, David Dolby, applied the right mixture of pressure, thoughtful suggestions, and nanny to get a busy professor to finish her favorite, but often neglected, task. A fellowship from the Office of Education (a Mina Shaughnessy Scholars program) helped me to devote some concentrated time to write about we blog. My thanks to Joan Bossert, my editor at Oxford University Press, whose belief in this book made the revised edition possible. Finally, Nancy Cage, Carolyn Dandisky, and Teresa Meehan were among the many individuals at the University of New Mexico who gave me assistance with editing, typing, and other necessary chores in preparing this manuscript for the publisher.

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Introduction to the Revised Edition

When I was a child in Budapest, Hungary, in the 1930s, the most valued human activity was developing and working with ideas. In those precarious years before World War II, nothing was certain. Yet the adults around me had the courage to continue addressing themselves to the great traditions of human knowledge. In the midst of their fears for the future, they still enjoyed impassioned conversations about Thomas Mann or the new physics. I wanted to understand how thinking and creative transformation can sustain life in the face of war and extermination. That was why I chose to study psychology. Part of this book has been a journey to try to understand the life-affirming power of intellectual endeavors.

That power was beautifully exemplified by a recollection of the Hungarian mathematician Pál Turán. In 1940, he was serving in a Hungarian forced-labor camp. While at labor, he thought of a new mathematical problem—counting the edges of a particular type of graph. Thirty-six years later, while suffering from a fatal illness, he recalled the pleasure this problem gave him: "I cannot properly describe my feelings during the next few days. The pleasure of dealing with a quite unusual type of problem, the beauty of it, the gradual approach of the solution, and finally the complete solution, made those days really ecstatic."[1]

As a graduate student in the 1950s, I was taught the positivist model of psychological research: a focus on precise, limited problems of behavior. Broader human questions that motivated me were put aside as unscientific. As time went on, however, I found that narrow focus constricting. My desire to understand how human beings at the edge of

danger could find freedom in the life of the mind remained unsatisfied. Yet I couldn't escape the positivist model, while I was at the university where that model was shaped. Twenty years later, I moved to the southwest and encountered the vastly different ways Native Americans visualize thoughts. Here, at last, I became ready to explore the issues that had motivated my choice of a profession.

It is quite a leap from Budapest to Rough Rock, Arizona, but the diversity of thought and the potpourri of cultures as part of thought were vividly manifested in both places. For Navajos, the creation of beauty in paintings and ordinary artifacts has a life-sustaining power in the midst of harsh conditions they often face. Seeing this power, I asked myself: What sustains creative and intellectual endeavor?

When I started this book, my questions—about diversity of thinking, about the sustained efforts of creative individuals, about the move from intent to realization—seemed to be at the margin of what was being studied in cognitive psychology. And the little literature that was available was fragmented. Therefore, I decided to interview creative thinkers from a variety of backgrounds who agreed to talk about how they work. In these interviews the intensity with which creative people live their work was unmistakable. Many of them echoed Albert Einstein's belief that people come to art and science to create "a simplified and lucid image of the world," helping to "take way to all of some peace and serenity amidst the cruelties of daily life."[2]

Powerful common themes emerged from the words of these one hundred very different creative individuals. Their voices contributed to the shape of this book. They also made me see that no single exploration can answer a question as ever-present and intriguing as the nature of creativity.

Since *Notebooks of the Mind* was first published in 1985, thinking about thinking and research on creativity have blossomed. Most significant in this expansion are the scholars who address the complexity of the human mind. There is a growing "thought collectivity" of creativity researchers, cognitive psychologists, and neuroscientists who reject reductionist approaches[3] or what Jerome Bruner called "ways of thinking that grew out of yesterday's physics."[4] The focus of these scholars is on the transforming possibilities of creative work. They also study how knowledge is passed from one generation to the next. The result is not a single, unified theory of creativity, but a shared framework of connected ideas. This book is part of this broader effort. It is part of an important shift in creativity studies, from a purely person-centered approach to one that includes the dynamic and social aspects of creative cognition.

