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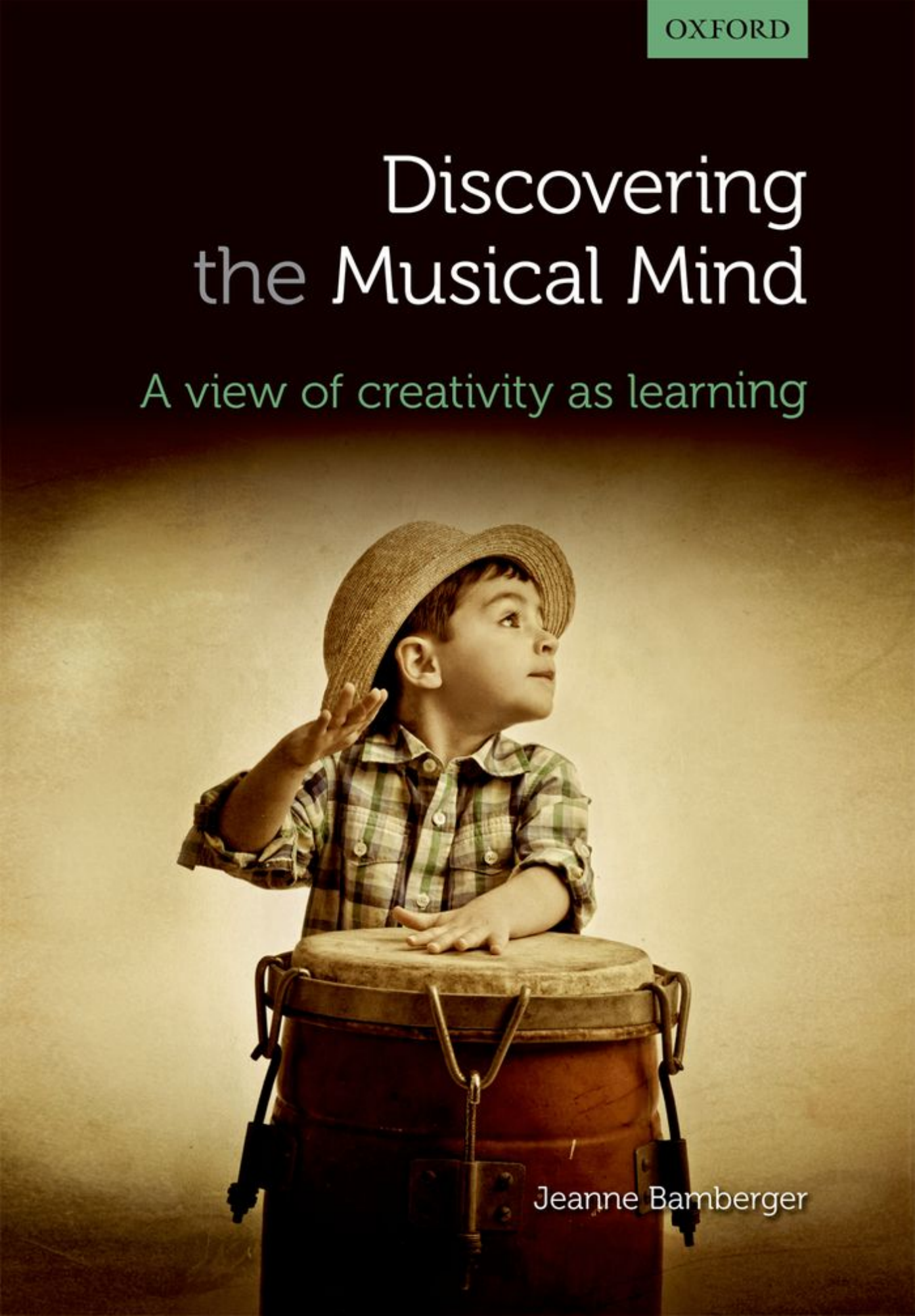
Discovering the Musical Mind

A view of creativity as learning



Jeanne Bamberger

Discovering the Musical Mind

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Discovering the Musical Mind

A view of creativity as learning

By

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Foreword

Just about 40 years ago, I was completing my doctorate in developmental psychology at Harvard. I was also a founding member of Harvard Project Zero, a small research group whose members were examining the philosophical and psychological facets of artistry. Through a connection that I don't recall (probably a mutual friend of one of the members), Jeanne Bamberger, a newcomer to Boston, had found her way to Project Zero, and that is how we became acquainted.

Shortly after her arrival on the scene, Jeanne and I heard that two mathematicians turned-computer scientists, Marvin Minsky and Seymour Papert, were giving a pair of lecture-demonstrations at nearby MIT. One Saturday I found myself accompanying Jeanne to this event. We paid careful attention as these two eminent geeks (as we'd now term them) were introducing a new computer language called Logo and speaking about the educational uses of computers.

Jeanne and I were both fascinated by the discussion. I am not the kind of person who remembers much from forty years ago, but I recall that we decided to have lunch at the S and S delicatessen near Central Square in Cambridge, just so we could continue our animated conversation about what we were learning that day and what it might bode for our future work. The Minsky-Papert initiative affected many individuals interested in improving education—and I believe it is fair to say that it changed Jeanne Bamberger's professional life. Due to this coincidental confluence of events, I feel I have had a ringside seat, observing Jeanne's career from the time that it first began to assume its current impressive shape.

Jeanne was unlike anyone I had met before and only gradually did I learn some details of her life. Apparently, she had come to Boston from Chicago where she had taught in the humanities program at the University. In Chicago she had also become interested in the education of young children and particularly the Montessori method. Earlier in life, in Minneapolis, she had been a piano prodigy, performing with the Minneapolis Symphony before she had reached adolescence. Her mother had a strong interest in psychology and had studied with Florence Goodenough, one of the pioneers in the systematic study of children. After childhood, Jeanne had attended the University of Minnesota, the University of California Berkeley, and studied with the renowned pianist Artur Schnabel as well as the equally eminent composer Roger Sessions. Jeanne was also a philosopher, well versed in psychology, a mother of two attractive young boys, and a magnanimous host who had no trouble whipping up a tasty lunch or dinner at a moment's notice. Nor was she at all intimidated by computers; as I recall, her husband was actually involved with computers. We soon became friends.

It was only a matter of time before a scholar with deep knowledge of music began to apply to that field the kinds of developmental observations and interventions that Jean Piaget, the great Swiss scholar of cognitive development, had carried out with reference to thinking in the sciences. As I watched Jeanne at work in the 1970s and thereafter, it became clear to me that Jeanne was that person: the pre-eminent scholar of musical development and cognition in our time.

From the beginning, Jeanne has put her unique stamp on this material. She has that rare gift of making original observations, perceiving their import, pondering their implications for periods of time, and then revisiting them in the light of appropriate analytic concepts – often ones which she has invented herself. This iterative process has characterized her work over the decades as she

has developed ways of elucidating children's rhythmic understandings, melodic mastery, fledgling notations, early instrumental performances, and the like. The observations that she has made and the distinctions which she has introduced (e.g., figural vs. formal, multiple representations, the "mid-life crisis" in prodigies) are now so widely known among music educators and cognitive psychologists that often they are no longer credited to Jeanne – they are simply assumed to be the basic knowledge of the field. Indeed, I discovered that even in China, musicians and music educators raise questions which, it turns out, are based on discoveries made by Jeanne Bamberger since her forays into psychology began in earnest in the early 1970s.

Extending beyond her work in the psychology of music, Jeanne has become an important thinker in the cognitive sciences. While a deep concern about music has always been central to her work, she views musical cognition as a paradigmatic example of thinking and acting. Therefore, her work in the aforementioned areas has had meaning not only for individuals engaged in music or in other art forms. Her work has also captured the attention of psychologists, educators, philosophers, cognitive scientists, and others interested more generally in the relation between thought and action, the affinities and tensions among various modes of representation, the nature and status of different notational systems, and a raft of other fundamental epistemological issues. Indeed, I think it is appropriate to think of Jeanne as an epistemologist, I would go so far as to suggest that, if Piaget had been immersed in the study of musical cognition, that "genetic epistemologist" would have approached problems much in the way that Jeanne has.

Over the years, Jeanne has steadily deepened our understanding of the major issues in the development of musical thinking: children's evolving comprehension of basic concepts like rhythm and pitch; the developmental challenges encountered during adolescence; the cognitive issues involved in various modes of representation and the manners in which they are coordinated or fail to be coordinated. In 1991 she published what I regard as her magnum opus, *The Mind Behind the Musical Ear*. In this work, she brilliantly brings together her major theoretical concepts in an imaginative set of scenarios. Jeanne's book was soon recognized in many areas of scholarship and, though the word has become overused in recent years, it merits the term "classic."

