Chapter 2
A TYPOLOGY OF CHILDREN'S INVENTED RHYTHM NOTATIONS

A. 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, Lucy Sperber, and I asked children in grades 1-6 during their regular music classes, to clap and to make notations for six different rhythms. The procedure was as follows:

Miss Sperber clapped each one of the six rhythm patterns in turn. After clapping a rhythm twice, she asked the children to clap it back which almost all could do. Then (learning from the children in the original 4th grade class) she asked them to:[1]

> *Put something on paper so you could remember it tomorrow or someone else who isn't here today could clap what you just clapped.*

After the children had completed dlqpping and drawing 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 aspects—different kinds of objects and relations. As it turned out, the numbers, as an alternative mode of representation, did prove very

[1] Putting the task in terms of practical use (like a set of instructions), turns out to be critical to what children (or adults) include in their notations. This is in contrast to putting the task, for instance, as to

useful in suggesting additional features, sometimes reinforcing and sometimes conflicting with the graphics (see Part 3 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, various versions of the basic distinction emerged among the younger children (aged 3 to 7) as well as among the somewhat older children (aged 10-12).

B. The Typology

Using the rhythm of the "class piece," (one of the six rhythms the children were asked to clap and draw), Figure 2.1 shows copies of children's actual drawings each illustrating a prototype within the typology.[2]

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draw what you just heard or clapped. The latter results often in pictures—of people, cars, nature, etc. supposedly capturing the feelings or associations that the sounds evoked. (see Barrett...)

[2] While I have selected examples with similar, circular kinds of graphics examples from among the total collection, children actually used all kinds of shapes while still clearly expressing similar types. For a more complete analysis and discussion, see Bamberger, 1995,

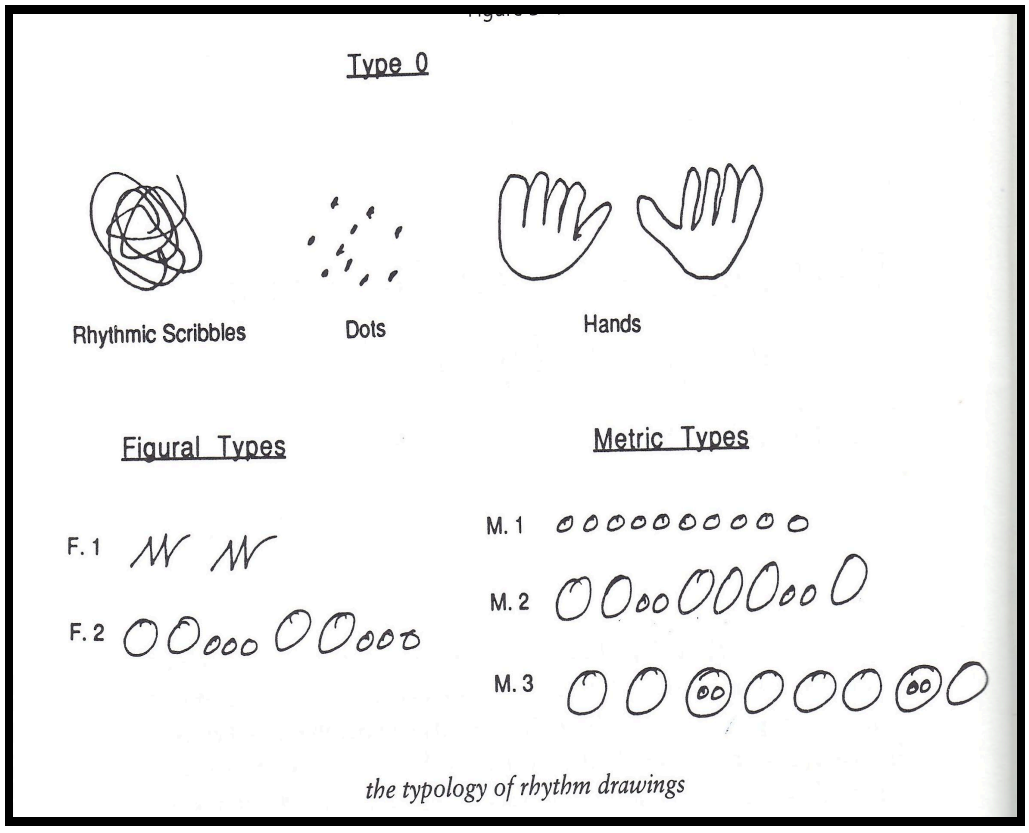


Figure 2.1: Typology of drawings[3]

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

[3] The term, "formal" has been changed to "metric" in this paper—thus, the labels, "M1" etc. in the typology.