This change of perspective is demanding because it challenges the

image of the lonely creative genius that has been part of the Western mindscape for generations. This image of a solitary person influences our conception of human nature and the way we try to measure creativity. And for most of this century, creativity was studied by identifying the traits, abilities, and thinking styles of creative persons.[5] In this approach the investigator compares individuals using a battery of tests. In contrast, the emerging framework, and the one governing this book, no longer focuses narrowly on the creative personality as a set of traits, but sees creativity as a dynamic system. One of the architects of this framework, the psychologist Howard Gruber, sees creative work as an evolving system that is developmental, pluralistic, and interactive. In his groundbreaking study of Charles Darwin, Gruber analyzes this scientist's notebooks as a springboard for studying the many aspects of his creative trajectory. In the recent *Creative People at Work*, co-edited by Gruber and Doris Wallace, the creative lives of artists and scientists are studied in an effort to uncover what sustains their creativity over a lifetime.[6] There is a deep, continuing kinship between their work and mine. We share a commitment to document the complex tracks of creative thought, and we favor notebooks, journals, letters, scientific records, and interviews as resources for understanding the creative process.

Another approach that is similar in spirit comes from creativity research. Mihaly Csikszentmihalyi. In 1965 he began a longitudinal study of several hundred young art students, tracking the beginning of his influential career. He and his co-workers hoped to predict the success of the participating young artists over the ensuing decades, but they found that individual characteristics (including the researchers' own occasionally dubious powers of prediction) could not explain why some artists "produced work that in the course of time would be judged creative while others did not."[7] A broader, more comprehensive approach was needed. Csikszentmihalyi subsequently suggested a dynamic model in which creativity is the result of the interaction of three shaping forces: (1) the domain, an organized body of knowledge about a particular topic; (2) the field, which selects promising variations from a domain; and (3) the person, who brings about changes in the domain. To illustrate this systems approach to creativity, Csikszentmihalyi drew on the history of art, particularly the five glimmers of the Renaissance in Florence.[8]

Over the years, like many of my colleagues, however, I have found that the study of creativity requires tools not furnished by psychology. Creativity demands multiple perspectives, including those of historians of science, literary critics, sociologists, and experts in *domains* engaged in creative work. This book is based on many such accounts. From a

positivist point of view, such a combination of objective and subjective approaches may be seen as lacking scientific rigor. In fact, at the time of its first publication, *Artistry of the Mind* was considered by some to be at the margin of traditional psychology. But now it is part of a powerful new paradigm of qualitative research, sharing interdisciplinary, interactive approaches of a growing community of creativity researchers.

Howard Gardner, a leading member of this community, was confronted with marginalization when he first developed his theory of multiple intelligences in 1983.[3] His thesis that human cognition is multidimensional was originally resisted by psychometric experts of intelligence, only to be embraced a decade later by thousands of educators. He addressed the issue of marginality again in his book *Creating Minds* in 1993, where he wrote of works at the edge of a domain and of their creative impact. There he described the ways that creative individuals are driven by a tension between their emerging perspectives and the constraints of established paradigms. To bring his theory to life, he profiled seven creative thinkers from the modern era, each of whom embodied a different cluster of intelligences—for example, Sigmund Freud, who exemplified interpersonal intelligence, and Martha Graham, who exhibited bodily-kinesthetic intelligence.[4]

The theme that links Gardner's work with this book is a shared emphasis on the breadth of human competencies. A central claim in his work is that there is a diversity of representational codes or languages of the mind—a position I have recently called "cognitive pluralism."[5] In both theories, language is but one of several codes or symbol systems that constitute human thought. Our approaches contrast with theories who favor linguistic thought or verbal thought to the exclusion of other modalities. There are important commonalities since the two theories were developed independently of each other. At the same time, there are significant differences in the way Gardner and I view the social, cultural, and individual sources of cognitive diversity. My approach is based on a Vygotskian, sociocultural theory of the mind, while Gardner's theoretical roots are in Freud and Piaget. I will next look at the way these different perspectives inform current debates in the cognitive sciences.