Usually when one thinks of a prodigy, one thinks of a person whose life had peaked early. Jeanne developed the notion of the "mid life" of the prodigy as occurring sometime during the second decade of life. However, while some prodigies may have coasted after their meteoric youth, Jeanne completely belies any equation between prodigiousness and a peak in early life. Indeed, over the years, her ideas and her oeuvre have steadily grown and deepened. At an age where most individuals have long since retired, she remains impressively active in mind and spirit. When one talks to Jeanne or reads her writings, one encounters an inspiring blend of ingenuity, creativity, and wisdom.

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Acknowledgements

It is totally impossible to thank all the people who, over the period of almost 40 years, have personally and bountifully contributed to the work, thinking, and music making represented in this volume. Instead, I have tried to bring to life their specific and critical participation as it was actually happening in the stories I tell.

But I would like to thank at least some of the people who have most recently helped to bring this collection of papers from the past into the present—be it ever a passing present. Stephanie Pang Brown, despite her move to Hawaii, managed to save multiple situations by cleaning up and making proper my previously unkempt manuscript—including those last minute changes and additions. I want to thank two of the students in my recent class who metamorphosed into sound engineer and computer-based music notation-maker, respectively. Josh Sheltzer was a whiz at making the notation figures for the book and most remarkably even did fix-ups and additions right up to the last minute. And Derek Weinmuller dragged his impressive sound recording equipment all the way up to my house to make live recordings of my performances of needed audio examples. I am grateful to Anton Vishio who almost magically appeared in the last moments as the book was becoming sound. Anton very thoughtfully made and recorded (both electronically and with himself at the piano) the last few audio examples to go onto the book's companion web site. Finally, I would like to thank Howard Gardner for his Foreword to this volume, beginning with revving up his memory of long past days when I was a visitor and he a mere graduate student helping Project Zero to grow up. And I especially want to thank him for his kind words about my work and the ideas that have emerged since those early days when none of us had even the remotest idea of what we would all be up to now, 35 years later.

Chapter acknowledgements

Part I: Beginnings

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Part II: Developing the Musical Mind

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Part III: Designing Educational Environments

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List of abbreviations

CRN	conventional rhythm notation
FGS	functional grouping structures
LMT	Laboratory for Making Things
MCAS	Massachusetts Comprehensive Assessment System
MIDI	Musical Instrument Digital Interface
MIT	Massachusetts Institute of Technology
RCC	Roxbury Community College
SRN	standard rhythm notation

Sound examples

Example audio files relating to the content are denoted in the text by a ♩. The files can be accessed via the book's companion website: www.oup.co.uk/companion/bamberger.

Part I

Beginnings

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Chapter 1

Introduction: Where do our questions come from? Where do our answers go?

> We are thus led to the conclusion that the simple classification of things is, on the one hand, the best possible theoretic philosophy, but is, on the other, a most miserable and inadequate substitute for the fullness of the truth. It is a monstrous abridgment of life, which, like all abridgments, is got by the absolute loss and casting out of real matter.
> (James, 1896/1956, p. 69)

Thinking about what I might include in a book that chronicles my current and past work, I looked back at the collection of children's invented rhythm notations that I have collected over the past thirty-plus years. As I leafed through the pages, I was reminded of my own earliest musical memories, experiences that have influenced the direction of all my subsequent studies.

My piano studies began at the age of 4 or 5 with the neighborhood music teacher, Miss Margaret Carlson. It was only sometime later that I learned that Miss Carlson had been a student of Jacque Dalcroze in Geneva, Switzerland. With this news, I recognized that Miss Carlson's Dalcroze studies had actually formed the background for our piano lessons and also the Saturday morning visits to her house where I, along with her other neighborhood piano students, participated in group Eurythmics lessons. I now realize that it was through these Eurythmics sessions that I first experienced an aspect of music that has strongly influenced my whole musical development and, more recently, the direction of my research. It was the experience of participating in actively *shaping musical time* by expressing, through movement, the motion of a phrase as it evolved towards its goals.

Much later, as a teenager, I was a student of Artur Schnabel, and looking back I can now see that these two widely separated studies had surprising and important aspects in common. Schnabel's teaching, like his playing, also focused intensely on the motion of the phrase as it makes and shapes time. He told us, "Practicing should be experiment, not drill," and experiment meant primarily experimenting with possible structural *groupings*—possible moments of arrival and departure of a melody line and how best to project these structural gestures as we made them into sound moving through time.

After an excursion into philosophy and, still later, in my studies with Roger Sessions, shaping time was again an important focus. But now it was the hierarchy of such structures along with just how the composer had generated these nested levels of organized motion. As he said, we must pay attention to the "details and the large design" as each creates and informs the other.

Looking back, I see more clearly that these earlier and later musical experiences and the associated academic studies were the germinal seeds from which my present interests have grown. Without them, I think I would have failed to notice the intriguing puzzles and the often hidden clues that children give us concerning what they are attending to in listening to or clapping even a simple rhythm, or following a familiar melody. For, as the experiments and experiences in the following chapters illustrate, it is eminently clear that a feeling for the motion of a phrase, its boundaries and its goals along with its inner motion, the motive or figure, are the natural and spontaneous aspects of even very young children's musical experience.[1] Indeed, I find that it is the continuing development of these early intuitions (the capacity for parsing a continuous musical "line") that also nourishes the artistry of mature musical performance—the performer's ability to hear and project the directed motion of a phrase and the relationships among phrases as the "large design" unfolds in time.

With all this in mind, I went back to revisit the children's invented notations for simple rhythms and melodies that I had collected back in the 1970s. Going through the old cardboard box in which I had stored some 200 children's drawings, I found myself intrigued and puzzled all over again. I saw in the drawings the centrality of the children's efforts to capture movement and gesture, but there was another aspect as well. Looking at one drawing after another, I marveled at how and why the children, like philosophers, scientists, and musicians, have continued to work at finding means with which to turn the continuous flow of our actions—clapping a rhythm, bouncing a ball, swinging on the park swing—into static, discrete marks on paper that hold still to be looked at "out there."

The children's invented notations helped me to see the evolution of learning and the complexity of conceptual work that is involved in this pursuit. Looking at the children's inventions, I saw that this complexity sometimes emerges in comparing one child's work with that of another. And sometimes complexity can be seen by watching one child as from moment to moment she transforms for herself the very meaning of the phenomena with which she is working. Caught on the wing of invention, the notations mirror in their making the process through which learning and the silence of perception can be made visible. The inventions become *objects of reflection and inquiry* for both child and teacher as together they learn from one another.

But this very reflection reveals a critical paradox. Christopher Hasty, in his book *Meter as rhythm*, makes the paradox poignantly clear:

> As something experienced, rhythm shares the irreducibility and the unrepeatability of experience . . . when it is past, the rhythmic event cannot be again made present. . . . Rhythm is in this way evanescent: it can be 'grasped' but not held fast.
>
> (Hasty, 1997, p. 12)

The paradox also helps us to recognize that the serious study of children's spontaneous productions requires a bold step to be taken. In order to understand another's sense making, we must learn to question our own belief systems, to interrogate and make evident the deeply internalized assumptions with which we make the musical sense that we too easily think is "just there."

The task of reflection thus becomes one that is mutual and reciprocal between teacher and student. It follows that the most evocative situations, and the most productive research questions, often occur during passing moments of learning in the real life of the classroom or the music studio. It is in noticing and holding fast these fleeting moments that arise unexpectedly, puzzling events caught on the fly, that teaching and research, instead of being separate and different kinds of enterprise, become a single, mutually informing one.

Children's invented notations of rhythms

I begin, then, with my earliest work on children's invented notations of rhythms, since much of the research that followed has been influenced by it. The first invented notations of rhythms were made when I was a participant in the Logo Lab at the Massachusetts Institute of Technology. My focus was on developing, with the help of others, a computer environment that would help to guide and develop musical perception (more about that in later chapters). However, I also knew that if my work in the academic "ivory tower" of the Lab was to be useful, it was necessary to learn more about how music was approached in "real-world" elementary school settings. To pursue that need, I volunteered to participate in teaching a 4th grade music class in my neighborhood school in Wayland, Massachusetts.