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, which different?
- What is the relation of these similarities and differences to the general distinctions between figural and formal/metric types?
- To what extent is the general distinction between figural and formal types a developmental one related to developmental trends in other domains?

The labels assigned to the types, reflect two global dimensions of the typology: First, the distinction between *figural and formal/metric* drawings, where figural drawings are labeled F.l and F.2 and metric drawings are labeled M.l, M.2, and M.3. And second, *developmental implications* of the drawings where Types 0, F.l, and M.l are thought to show earlier phases of development, and Types F.2, M.2, and M.3, later phases of development. 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 dis-

[4] See in this regard, E. Ferreiro's work on children's early reconstructions of written language (Ferreiro, 1978).

tinctions 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. [5]

Given this proviso, the data do, however, suggest some connections between a child’s age and a type of drawing (See also, Hildebrandt & Richards). For example, looking at the extremes of age among the 6-l2-year-olds, most of the youngest children (ages 6-7) made either Types F.l, M.l, or F.2 drawings, and only 1 child out of 21 was classified as M.2. In contrast, children in the oldest group (age 11-12) were about equally divided between Types F.2 and M.2, with only 2 children (out of 44) classified as F.l or M.l.[6] Only 4 children out of the total sample made an M.3 drawing--1 in the fourth grade and 3 in the sixth 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 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.

C. Analysis of the Typology

C.1 Type 0: Scribbles, dots, hands

[5] Notice that the original figural and formal drawings of the class piece are still present in the middle of the typology and labeled F2 and M2 respectively.

[6] Interestingly, in the mid-age group (8-9 year olds) several children did make M.1 drawings. Of these, all were identified as reading below grade level. This finding clearly bears further study.

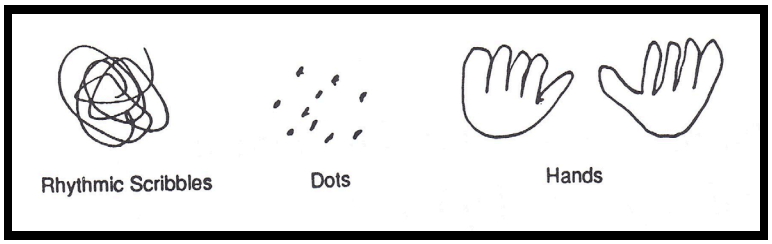


Figure 2.2: Drawings made by the youngest children

Type 0 drawings were made only by the very youngest children--ages 3-5. 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 (CRN). 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, Meno, p. 130)

Look first at the drawing labeled “rhythmic scribble.” If, following Plato’s advice, you make an initial assumption that the drawing pictures 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 that your movements are actually continuous even though the span of the swings changes. However, as adults influenced by the conventions of music notation, we have become entirely inattentive to our continuous body motions in making the rhythm. Thus, by considering that the children's focus might be different from mine, and in searching for what it might be, an aspect of performing rhythm was "liberated" that previously escaped my attention. 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 in contrast to the discrete sounds--the external, public, acoustic results of these motions--just what is represented by conventional rhythm notation (CRN) 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, 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 2.2).

The 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 (1967), and others. However, these researchers were referring to drawings made by much younger children (ages 1-2) in their first spontaneous experiments with crayons and paper or their earliest attempts to draw familiar objects, 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*

[7] See, Buder (Note 3) for a more extended and quite elegant study of drawings made by 4-5-year-olds.

from such a rhythmic pattern of movement that the first shapes come to be distinguished as Stage 1. [Piaget & Inhelder, 1967, p. 59.].[8]

It is not surprising that rhythmic scribbles reappear with our 3-5-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 2.2), 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

[8] The term *rhythm* as used within musical terminology has a much broader meaning that includes such cyclic motion but is not limited to it. The terms *beat* and *meter* are used specifically to refer to periodic, cyclic and invariant underlying time units. These are distinguished from, for example, the varied durations of a melody (its "rhythm") and also from "rhythmic grouping" or figures. The relationship between these two aspects of rhythm (meter and grouping)-separating them on one hand and coordinating them on the other-is central to the distinctions upon which the typology of drawings is based. (See, in this regard, Cooper and Meyer, 1960, and Lerdahl and Jackendoff, 19)

would help then 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 onto paper. But the trace 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. 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 (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 2.2 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, yet 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, becomes visible, holds still, to be seen all at once.