Cognitive pluralism

Thinking about the nature and diversity of mental representations reaches back to the Greeks. It is also a hotly debated contemporary concern. Aristotle believed that we think and remember in images, and many

cognitive theorists favor such a "monistic" stance, which ascribes an exclusive role to language, or images, or a "computational mentalese,"[2] while ignoring other symbolic codes. The psychologist Rudolf Arnheim argues that thinking is primarily visual, and that thinking and seeing are dynamically interconnected. The neuroscientist Antonio Damasio proposes that "images are probably the main coin out of our thoughts, regardless of the sensory modality in which they are generated."[3]

Other theorists favor pluralistic models. Steve Kosslyn includes verbal and auditory images, verbal propositions, musical and mathematical notational systems as part of the content of thought.[4] Gardner bases his pluralistic position on neurological, evolutionary, and cross-cultural evidence. He writes: "To my way of thinking the mind has the potential to deal with several different kinds of content, but a person's facility with one content has little predictive power about his or her facility with other kinds. In other words, genius (and a fortiori, ordinary performance) is likely to be specific to particular contents; human beings have evolved to exhibit several intelligences and not to draw variously on one flexible intelligence."[5]

In reflecting in 1993 on the development of his pluralistic position—a decade after the first publication of *Frames of Mind*—Gardner suggests that he "fastened the multiple intelligences far more within the skull of a single individual" than he would today,[6] pointing out that there has been a shift in the field toward a more social conception of human thinking and creativity.

Manifestations of the trend anticipated this shift. It is shaped and sustained by the sociocultural approach to human development. Thinking, language, and creativity. The ideas of L. S. Vygotsky (1896–1934)—one of the founders of the sociocultural framework—provide the foundation for this exploration of creativity. It is as yet only a small one. The foundation is visible only to those looking for it. In the first edition of this book, many Vygotskian notions were kept in the background. They were discussed by knowledgeable readers without being fully explained. My reasons for such a strategy included the nature of Vygotsky's writing. His ideas are often cryptic. The reader must work through them again and again. This quality can be explained in part by the conditions of his short life. He contracted tuberculosis at an early age and, during his terminal illness, worked with fitful bouts of energy, leaving many unpublished manuscripts. For thirty years after his death, his work was largely ignored both in the West and the East.

This situation changed in 1962 when his classic *Thought and Language* was published in the United States.[7] Since then, Vygotsky's ideas have

because increasingly available to a worldwide readership. Central to his approach is a view of the mind which extends beyond the "skull" which does not situate thinking in the conflicted egocts of the individual brain or mind. Instead, he proposes a sustained dynamic between other humans both present and past, across the rest of our material and symbolic culture, and the individual engaged in symbolic activity. For Vygotsky, interaction with caregivers, peers, teachers, and the material world is the basis of intellectual development. As I show in this book, shared experience is crucial in the development of creative individuals. I explore the relationship between interdependence and the fashioning of a personal voice in the varied contexts of literature, music, and science.

While interest in Vygotsky's social and participatory views of learning has grown steadily, few of his notions have been applied to the study of creativity. The primary arena for testing his analyses is in education, particularly literacy studies. Although my involvement with Vygotskian theory goes back to the sixties, I found it a complex task to extend his theory to include creativity. Part of my challenge back then resulted from my participation in two groups which traditionally ignored each other. Creativity researchers gave limited recognition to sociocultural ideas, and Vygotskians were generally reluctant to discuss creativity. This book is a bridge between these two thought communities, each of which has grown in size and influence in the last few years.

During this period of rapid growth starting in the 1980s, the connection between these two independent "networks of enterprises"—creativity researchers and sociocultural theorists—became clearer to some participants. During this same period, some of Vygotsky's writings on imagination were translated into English. And recently David Feldman, a student of prodigies and an influential creativity researcher, acknowledged the profound impact of Vygotsky on his own work and on the field. At first, Feldman as well as most of his colleagues based their work on Piaget's epistemological framework. But as theoretical lenses began to change as we considered the concept of novelty in thought and domain-specific development. Yet the change was slow. Up to this time most influential theories in psychology had focused on individual development. Piaget, for example, or on the dynamics of motivated thought within the human organism, following Freud. These preeminent theories served as starting points for many theorists studying development and creativity. But once creativity researchers began to examine creative lives in depth (including Feldman's own work on prodigies), they became increasingly constrained by theories that limited them to an individual focus. In 1993, in the preface to the second edi-

tion of Beyond Universals in Cognitive Development, Feldman writes that the enormous growth of interest in the sociocultural writings of the Russian psychologist L. S. Vygotsky in the last decade "and a decline in Piaget's hold on the field of cognitive development" were linked to broad concerns with diversity.[6] Moreover, he detected a relationship between theories of multiple intelligences and a decline in "all-purpose" universalistic theories, since these pay scant attention to cultural and cognitive pluralism.