Like many of my "experiments," the first example of children's invented notations happened quite by accident in this 4th grade music class. As such, the story exemplifies the power of insight that can accrue if one is alert to noticing a moment of learning that might otherwise go by as just not in the plan for the day. As Whitehead put it, "Everything of importance has already been seen by somebody who didn't notice it" (Whitehead, 1927). The events on this particular day ultimately turned out to become the conceptual framework for many of the studies that followed—most specifically the emergence of the *figural* ↔ *formal transaction* (Bamberger and Schön, 1979).

Note

1 However, we need to be reminded that these intuitions are always and only within the varied musical cultures of which one is a part.

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Chapter 2

The first invented notations: Designing the Class Piece

On an ordinary day in a public school in suburban Wayland, Massachusetts, the children in this 4th grade music class had begun their work by listening closely to the fourth movement of Hindemith's wind quintet from his *Kleine Kammermusik*, op. 24 no. 6 (♪ 2.1). After they had listened carefully, the children's task was to design their own composition modeled after the Hindemith movement but using just classroom percussion instruments—drums, sticks, and clapping. Over a period of several days the children listened attentively to the work and discussed it at length. They had noticed that the most important contrasts were between the solos played by each of the wind instruments in turn, and the part that they called the "chorus" played by all the instruments together. There was an alternation between solos and chorus. In the solos, each player seemed to be improvising new material just for his instrument, while in the chorus, all the instruments, playing together, seemed to be repeating much the same music each time. The contrast between the solos and the chorus created boundaries or "edges" that outlined the large structural elements of the piece.

To help the children in designing their own piece, I asked them to make drawings of the Hindemith—the two kinds of structural elements, improvisatory solos and the "chorus," alternating with one another. After the children had made initial sketches, we derived a kind of template showing the alternation of solos and "chorus."

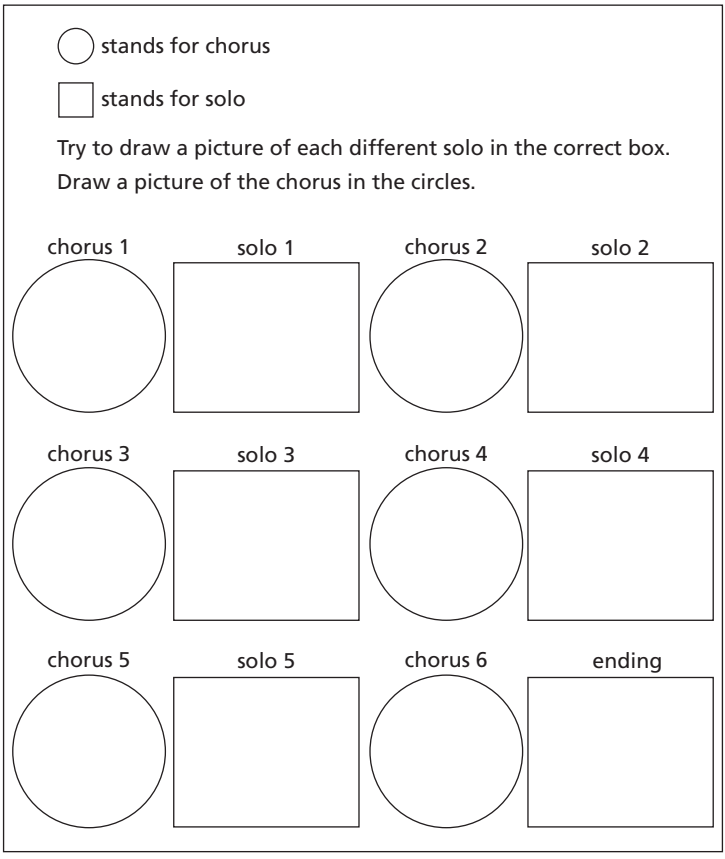

Figure 2.1 A template: Solos and chorus. Reproduced from Bamberger, Chapter 1, *The mind behind the musical ear*, © Harvard University Press, 1991/1995, with permission.

Using the template, each child was to fill in the alternating solo-chorus shapes with their own drawings to show the character of each solo in the order of occurrence in the piece as well as the returning "chorus." Once made, the drawings were to function as a "score" for the basic design of their new piece. Figure 2.2 shows an example of one of the children's drawings. Listening to the piece and following the drawings, you can see how this child did, indeed, capture the character of the distinctive solos.[1]

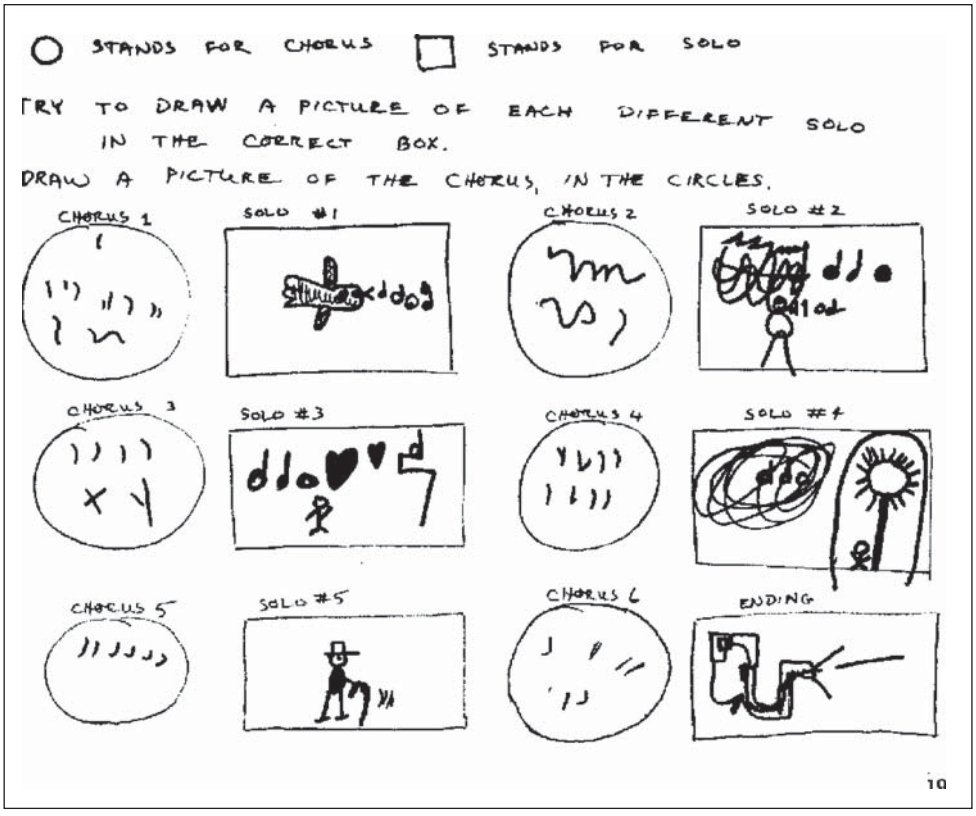

Figure 2.2 One child's "score." Reproduced from Bamberger, Chapter 1, *The mind behind the musical ear*, © Harvard University Press, 1991/1995, with permission.

After some discussion, the group agreed that their piece would follow the Hindemith with the "chorus" played by the whole class in unison, while the solos would be improvised by individual children as "soloists." But the chorus needed to be actually composed since "everyone had to play the same thing, together."

On the fourth day of the project—the session with which I am concerned here—the children had completed their "scores" and had set to work on the details of actually making their piece. One child—I'll call him Henry—played a rhythm on his drum that he proposed everyone would play together, and it should function as the "chorus."

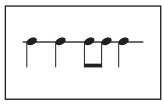

Figure 2.3 Henry's rhythm. Reproduced from Bamberger, Chapter 1, *The mind behind the musical ear*, © Harvard University Press, 1991/1995, with permission.

But the group felt it was "too short." It was finally agreed that the same pattern should be "played twice (♩ 2.2)."[2]

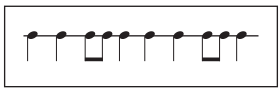

Figure 2.4 Henry's rhythm played twice: The finished Class Piece. Reproduced from Bamberger, Chapter 1, *The mind behind the musical ear*, © Harvard University Press, 1991/1995, with permission.

All the children learned to play Henry's repeated rhythm pattern in unison on the percussion instruments that formed their "orchestra." They called their rhythm the Class Piece.[3,4]

Now at this point a fortuitous situation occurred, With much work still to be done on the project, someone noticed that the music period was nearly over. While the regular music teacher, L. Sperber, assured the class that they could go on with their work the next day, one of the children quite wisely said, "But how will we be able to go on if we've forgotten the Class Piece by tomorrow?" Someone else suggested a creative solution to this problem: "We could write it down and then we'd have something to remember it by" (perhaps inspired by the group's earlier work with drawing their scores).