C.2: *Development within the Figural Dimension of the Typology*

Consider first, the drawings marked F.1 and M.1 within the framework of the two global dimensions of the typology: Along the developmental dimension, the distinguishing features of scribbles and dot drawings seem to have crystallized in these drawings of slightly older children.

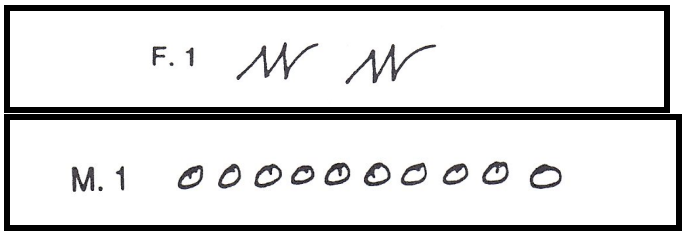


Figure 2.3: F.1 and M.1 drawings

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!

Considering development now 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 a 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, 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 of the original Class Piece, 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 four and five 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 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.

C.3 Fully Developed Figural Drawings

Figure 2.4: F.2 Drawing

These fully developed figural drawings are much like Roger's original figural drawing of the Class Piece. Comparing this fully developed figural drawing, F.2, with the earlier F.1 drawings, 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 F.2 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 onto the paper (playing/drawing); what we see instead are "thought actions"--discrete graphic shapes that *stand for*, *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 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 grouping are shown in Figure 2.5.

Events: 1 2 3 4 5 6 7 8 9 10

Figure 2.5: F.2 drawings show 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 duratlon, like Events 1 and 2 or 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 & Bamberger, Note 4).

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 on-going

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.I 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.I 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, 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.

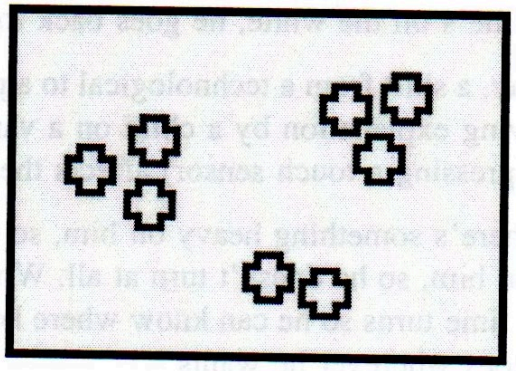


Figure 2.6: Proximate shapes form three groups[9]

Second, even though Clap 5 is a “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.

[9] The classical gestalt principle states: *Proximity* occurs when elements are placed close together. They tend to be perceived as a group. In music, these have have been called “temporal gestalts” (Tenney, et al (1980))

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 2.6.

Figure 2.7: 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.I 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.I 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."

C.4 *Development within the metric dimension of the typology*

Type M.1

Figure 2.8: 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? Just looking at it will not, by

[10] For more on "in between" see Chapter 18

[11] Our informal experiments with subjects listening to computer generated random durations provide initial evidence for this claim. See also, Miller, 1958).

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 because first, 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 that stays the same in its value 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.

Type M.2: Classifying Relative Durations

Figure 2.9: Type M.2

Comparing this prototypical M.2 drawing with M.1 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 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, 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.

[12] "Duration" is more accurately defined in terms of "onset" or "attack time"—that is, the time from the attack of one event to the attack of the next event.

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 thus 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.