In theories which posit universal stages of growth, development is seen as fueled primarily by biological forces. In contrast, sociocultural theories stress the constant dynamic between internal and external forms of human activity. One interesting example of such an interaction can be seen in philosopher Hannah Arendt's account of the role of language in thought. As she sees it, "discursive thought is inconceivable without words already meaningful."[7] It is a depiction that resonates with philosophers, writers, and social scientists for whom the inner voice is ever-present in thinking. Yet she adds that there are cultural variations in the forms and roles of language and their connections to other symbol systems. Her example is the highly visual character of Chinese writing, in which "the power of words is supported by the power of the written sign, the image."[8] By including images in her conception, Arendt differs from Vygotsky, as well as the team of linguist Jerry Fodor and psychologist Zenon Pylyshyn, who developed a so-called "language of thought"—or to put it another way, a single, internal code. Arendt, while favoring language, also proposes a link between external forms of symbol systems—alphabetical or hieroglyphic writing systems—and internal codes. In doing so, she breaks the monistic approach and goes beyond a single, universal concept of a "language of thought."

I take a similar stance in this book, and claim that there is a relationship between external and internal forms of symbolization. In constructing meaningful representations of experience, children and adults appropriate culturally patterned modes of reflection and expression. I describe some of these verbal, kinesthetic, and visual modes in the early chapters of this work. The development of this pluralistic model of thinking was first motivated by my observation of Native American children in the Southwest.[9] Their reliance on visual symbols in play and in communication with others—frequently across language barriers—differs sharply from my own upbringing in the highly verbal culture of Central Europe. The search for a theoretical framework that could accommodate these varied modes of thought is described in this work. The resulting

approach, cognitive pluralism, addresses contemporary concerns about diversity. It also structures my discussion of creative development in visual, verbal, musical, mathematical, and scientific domains.

I make the claim that diversity of inner representational modes exists, just as there is a diversity of expressive means by which thinkers convey their discoveries to others. Such diversity is critical to our understanding of thinking and creativity. In addition, I claim that there is a commonality among these diverse codes, a shared dynamic that transforms modes of thought into communicative forms.

My understanding of Vygotsky's approach to such diversity was deepened during the writing of this book, and during the subsequent decade. When I first read *Thought and Language*, like many other readers, I interpreted his statement, "Words play a central role not only in the development of thought but in the historical growth of consciousness as a whole," to mean that language and only language is critical to human symbolic endeavors.[24] Such an interpretation is not surprising, because Vygotsky did consider language as the *primary* vehicle of conscious thought. His focus on language in thinking is linked to his own life as a young Jewish man in Russia. His daughter recently recalled the rich verbal culture of his home and his love of poetry.[25] But his early interests and achievements were in the humanities, social sciences, and philosophy, in addition to psychology. To his analyses of the relationship of language and thought, he brought scholarly breadth, creative insights, and a deep love of words. The resulting work is inspiring. *Thought and Language* is one of the classics of the human sciences.

In the present book, Vygotsky's influence is strongest in Chapter 6, which looks at verbal thinking. He saw inner speech as serving a variety of functions: planning, reflection, and wondering and transforming life known into new perspectives and insights. Vygotsky focused on the spoken forms of this process. I add in this book new evidence drawn from the notebooks of creative individuals or what I have come to call "inner speech writing." This is a condensed, even cryptic form of written language, which allows "experienced thinkers" to keep abreast of their rapid bursts of thought. Such notes exemplify the packed, telegraphic features of inner speech described by Vygotsky. This chapter, with its applications and additions to Vygotsky's thinking, has been widely used by teachers to help students understand his complex notions.

As I worked on other chapters in this volume, I started to see a broader pattern of cognitive dynamics, of condensation and expansion,

beyond those characterizing language as described in Chapter 6. I found planning notes, drawings, and a generative use of mathematical notations in the personal documents of creative individuals. I called these varied jottings on the set "notebooks of the mind." Some of them were later expanded and refined into accomplished works.