With only a few minutes left, paper and crayons were quickly handed out and everyone clapped the Class Piece once more. Following the lead of the spontaneous and practical idea, the children were encouraged to "put down on paper whatever you think will help you remember the Class Piece tomorrow or help someone else play it who isn't here today." In the ten minutes or so before the bell rang, all the children finished their drawings. In doing so, each of the children invented a way to translate their actions—their experience in playing the rhythm—into graphic descriptions of it.

The next day the inventions were indeed still there. And following one of the children's drawings of the Hindemith, along with a drawing of the Class Piece, the group did complete the design and performance of a whole composition. They all played the Class Piece in unison, alternating with solos that individual children improvised on their respective percussion instruments. The result was a new composition that did indeed "work like the Hindemith."

The drawings of the Class Piece not only served the functional need that had inspired them, but there was an unexpected spin-off. I had taken home the children's drawings of the Class Piece and, looking more carefully at the collection of drawings, I was surprised and more than a little puzzled. Indeed, it actually took much more time and thought before I was able fully to appreciate the significance and the implications of these first invented notations. However, I was able to glimpse that the drawings fell generally into two types. It was only later that I came to call them "figural" and "formal," respectively.

Introducing the figural ↔ formal transaction

Figures 2.5 and 2.6 show copies of two characteristic drawings of the Class Piece. Roger made a typical figural drawing, while Jessica made a typical formal drawing.

Figure 2.5 Roger's figural drawing. Reproduced from Bamberger, Chapter 1, *The mind behind the musical ear*, © Harvard University Press, 1991/1995, with permission.

Figure 2.6 Jessica's formal drawing. Reproduced from Bamberger, Chapter 1, *The mind behind the musical ear*, © Harvard University Press, 1991/1995, with permission.

While I sensed that there were two distinctly different types among the 25 drawings that the children had made, it was only by developing a different kind of thinking that I was able to clarify what I had first seen quite intuitively.[5] For example, rather than asking which drawings were more "correct"—that is, closer to our conventional rhythm notation—I approached the analytic process by simply asking the following question. Are there specific features that *differ* between the two types of drawings, and are there specific features that they *share*?

I saw that both types of drawings included the same total number of shapes—ten—representing the ten claps in the Class Piece. Further, within all of the drawings, the first five events are drawn the same as the second five events—that is, the drawing of Events 1–5 is repeated exactly for Events 6–10. But there was one singularly important difference. It was only in the drawings I subsequently labeled "figural" that the *two repeated figures were graphically and visually clear*. In the drawings subsequently labeled "formal," *the repeated figures were visually obscured*.

In view of this distinction, it was important to recall that in creating the Class Piece the children had made the repetition quite explicit. Henry had initially clapped what became just the first half, but the children had subsequently agreed that "it should be played twice." The piece was thus composed and also described as in two parts, the second an exact repetition of the first. It was significant, then, that in the formal drawings that repetition was visually obscured—to the eye, it essentially disappeared. It was this initial difference that led me to label the drawings "figural" and "formal," respectively.

I chose the term "figural" to refer to the clarity of the *grouping and boundaries* of clapped events that characterized drawings like Roger's. I borrowed the term "figure" from conventional music terminology. "Figure" as used in "music speak" refers to brief patterns that form and function as meaningful structural entities—*perceived bounded structures* that organize a continuously unfolding rhythm or melody as it goes on through time. The term *figural* was thus meant to characterize drawings in which one sees the child's effort to *parse* her clapped events into small, structural gestures, with the boundaries of these *figures* in turn reflecting momentary goals of motion. Grouping structure in music has more formally been described as:

> . . . the most basic component of musical understanding, expressing a hierarchical organization of the piece into units such as motives, phrases, sections, etc.
>
> (Lerdahl and Jackendoff, 1983)[6]

It is just such small, bounded structural entities that form the unique, developmental material of large, complex compositions as well as very simple melodies or rhythms such as the Class Piece.[7] For example, the opening figure or "germinal motive" (as Schoenberg would call it) of Beethoven's Fifth Symphony (see Figure 2.7) is the familiar musical *motive* with which the movement begins and, through its continuing and remarkable transformations, the whole movement evolves.

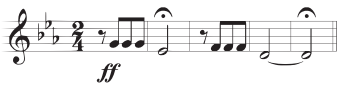

Figure 2.7 Beethoven Symphony No. 5 opening figure or "germinal motive."

But what about the name I have given to the second type of drawing? Why have I called them "formal" when it is exactly the *form* of the rhythm that is graphically obscured? I termed these drawings "formal" because the children focused on an effort to show the *relative duration* of clapped events, rather than focusing on contextual groupings and gestural motion of events towards structural goals. Put more precisely, the drawings reflect the relative times from one clap to the next or what is technically called "attack time." I later called these drawings "metric," to reflect the measured aspect more specifically.

As suggested above, the difference between the two types is seen most clearly in which events were drawn the same and which were drawn differently. For example, notice how the clustering of alike shapes differs. In figural drawings, Events 3–4–5 form a run of alike shapes (smaller), and these shapes differ from those representing Claps 1, 2 and 6, 7 (bigger). By contrast, in the drawing labeled formal, Events 5–6–7 form a run of alike shapes (bigger) and these differ from Events 3–4 and 8–9 (smaller). Event 5, then, is the critical element—it is drawn the same as Events 3 and 4 in the figural drawing, but the same as Events 6 and 7 in the formal drawing (see Figure 2.8).

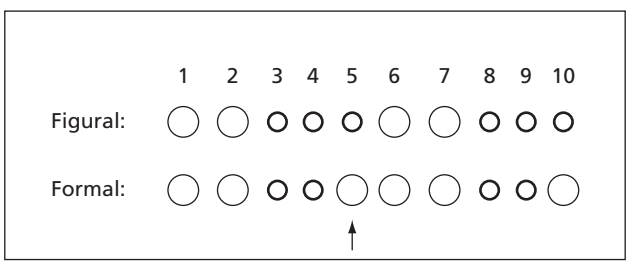

Figure 2.8 Event 5 is the critical element. Reproduced from Bamberger, Chapter 1, *The mind behind the musical ear*, © Harvard University Press, 1991/1995, with permission.

These differences in the clustering of similar shapes help to account for why the repeated figures are so clearly visible in the figural drawings but obscured in the formal ones. With respect to visual phenomena such as the drawings, the Gestalt psychologists (Kohler, Koffka, and Wertheimer)

have shown that we tend to see shapes that look similar as "going together" so as to form bounded *figures*; these figures, in turn, are seen as visually separated from the differing shapes around them (see Figure 2.9).

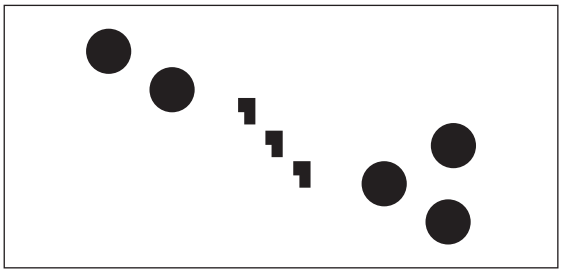

Figure 2.9 Shapes that look similar cluster together. Reproduced from Bamberger, Chapter 1, *The mind behind the musical ear*, © Harvard University Press, 1991/1995, with permission.

In the same way, the runs of similar shapes in the children's drawings visually cluster together to form bounded figures as well.

The two types of drawings also reflect, in their differences, the way the rhythm was composed and performed. As pointed out earlier, the repetition that emerges so clearly in the *figural* drawing corresponds to and reflects the repetition in the Class Piece that the children had explicitly chosen to add to Henry's initial pattern. In contrast, the run of similar shapes in the *formal* drawing (5–6–7) runs right across the boundary separating and articulating the larger repeated figures.

Accounting for same and different

To account for the drawing of events as the same or different, the questions we now need to ask are in what respect could Events 3–4–5 be alike, and in what respect could Events 5–6–7 be alike? What possible features of the rhythm could give rise to these expressions of similarity and difference?

The accounts the children gave of their own drawings provide some clues. For example, when I asked Roger, who made the figural drawing, "How does your drawing work?", he said "Well, you can see that there are two claps and then three. The three little circles go together and they get faster." He gestured with his arm to show that "go together" meant somehow bound together as in one gesture. Jessica, who made the formal drawing, challenged Roger's comments. She said "But that clap (pointing to Clap 5 in Roger's drawing) is a long one; it's the same as the first two. It's hard to play it with a short clap there." Roger countered with "No, there's a gap there, a space. It doesn't matter how long that one is (Clap 5); you just stop and start again."