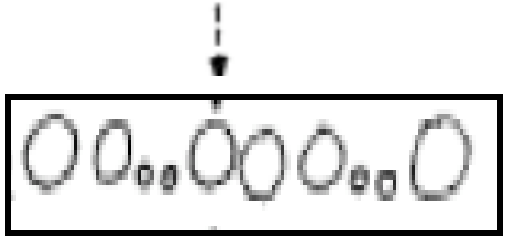


Figure 2.10: Event 5 makes the difference

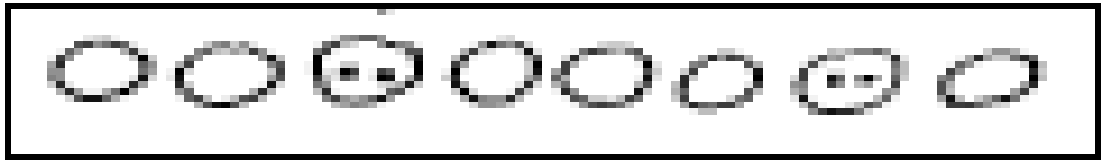
Notice also, that M.2 drawings *obscure the boundaries of structural figures*. Why? Looking at the M.2 drawing (Figure 2.9), we see that Event 5 (marked by an arrow) is drawn as a longer event which creates a run of three, alike items (5->6->7). The result is a visual grouping, generated by similarity and proximity, that entirely obscures the boundary between the first and second figures. At the same time, a new and different bounded visual figure emerges (events 5-6-7), an aspect that most likely makes these drawings seem *unnatural,* even quite *wrong* to those who spontaneously

make F.2, figural drawings. ***Consistency and greater objectivity sometimes blur important and more intuitive distinctions!*** [13]

C.5 Type M.3: Fully Developed Metric/Formal Drawings

The shift in focus found in M.2 drawings is further developed in M.3 drawings. M.2 drawings classify events with respect to the *relative* duration of one event as compared to another. M.3 drawings show not only longer and shorter durations but *how much* longer or shorter. The invariant unit of measure is the underlying "beat."

Figure 2.11: Clapped events in relation to an invariant beat



Beat:	1	2	3	4	5	6	7	8
Events:	1	2	3-4	5	6	7	8-9	10

As shown in Figure 2.10, the large circles stand for the background beat--eight beats in all. When performed events are equal in time to the background beat, coinciding with it like events 1 and 2, there is only an empty circle. But when performed events go twice as fast as the background beat, like events 3 and 4, the two little circles inside the big circle stand for the two faster claps. As one child said of Events 3 and 4, "You can see there's two for one, there." Thus, the two faster

[13] One adult faculty member at MIT who had made a figural drawing, on seeing the M.2 drawing said, "Well, if you start with this one (pointing to event 3) and continue till the end and then "wrap it around", that would work."

claps together equal the time of one background beat--a proportional relation of 2:1. It is in this sense that the M.3 drawing shows not only long and short events, like the bigger and smaller circles in the M.2 drawing, but also *how much longer or shorter.*

Indeed, the M.3 drawing comes very close to conventional rhythm notation (CRN). In conventional rhythm notation a “beam” connecting notes indicates that the joined notes are, together, equal to the unit time. Thus, in the notated rhythm,  the beamed notes are equivalent to the child’s  . The child’s invention has the advantage of showing both the underlying unit  and also the relation of performed events to it  .

Indeed, M.3 children have invented what might be called the beginnings of a formal symbol system. A *formal symbol system* (as used here) is expressed by a set of signs that refer to:

- elements and relations that are consistent with respect to a fixed, external reference system;
- elements that are generalizable to all instances within the given domain (i.e., to any rhythm);
- signs that are applicable across internal contexts and across individual readers familiar with the system.

In this case (and often in others) the system is also hierarchic. That is, levels of the temporal structure and the relations among levels are explicitly included in the signs associated with the symbol system.

Children who made M3 drawings demonstrate a growing capacity for reflection: They not only must remove themselves from, but also reflect upon their continuing felt paths. Although the beat is actually being generated by the varied durations they are clapping, the beat, itself, is not actually being performed. Thus, to extract it and hold it constant in the face of changing situation and function, is a necessary and critical component of making an M.3 drawing. Moreover, M.3 children must coordinate the underlying beat and their performed events—that is, they must map onto one another the varied durations of the events they are clapping and the beat as the underlying reference unit. If F.2 children have drawn "thought actions," M.3 children have constructed a "thought schema" and have found a way to coordinate it with their "thought actions."

Finally, in terms of the developmental account, M.3 drawings show a fully developed representation of an *internally generated temporal unit*. As proposed earlier, it seems plausible that this aspect is actually found in nascent form in M.1 drawings. On that view, if M.I children construct a unit by treating each *clap* as equivalent and counting them up, M.3 children construct an *invariant time-unit* by extracting the beat from the varied durations that they are clapping.