At the first publication of this book, my expansion of Vygotskian theory met with bafflement from some colleagues. The pluralistic stance in this book, concerning diverse languages of the mind, was disturbing to their interpretations of Vygotsky's position about the primacy of language in thought. I understood their concerns as my own early interpretation of this theory had been akin to theirs. But since then, several developments have supported the pluralistic position of this work. One is Howard Gardner's continuing work in multiple intelligences. Another is the theory of psychological tools (such as language, scientific diagrams, etc.) proposed by a leading Vygotskian, James Wertsch. And third is the work of several cross-cultural researchers who have documented culturally diverse modes of symbolization. We have already looked at Howard Gardner's multiple intelligences, so let's turn now to James Wertsch's theory.

Borrowing a metaphor from Ludwig Wittgenstein, Wertsch writes of the "tool kit" of psychological processes that mediate mental functioning.[24] While physical tools are directed toward the external world, psychological tools are symbol systems used by individuals engaged in thinking. Wertsch sees these psychological tools as symbol systems that mediate activities and represent their meanings. In describing these tools, Wertsch quoted a passage from Vygotsky I had not seen when writing this book:

> The following can serve as examples of psychological tools and their complex systems: language; various systems of counting; mnemonic techniques; algebraic symbol systems; works of art; writing; schemes, diagrams, maps and mechanical drawings; all sorts of conventional signs; and so on.[25]

My findings support this view of varied psychological tools. I write of *languages* of the mind, where Wertsch writes of psychological tools. Both formulations view human thinking as varied and adaptive to historical and cultural circumstances.

The pluralistic ideas of *Notebooks of the Mind* have also been used and

expanded by scholars engaged in cross-cultural research. The developmental psychologist Barbara Rogoff states an argument close to those in this book:

> Each generation of individuals in any society inherits, in addition to their genes, the products of cultural history, including technologies developed to support problem solving. Some of the technologies that have received attention as inherited tools for handling information include language systems that organize categories of reality and structure ways of approaching situations, literate practices to record information and transform it through written exercises, mathematical systems that handle numerical and spatial problems, and mnemonic devices to preserve information in memory over time . . . Japanese abacus experts, for example, evidence specific but powerful consequences of their skill in the use of the abacus as a tool for mathematical operations. They use internalized representations of the abacus that allow them to mentally calculate without an abacus as accurately as with an abacus, and often faster.[26]

This description of psychological tools is informed by a Vygotskian perspective. It demonstrates the way in which a socially constructed artifact—the abacus—becomes part of internalized thinking processes, even reshaping them in significant ways.

There is a useful complementarity between cross-cultural studies and research in creativity. Cross-cultural researchers identify specific contexts in which development takes place, describing the various ways of knowing. And in many ways, cross-cultural work sets the stage for our study of cognitive pluralism. But in any culture only a subset of human possibilities are fully realized.

Those studying creative lives, on the other hand, look at more specific details. They study ways that different technologies, characteristic psychological tools, and scientific and artistic symbol systems are internalized and expanded in the works of creative individuals over the course of a lifetime. The study of creative lives provides specificity to

our understanding of the language of the mind. In Chapter 5, for example, I describe the many kinds of pictorial models and tools that support the development of young painters. I write of their voracious visual appetite, of their studying early and contemporary masters, their fascination with photographic illustrations, their immersion in art books. In short, I write of their internalization of visual conventions and culture, which for many artists is necessary for their subsequent transformation of the known into new forms and expressions.

These processes of internalization do not take place in isolation. They are embedded in apprenticeships with parents, mentors, and distant teachers. Vital relationships across generations and between peers are documented throughout this book. When these collaborations are successful, novices develop fluency and learn how experienced artists and scientists think. At the same time, such collaborations offer renewal for the experienced individual and the use of shared knowledge for the novice's development of skill. From a Vygotskian point of view, these interactions are central to the transformation of the novice into an experienced thinker. His well-known concept of the zone of proximal development is relevant in this context. He proposes that what a child can do with assistance today, he or she will be able to do independently in the future. The primary application of this concept has been to learning and development among school children. In this work, I broaden this approach to include creative apprenticeships. Some of the best-depicted examples of the transformation of prior experiences into the foundation of an individual's creative development are drawn from the lives of composers in Chapter 6. These musical apprenticeships reveal the productive tension that exists between social connectedness and individual voice—a recurrent theme in many creative lives.

Models of the Mind challenges narrow interpretations of Vygotsky's work. I hope this book can inspire new readings of some of Vygotsky's key ideas and provide an entry for the newcomer to Vygotskian thinking.

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