The children's comments are revealing. First of all both children make it quite clear that bigger circles stand for "longer" events while smaller circles stand for "shorter" or "faster" events. The disagreements over Clap 5, then, seem to relate to whether it is a long or a short event. Roger draws Clap 5 with a small circle (for short); Jessica draws Clap 5 with a larger circle (for long). Further, Jessica seems more concerned with classifying and measuring; she compares events (claps) in terms of duration even when they are not adjacent to one another in the rhythm: "[Clap 5] is a long one; it's the same as the first two." Roger pays more attention to a succession of adjacent events and how they group together—"two claps and then three." He focuses on boundaries

of groups as these form landmarks along the path of his actions. And for Roger, the *function* of a clapped event takes precedence over comparative measuring: " . . . there's a gap there. . . . It doesn't matter how long that one is; you just stop and start again." Notice, too, that Roger uses a kind of action-language: " . . . get faster," " . . . go together," " . . . stop and start." Jessica uses more static language in her account: " . . . is a long one," " . . . it's the same."

Expressions of similarity and difference among events reflect, then, the specific kinds of possible features of the rhythm that each drawer chooses (or is able) to give precedence to— grouping of adjacent events into figures and their function, on the one hand, and on the other, comparing, measuring, and classifying events according to the property, relative duration. The answer to my earlier question—why I have called these latter drawings "formal,"—should now be clear. I use the term to refer to the child's focus on formal *properties*. And in this case I use the term "formal" to refer to a drawer's explicit or implicit classification of events as the same according to the duration or metric properties that they share.

It was *noticing* and taking *seriously* these initially puzzling results of the children's response to a practical need that inspired the research program that I have pursued over the subsequent many years. Some of the early results of that research are the focus of Chapters 3 and 4.

Acknowledgement

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Notes

1 I chose this drawing because it so vividly captures the character of the respective solos.

2 Since we did not keep these original drawings of the Hindemith, I show this drawing that was actually made in a subsequent experiment.

3 Taking notice of the repetition as a specific event in developing the Class Piece becomes important in studying the invented notations.

4 The rhythm of the Class Piece matches the rhythm of the familiar nursery rhyme, "Five, six, pick up sticks; Seven, eight, shut the gate."

5 I detail this process here, since I believe that arriving at an appropriate analytic approach (so often left aside) is critical to understanding the "results."

6 These brief structural entities as they are happening in time and motion have also been called "temporal gestalts", in comparison with the more familiar spatial configurations or spatial gestalts: " . . . distinct spans of time . . . internally cohesive and externally segregated from comparable time-spans immediately preceding and following it." (Tenney and Polansky, 1980).

7 Since coining the term "figural" I have learned, through coming upon the unfortunate misunderstandings of others, that the term has quite different meanings for those in different fields. In particular, for visual artists "figural" often becomes "figurative," meaning representational in contrast to "abstract," and for those in literature fields it is taken to mean the use of images such as metaphor, analogy, metonymy, etc., or even just "imaginative."

Chapter 3

Children's drawings of simple rhythms: A typology of children's invented notations

Learning from the children we teach

Given the findings from the children's spontaneous drawings made by the 4th graders in the Wayland School, it seemed important to inquire into the robustness of the *figural–formal* distinction that was emergent from their notations. Pursuing this idea, the music teacher in the school, Miss L. Sperber, and I asked children in grades one through six during their regular music classes to clap and to make notations for six different rhythms. The procedure was as follows. Miss Sperber clapped each of the six rhythm patterns in turn, for each one she asked the children to clap it back, and then (learning from the children in the original 4th grade class) she asked them to "Put something on paper so you could remember it tomorrow or someone else who isn't here today could clap what you just clapped."[1]

After completing their drawings of all six rhythms, the children were asked to clap each rhythm again and this time to add to each drawing "some numbers that seemed to fit." I wasn't at all clear at the time why I had proposed adding numbers, except that perhaps another medium would encourage children to focus on alternative kinds of objects and relations. As it turned out, the numbers, as an alternative mode of representation, did prove very useful in suggesting additional features, sometimes reinforcing and sometimes conflicting with the graphics (see Part III for a discussion of numbering).

In addition to the children in the Wayland School, Eugene Buder, then a student in the Graduate School of Education at Harvard, worked individually with pre-school children between the ages of 3 and 5. These youngest children were asked to clap and draw only two rhythms. Altogether we were able to work with drawings from 186 children. Analysis of the drawings confirmed the stability of the original *figural–formal* distinction. However, with the larger sample, versions of the basic distinction emerged among the younger children (aged 3 to 7) as well as among the somewhat older children (aged 10 to 12).

The typology

Using the rhythm of the Class Piece (one of the six rhythms the children were asked to clap and draw), Figure 3.1 shows copies of children's actual drawings, each illustrating a prototype within the typology (♩ 3.1).[2,3]

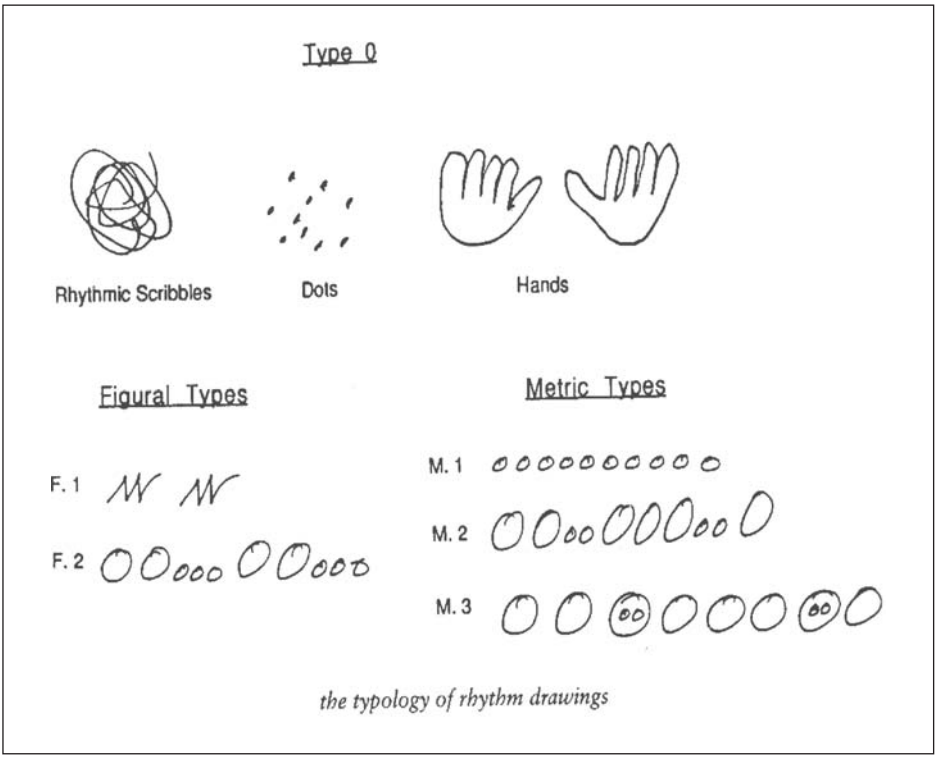

Figure 3.1 Typology of drawings. See also Figure 3.4.

It is important to mention at the outset that while the children were able to clap back this rhythm, few had been sufficiently exposed to notations for rhythms to have a predetermined notion of what might even be an element, a "thing" to include in their "notation." The drawings, then, can be looked on as the children's invention for externalizing their "knowledge-in-action"—that is, what they knew how to *do* but had not before tried to *say* in some external, static way.[4]

The distinctions that define the typology were developed in answer to the following questions:

- To what *possible* features and relations of the given rhythm pattern could the drawn shapes refer?
- How can we account for specific and consistent differences as to which shapes are drawn the same and which different?
- What is the relation of these similarities and differences to the general distinctions between figural and formal/metric types?
- Finally, to what extent is the general distinction between figural and formal types a developmental one related to developmental trends in other domains?

The typology, then, has two global dimensions reflected in the labels I have assigned to them. One is the figural–metric distinction (F.1–F.2; M.1–M.2–M.3), and within this, differences related to age, development, and/or learning (0, F.1–M.1; F.2–M.2; M.3). The reader should bear in mind that these two dimensions are importantly different in kind. I will argue that the figural–metric

distinction refers to differing aspects of music *all of which are inherent in the structure of even such simple rhythms*; it is their interaction that gives a rhythm pattern its particular coherence. It follows from this that the developmental distinctions should not be seen as representing a single linear "progression", but rather as an interacting evolution between two complementary ways of understanding or "hearing" a rhythm, each of which enriches the other.