D. Summary of Developmental Implications

Types F.I and M.I show the beginnings of contrasting modes of representation while at the same time, both show important developmental change as compared with Type 0 drawings. The nature of this change bears interesting similarities to Piaget and Inhelder's account of the very young child's moves from early rhythmic scribbles at age 1.5-2.5, to their later capacity to draw simple geometric shapes:

It is on the basis of the rhythmic movement which the scribble constitutes that the rectilinear and curved shapes (of geometric figures) will later be gradually differentiated through a series of perceptual-motor and intuitive regulatory processes. ... They already constitute in an undifferentiated state all those elements which will later go to make up the drawing of straight lines, curves and angles, even though the child cannot yet extract or "abstract" these from the rhythmic complex. Consequently, the child has to break this continuous rhythm even to draw a simple circle, while at the same time taking advantage of its bends and natural closures [Piaget & Inhelder, 1967, p. 59,].

Despite the differences in the draw-a-shape and draw-a-rhythm tasks, there are clear similarities between the above formulation of the issues facing the very young child in conceptualizing and reproducing objects in space and those faced by our somewhat older children in conceptualizing and representing their own actions. In particular, Type F.I children demonstrate "regulatory processes" in their capacity to interrupt and contain--to "break this continuous rhythm" of clapping as they mark the clapped events and the two repeated figures. Piaget, again:

> *It is a matter of arresting or interrupting the primitive rhythms of scribbling. This means breaking it down into discrete elements, arranging these elements in relation to one another, and then reassembling these elements with the aid of a series of perceptual-motor and intuitive regulations.* (*Ibid*: P.65).

In turn, M.I children demonstrate such "regulatory processes" in their capacity to "extract" each discrete clap "from the rhythmic complex" and to count them up. But neither Types F.I nor M.I show the changes in pace that the children actually performed. Differentiating events with respect to faster and slower actions remains still to be achieved. Yet, these drawings reveal kinds of features that are inherent in clapping a rhythm that will be obscured as the children come to include others.

The typology has shown a transition from the diffuse “rhythmic scribbles” to the regulations expressed in Types M.1 and F.l and the more articulated regulation of F.2, to the construction of a fixed reference schema in M.3. Piaget tells the story this way:

> *Let us first of all suppose that we disregard the qualitative character of a duration A, in the way we do when we say 'a moment' without defining which precise moment we have in mind... How can we transform this duration into a 'unit' of time that can be equated to successive durations? To do so, we must, of course, be able to remove the duration A from its fixed place in the temporal framework--i.e., we must establish a mobile unit that lends itself to repeated application (iteration) and to substitution for any other unit in the series.,,, Now, since that duration can be substituted for any other, it loses its distinctive quality. But as soon as it comes to distinguishing any two A's (for example two different hours) we are forced to reintroduce their general succession in the form of the precise order in which the identical motion x was repeated. ...the two are but different aspects of one and the same thing.*
> [Piaget, *The Child's Conception of Time. 1967; 174, 182 (my emphasis)]*

Of special relevance, here, is Piaget’s point that if we remove a duration [event] from its place in a “temporal framework” (read, “felt path”), so it can substitute for any other [event] in the series, *it loses its distinctive quality!* Applying this to rhythm patterns: when a temporal unit is extracted and used as the underlying basis for a measured representation, *the distinctive quality* of the pattern, the figural groupings and boundaries, is lost.

But notice that just as M.I children lose, in their singular focus on counting, the marking of the large figural boundary found in F.I, so M.2 and M.3 children, in their more objective focus on measuring, obscure figural boundaries as well as the changing function of events found in F.2. Thus metric graphics (along with conventional notation) leave the performer with the problem of “putting in the interpretation”-- that is, finding the figures, the *phrasing* now hidden in the carefully denoted metric units. Neither conventional notation nor the invention of figural descriptions, adequately capture the two faces of the fully apprehended rhythm-- *discrete, measured events and continuous but bounded figures*. For practicing musicians, these multiple and coordinated features become, as Piaget suggests, *different aspects of one and the same [*even*t].*

Before going on, I would like to sympathize with readers who may feel, by this time, a little like they are in Alice's Wonderland where the most ordinary things seem to come to life in confusing ways. And this will get even more problematic when we come to naming things--what do we give names to and what do the names mean? Or as Humpty Dumpty and Alice put it in Through the Looking Glass:

> *"Don't stand there chattering to yourself like that," Humpty Dumpty said, looking at her for the first time, "but tell me your name and business."*
> *"My name is Alice, but..."*
> *"It's a stupid name enough!" Humpty Dumpty interrupted impatiently.*
> *"What does it mean?"*
> *"Must a name mean something?" Alice asked doubtfully.*
> *"Of course it must," Humpty Dumpty said with a short laugh: "My name means the shape I am--and a good handsome shape it is, too. With a name like yours, you might be any shape, almost."*