It is important to notice that both figural and formal/metric tendencies emerge in the drawings at all ages (even among the youngest children) and in all periods of development. I take this as strong evidence for my contention that both figural and formal characteristics are inherent in rhythmic structure itself. Indeed, as suggested earlier, this is precisely what is behind the statement that "a clap can be heard as both the same and different depending on where they happen and what you are paying attention to." At the same time, by looking at the drawings along both of these global dimensions, distinct features of rhythmic structure emerge that otherwise tend to be blurred or overlooked entirely.[5]

Given this proviso, the data do, however, suggest some connections between a child's age and a type of drawing (see also Hildebrandt and Richards, 1978). For example, looking at the extremes of age among the 6- to l2-year-olds, most of the youngest children (ages 6 to 7) made either Type F.l, M.l, or F.2 drawings, and only one child out of 21 was classified as M.2. In contrast, children in the oldest group (age 11 to 12) were about equally divided between Types F.2 and M.2, with only two children (out of 44) classified as F.l or M.l.[6] Only four children out of the total sample made an M.3 drawing—one in the 4th grade and three in the 6th grade. Although the trend seems clear, it provides only a rough picture because we did not control for, and thus cannot determine, the influence of music instruction. That there was such an influence, however, is certain since all the children were exposed to some music instruction throughout the grades in school and some were receiving private instrumental lessons as well.

Analysis of the typology

Type 0: Scribbles, dots, hands

Type 0 drawings were made only by the very youngest children—ages 3 to 5. As such, these drawings can be seen as constituting the "primitives" (the basic essentials) from which all the other drawings emerge. They reveal aspects of performed rhythms that are essentially buried by the conventions of standard rhythm notation (SRN). I shall spend time on them because of this and also because they are such a wonderful example of what can be learned if we take Socrates' advice seriously. As he says, " . . . we will be better and braver if we believe it right to look for what we don't know than if we believe there is no point in looking . . . " (Plato, *c.* 403 BC/1956).

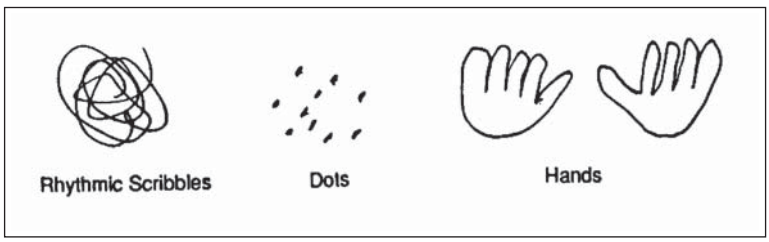

Figure 3.2 Drawings made by the youngest children.

Look first at the drawing labeled "rhythmic scribble." If, following Plato's advice, you make an initial assumption that the drawing depicts some aspect of the performed rhythm, what could that aspect be? Of course we could conclude that the children were simply at a loss and so "scribbled." But the persistence of these drawings, the manner in which the children drew them, along with the characteristics they share with the other drawings made by children of this age (dots and hands) make strong arguments that the scribbles should be taken as the children's serious attempt to picture what for them was "memorable."

If you try clapping the rhythm, paying particular attention to your movements as you clap, you may discover for yourself what these scribbles could represent. Notice that in clapping the rhythm, your movements are actually continuous. That is, your arms move back and forth or in and out in a continuous swinging motion, even though the span of the swings changes. However, as adults influenced by the conventions of music notation and other external descriptions of events in time and motion, we have become entirely inattentive to our own continuous body motions in making the rhythm. Focusing only on the results, the discrete "attacks," the individual clap-sounds alone, we fail to notice the means by which we make these sounds. We thus represent to ourselves as "the rhythm" only the separate sounds that result from our continuous actions, no longer noticing the continuousness of our performance.

Thus, by considering (in my conversation back and forth with the material) that the children's focus might be different from mine, and in searching for what it might be, an aspect of rhythms was "liberated" that previously escaped my attention—the continuousness of actions in actually performing rhythms which also mirrors the rhythm's continuous unfolding in time. In turn, I had found an aspect of performed rhythms that would give meaning to what at first seemed meaningless scribbles: the children, in scribbling, could be putting on paper, imitating, the feel of their own continuous body motions in clapping the rhythm. This is in contrast to the discrete sounds—the external, public, acoustic results of these motions—just what is represented by SRN and what we usually think of as simply "the rhythm" itself.

But there is more—not to be seen in the trace left behind on paper, but rather in the children's actions as they drew. Watching them, we saw the children moving their hands continuously, with a regular pulsing motion—each circular scribble "keeping a steady beat." As the children moved their hands, they did not copy the rhythm of the Class Piece—the longs and shorts that they had previously clapped. Instead they seemed to be responding to the pulse which is also going on in the background. Indeed, the possible ways of structuring, as well as the tensions between these two faces of any common rhythm—*the temporal variety that we clap, and the temporal constancy that lies behind but is not actually performed*—emerges as critical in making sense of and differentiating among the children's drawings.

But having recognized what possible aspects of the rhythm the children are attending to, it also becomes clear what it is the children are not attending to in their scribbling. They do not differentiate or separate out ("extract") the discrete sounds or the variations in time among them from the swinging, continuous motions of their own bodies in producing these acoustic events. As a result, the trace shows the process of "clapping" but nothing that would help either the player/drawer or another person to recognize the features of the clapped rhythm (see Figure 3.2).

We, as adults, are accustomed to focusing on just the sounds, the effect of our actions as the salient feature; we do not attend to the actual continuousness of performance. Indeed, this shift in focus from the continuous actions of bodily performance to a more distanced focus on the discrete events they produce turns out also to be of major significance in the developmental moves

reflected in the drawings—from internally experienced body-feel to its externalization in static, discrete, symbolic notations.[7]

As for developmental issues, it is significant that these early drawings of rhythms look similar to those described as "rhythmic scribbles" by Gardner (1980), Goodnow (1977), Piaget and Inhelder (1948/1967), and others. However, these researchers were referring to drawings made by much younger children (ages 1 to 2) in their first spontaneous experiments with crayons and paper or their earliest attempts to draw familiar objects, and geometric shapes. Piaget and Inhelder describe these drawings (called Stage 0) as follows:

> The primary feature of the children's drawing or scribbles is their simple rhythm. This very primitive expression of ability to draw is the product of a continual hither and thither movement of the hand across the paper, and it is from such a rhythmic pattern of movement that the first shapes come to be distinguished as Stage 1.
>
> (Piaget and Inhelder, 1948/1967, p. 59)[8]

It is not surprising that rhythmic scribbles reappear with our 3- to 5-year-olds when they are asked to *draw their own actions*. Consider in this regard that the much younger subjects in Piaget's experiments were asked to make a drawing of static objects—a man, a circle, a rhombus—objects outside of themselves in which they did not actively participate. Our subjects, in contrast, were asked to draw their own actions. And since actions disappear as they clap, it is impossible to look at them all at one time, as one would a circle or a rhombus.

A comparison between the rhythmic scribble and the dot drawing (see Figure 3.2) makes the distinction between continuous and discrete aspects of clapping very clear, even in these drawings by children of about the same age: the scribbles show a continuous, essentially undifferentiated swirling line while the dots are separate and discrete. Moreover, while the dots appear to be randomly arranged on the paper, the way the children made them points up another important difference. Watching the children, we saw that, unlike the scribblers, these children did actually tap out the rhythm of the Class Piece on the paper. In doing so, they gave the pencil two functions: it was a percussion instrument used to play the rhythm, and at the same time it was a graphics instrument used as a means to carry out the task they were asked to perform—to put on paper something that would help them remember what they had clapped. As a result of this dual function, the children's performance left a graphic trace of the sounds they actually made but no trace of the temporal relations among them. Focusing on the longs and shorts they had just clapped, they transported these discrete and temporally varied actions on to paper. But the trace, which left a jumble of dots, shows neither the process by which it was created nor any recognizable features of the rhythm itself—characteristics that the dot drawing shares with the rhythmic scribble.

Although the dot drawing does show quite literally the separate events the children played, it would hardly be correct to say that the dots *refer* to these events; rather, the dots are simply the *result* of the performed events themselves. And it is exactly in this respect that we cannot see the rhythm in the picture. In transporting actions directly to paper, the children are not concerned with following some orderly transformation rules whereby action in "performance time/space" becomes recognizable in static, two-dimensional "paper space."

This, then, is another instance of how, in trying to make sense of what at first seemed senseless material, the jumble of dots, I became aware of conventions so thoroughly internalized that I had forgotten I ever learned them—that is, the rules for transforming action/events moving through time into static paper space. It is easy to forget that we have learned a set of conventions when we have learned how to make time and actions stand still to be seen all at once (wheels turning or

drummers drumming). For once these conventions are internalized, their influence becomes, so to speak, invisible. We hardly notice that in using them, we transform actions and their temporal relations into various signs or symbols and arrange them spatially in paths or "line-ups" with time always going from left to right on the paper.

The third picture in Figure 3.2 was particularly surprising. These children put one hand and then the other on the paper and with the crayon traced around each hand in turn. When I watched the first child tracing her hands, I assumed that this must be unique and somewhat weird behavior. But when it was repeated by a number of other children, I had to take it as the children's serious effort to carry out the task. Again the other drawings were helpful. It seems that in responding to the instruction, " . . . so you can remember what you clapped . . . ", those who traced their hands did not distinguish between the objects that *made* the claps, their hands, and the "objects" that are *made by them*, namely the sounds. And once I "let the material tell me," the hand drawings also helped make sense of the scribbles and dots. While these drawings of hands are totally different from the scribbles or dots as pictures, all of them show the children putting on paper, in various ways, their own bodily experience: they transport to paper either their motions in making the rhythm (scribbles, dots), or a picture of what did the job (hands).

While the draw-a-rhythm task triggers at this early age a non-reflective, direct expression of bodily experience, the act of drawing is itself an important step. By externalizing that which is otherwise evanescent, invisible, gone except for its remembered reconstruction in body-feel, it becomes visible, and holds still, to be seen all at once.

Development within the figural dimension of the typology

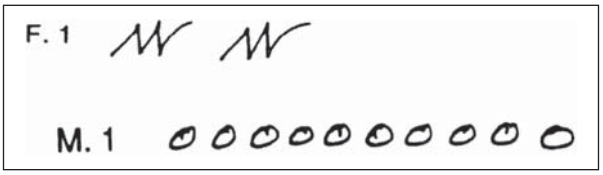

Figure 3.3 F.1 and M.1 drawings.

Looking first at the drawings marked F.1 and M.1 (see Figure 3.3) within the framework of the two global dimensions of the typology, we see the following. Along the developmental dimension, the distinguishing features of scribbles and dot drawings seem to have crystallized in these drawings of slightly older children.

That is, the drawing labeled F.1, with its two continuous undulating lines, can be seen as a more articulated scribble. In turn, the M.1 drawing, with its discrete and alike shapes, can be seen as a more fully articulated dot drawing. And now in both we see line-ups. Instead of swirling, undifferentiated lines or a jumble of dots, both the lines and the discrete shapes line up, with time moving "straight ahead" from left to right across the page!

Moving on, now, to consider development along the figural dimension, we see in the F.1 drawing, albeit still dimly, familiar features that characterize prototypical figural drawings. For example, the undulating lines of F.1 are interrupted by a space, a "gap" forming two graphic figures, the second an exact repetition of the first. In turn, the ups and downs within the boundaries of each figure articulate the continuous line into exactly five events.

The children who made F.1 drawings, like those who made dot drawings, actually played the rhythm on the paper, but the process was quite different. Instead of using the pencil as a

percussion instrument to tap out the rhythm on the paper, these children moved their pencils continuously across the paper within each figure—first slowly (/\), then proportionately faster (/\/), a pause, with the pencil suspended in the air, and then an exact repetition of their previous actions. The trace left behind almost magically reflects back the figural structure of the rhythm—two alike figures with their boundaries marked by the pause which is transformed into a space, an "in between."

But within these figural boundaries, the trace left by their playing/drawing remains continuous—we see the correct number of events (since they played the rhythm correctly) but no trace of the changes in pace, and no differentiation among them save succession. Yet, in carefully interrupting their continuous actions at the larger figural boundary, these children quite clearly demonstrate their attention to the grouping of their claps into two large gestures. But unlike Roger's fully developed figural drawing (see Chapter 2), the trace left by their playing/drawing does not capture the inner groupings formed by the changes of pace along the way.

However, compared with the uninterrupted, pulsing, swirling scribble made by 4- and 5-year-olds, these drawings by slightly older children who have already been in school, show significant development within a basically figural approach:

- the correct number of events
- the conventional line-up going from left to right across the page
- the two clearly articulated graphic figures corresponding to the repeated figures that the 4th grade composers had originally designed into their Class Piece.

And finally, it is important to note that because the children's playing leaves a trace that in many of its aspects is recognizable as what they clapped—a reflection of it as if in a blurry mirror—it also holds still so that the children can reflect *on* it. In a conversation back and forth between playing and looking back at what they played, the children can learn about their own functional knowledge that ordinarily escapes scrutiny as it passes by in action and through time.

Fully developed figural drawings

Figure 3.4 F.2 drawing.

Looking now at the fully developed figural drawing F.2 (see Figure 3.4), and comparing it with these earlier F.1 drawings (see Figure 3.3), we see in the F.2 drawing the results of a growing ability for reflection among these somewhat older children (between the ages of 8 and 12), particularly an ability to reflect on their own actions. As evidence, notice that these drawings include more information—the continuous undulating lines of F.1 drawings are differentiated into big and small shapes that show both changes in pace and also inner groupings. And most important, in making these shapes, the children are no longer simply transporting their actions directly on to the paper (playing/drawing); what we see instead are "thought actions"—discrete graphic shapes that stand for and refer to actions, rather than being the direct result of the actions themselves. Just as the F.1 drawings are more distanced from the immediate experience of actually clapping the rhythm as compared with the swinging scribbles of the youngest children, so the F.2 drawings are more distanced from immediate experience as compared with the F.1 drawings. It would

seem, then, that a critical aspect of development is the moves back and forth between reflections *of* experience and reflection *on* experience.

Thus we now see two repeated graphic patterns but now, in general, larger shapes stand for slower motions (events of longer duration), and smaller shapes stand for faster motions (events of shorter duration). In addition, in differentiating the rate of events, the two large repeated figures are further differentiated into two inner figures. The larger figures and their inner groupings are shown in Figure 3.5.

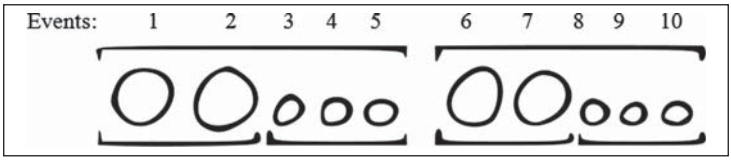

Figure 3.5 F.2 drawing showing inner groupings.

However, the F.2 drawings present an intriguing puzzle. The relation between size of shape and actually performed duration is not consistent. Clap 5 is *performed* as an event of longer duration, like Events 1 and 2 or Events 6 and 7, but it is *drawn* with a small shape like the faster Events 3 and 4 that immediately precede it. And yet these F.2 drawings seem accurately to represent the rhythm not only to the children but also to musically untrained adults (see Hildebrandt and Bamberger, 1979).

To grasp the significance of these figural drawings we need to ask, then, why are these F.2 drawings seen as *natural, intuitively right* by these varied groups of people and what does that tell us about "developmental" claims? More particularly, what are the *possible* circumstances under which Event 5 can be apprehended as the same as Events 3 and 4 while different from Events 1 and 2 or 6 and 7? Roger put it like this in describing his 4th grade drawing: "You can see that there are two and then three claps. The three little circles get faster and they go together", and he gestured with his arm to show that "go together" meant as in one gesture.

Like Roger, those who make F.2 drawings are representing not only individual, discrete, local events but also their feel for the *grouping* of their ongoing actions as these influence the mental construction of figures. In this context a *figure* is a grouping of contiguous action-events, where the beginning and ending boundaries are generated by changes in pace. In F.2 drawings, the inner figure, 3 → 4 → 5, is set off by a change to faster actions (at Event 3) and delimited by a change to slower action (at Event 5)—these become the boundary-making events of this small figure.

The definition of a figure obviously applies as well to F.l drawings. However, the younger children are only responsive in their drawings to the single change in pace between Events 5 and 6. Event 5 as a longer event marks the ending of the first larger figure; the repetition or the "begin again" at Event 6 sets off the second figure.

Although an F.2 drawing as a description is more distanced from experience than an F.l drawing, since it is not actually drawn-played on the paper, the F.2 drawer is still, in effect, inside the performance, moving with it, as he or she re-enacts the experience. I will call this graphic reconstruction of experienced actions a description of a player's *felt path*—actions following one another through time, *next-next-next* as they group together to form figures. Players are both making and following their felt path. As a result, the child (or adult) is continuously responding to the unique *situation* of action—events as they occur, and also the particular *function* of an event within the figures of which they are members.

Given this formulation, we can reasonably account for why Event 5 is drawn as a small circle, as if it were a faster event. First, along the player's felt path it is "felt" to occur as a member of the inner figure, 3 → 4 → 5. Just as proximate and alike graphic shapes form a *visual* gestalt (see Figure 3.6), so F.2 drawings form a temporal gestalt. As the Gestalt psychologists have told us, when we perceive objects that are relatively closer together, we see them as a "collection"—that is, as forming a group.[9]

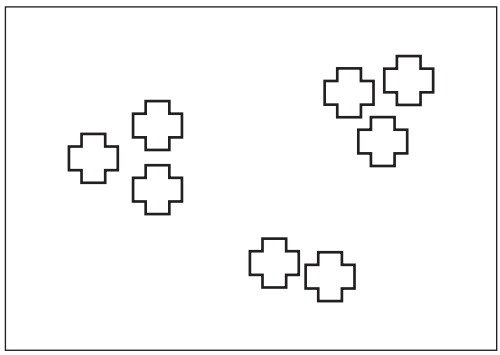

Figure 3.6 Proximate shapes form three groups.

Second, even though Clap 5 is "long" like Clap 6, it is apprehended as different because it has a different *figural function*. Clap 5 functions as the *ending* of the figure, 3 → 4 → 5, whereas Clap 6 functions as the *beginning* of the figure, 6 → 7. Finally, the F.2 player in action and in hearing does not compare events across the boundaries of figures. For example, in clapping the rhythm, Event 5 remains within the boundary of its figure; the player does not listen across the boundary to compare it with Event 6. As the 4th grade child put it, "You just stop and start again." Indeed, in moving along a felt path, one's actions *between* figures in crossing over figural boundaries are of a significantly different kind from actions *within* figures.

One adult, on recognizing that there could be an event, even though a silent event, between Claps 5 and 6, said, "Oh I see, so there's a ghost beat there that isn't played." She drew the picture shown in Figure 3.7.

Figure 3.7 A ghost beat.

On this view, Clap 5 is drawn as a "short" because it is experienced as if it were two actions. One, the clap action, functions as the last clap event in the faster figure; the other is an in-between action of silence, a "gap," that is correctly performed but it is neither attended to as an action-event along the felt path nor accounted for in the drawing. How do you draw a picture of "in between?"[10]

Once one is willing and able to notice the children's (and adults') perspective, what seemed an inconsistency in F.2 drawings turns out actually to be totally consistent. With the focus on figural function, action-events with different figural functions but with what we conventionally describe as the same duration are heard and drawn differently; in turn, action-events that are only functions (like boundary-making silence) are not accounted for at all.

It is precisely our capacity to apprehend a few figures rather than the larger number of discrete bits of information (claps) that makes the string of elements comprehensible. It is unlikely, for instance, that a string of 10 elements, all with the same duration, could be remembered and reproduced (without counting). Reproduction is most likely only possible if there is variation in the durations and if the ordering of variations makes it possible to construct groupings or figures within which each element assumes a function.[11]

In summary, then, F.2 drawings differ from F.1 drawings in significant ways, suggesting development within a basically figural approach:

- F.2 drawings require that the children *reflect* on their actions. The drawings show "thought actions" rather than a tracing of the actions themselves. The pictured elements *stand for* actions rather than being them.
- F.2 drawings are more *complete*. The drawings show differences in pace of actions and, in doing so, show a further articulation of the figural grouping structure as a *hierarchy* of groupings—two larger figures and, within them, two inner figures.
- F.2 drawings are more *adequate* than F.l drawings in terms of the draw-a-rhythm task. That is, they provide more explicit directions so that the drawer could "remember the piece tomorrow or so someone else could play it."

Development within the metric dimension of the typology

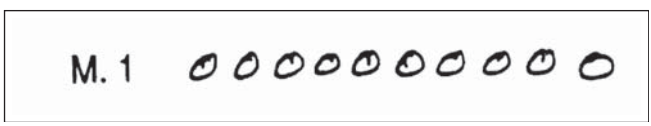

Figure 3.8 Type M.1: A nascent metric drawing.

Going on, now, to the metric dimension of the typology, in what sense can the drawing marked M.1 in fact be considered metric (see Figure 3.8)? Just looking at it will not, by itself, help. As with other drawings made by the younger children, you need to have been there while they were making their drawings in order to make sense of what they leave behind as a product. Indeed, as we watched the children making their drawings, we saw them also watching themselves, clapping the rhythm back to themselves; we saw them at the same time slowly, laboriously "grabbing" and counting up each clap as it went by, 10 claps in all. Then, with the result of their count-up clearly in mind, they carefully put down on their papers a row of 10 discrete shapes—ungrouped and undifferentiated with respect to shape or size—a count-up.

I have called M.1 drawings at least nascently metric, in contrast to F.1 drawings, first because the children focus on discrete events in contrast to continuous motions, and second, because they focus on *counting* in contrast to the construction of *figures*. The children who made M.1 drawings select out or "extract", as a memorable property from their continuous actions, a single property—just how many discrete sounds they made. But still, like the children who made F.1

drawings, these children do not attend to differences in the pace of their actions. Each clap is drawn the same except for its position in the series—simply next-next-next. Thus, even though the children's interest is in counting each event—each clap is a "unit" to be counted—their counts do not stand for units as in a "metric unit", something whose value stays the same so that it can be used to measure, as in counting along a number line or counting inches along a ruler. As we move on to the M.3 drawing, it is exactly the sense of what constitutes a "unit" in these drawings (i.e., what is a thing to count on and to count up) that will distinguish them from all the others.

But still the M.1 drawings, like the F.1 drawings, show evidence of a growing capacity for reflection on, and distancing from, immediate experience as compared with the earlier dot drawings. For in order to make these drawings, the children had quite literally to look *at* themselves clapping—first, translating their continuous actions into a count-up, then translating the count into a line-up of all-alike shapes going left to right across the page. And finally the shapes, unlike the F.1 continuous lines, *stand for* claps rather than being the *direct result* of making them.

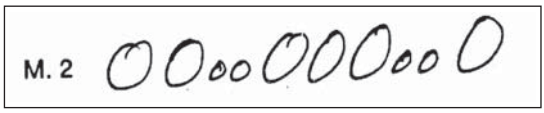

Figure 3.9 Type M.2: Classifying relative durations.

Comparing this prototypical M.2 drawing with M.1 (see Figure 3.8) drawings within the metric dimension of the typology, reflection *on* actions and distancing *from* immediate experience once more come into play. Like the F.2 drawings in comparison with F.1 drawings, M.2 drawings (see Figure 3.9) include more information than M.1 drawings. We see large and small shapes rather than the all-alike shapes of M.1 standing for an indiscriminate count-up. Most noticeably, in contrast to M.1 drawings or F.2 drawings, in M.2 drawings, events of longer duration are consistently drawn with larger shapes, whereas events of shorter duration are consistently drawn with smaller shapes.[12] In relation to the F.2 drawings, each event is consistently classified with respect to duration, irrespective of where it falls in the course of the rhythm pattern, and irrespective of its figural membership and function.

Children who made M.2 drawings, unlike those of about the same age who made F.2 drawings, must not only distance themselves from their immediate experience, but also from the given sequence of their performed actions. Rather than going along the path of the rhythm, next-next-next, they must remove themselves from this path so as to compare events that may be distanced from one another in their order of occurrence. And most important, they must compare events that belong to different figural groups. As in all metric drawings, the figural groups that are so clear in both F.1 and F.2 have disappeared entirely in M.2 drawings.

The contrast can be best understood in terms of the different meanings of "group" in comparing F.2 and M.2 types. An F.2 group is a *figure—a sequence of unique, necessarily contiguous and bounded events*. An M.2 group is a *class*—its members are single events that *share the property, same relative duration*. Thus we can say that M.2 children, by reflecting on their felt path, consistently compare and classify events that are distanced in time and are not necessarily contiguous. For instance, they may compare events that are members of different figures and that occur across figural boundaries. It is this reflective attention to *classifying* events in contrast to attention to situation and function of actions within figures that most particularly distinguishes F.2 from M.2 drawings.