Chapter 3
CHILDREN'S DRAWINGS OF SIMPLE RHYTHMS

3.1: A Typology Of Children's Invented Notations[1]

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 had emerged 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:

The teacher, Lucy Sperber, clapped each one of the six rhythm patterns, asked the children to clap it back, and then (learning from the children in the original 4th grade class) asked them to:[2]

Put something on paper so someone else who isn't here today could clap what we have just clapped.

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

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[1] This chapter is an amalgam of Chapter 3 in The Mind behind the Musical Ear (1991/95) and a chapter in S. Strauss (ed) U-Shaped Behavioral Growth, (1982).

[2] 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 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...)

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.

In addition to the children in the Wayland School, Eugene Buder, then a student in the 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 a total of 186 children's drawings. 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 10-12).

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]

[3] 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,

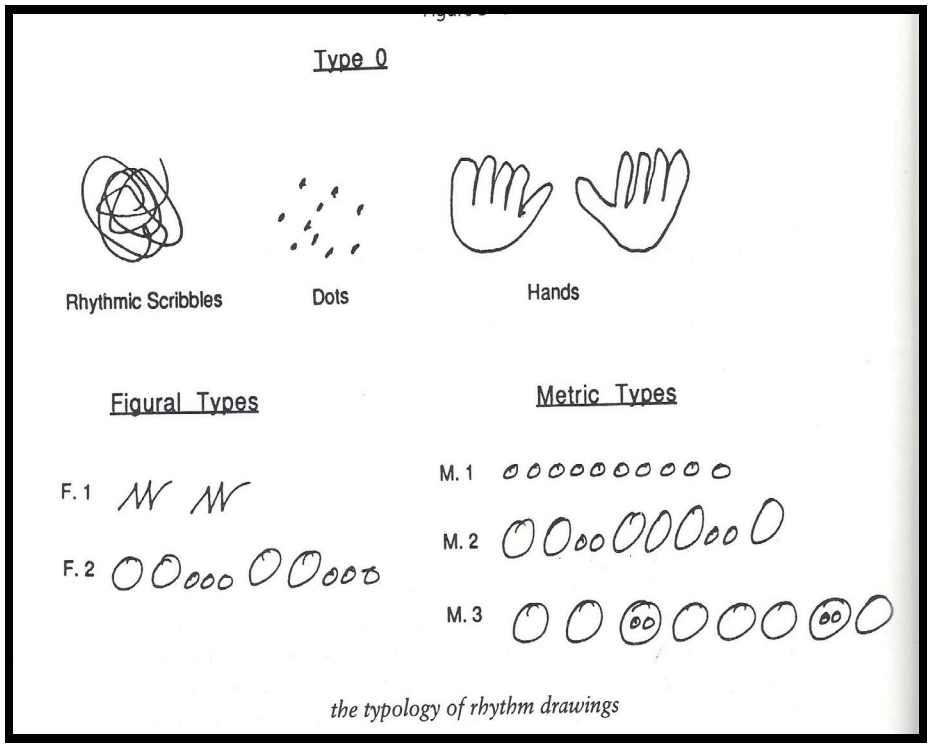

Figure 3.1: Typology of drawings[4]

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.[5]

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

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

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 this similarity and difference 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 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 musical aspects both 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. [6]

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.I, M.I, or F.2 drawings, and only 1 child out of 21 was classified as M.2. In contrast, the oldest group (age 11-12) was about equally divided between Types F.2 and M.2, with only 2 children (out of 44) classified as F.I or M.I.[7] 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.

Part 3.2

Analysis of the Typology

Type 0: Scribbles, dots, hands

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

[7] 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.

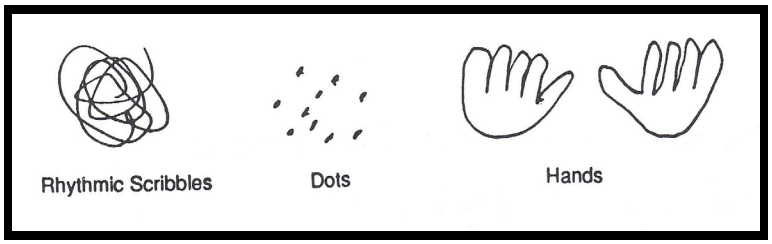

Figure 3.2: Drawings made by the youngest children

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 (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, Meno, p. 130)

Look first at the drawing labeled “rhythmic scribbles.” My first reaction to them was simply one of dismissal—the children were just scribbling. But the persistence of these drawings and 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), made a strong argument that the scribbles should be taken as the children’s serious attempt to picture what for them was “memorable.” In the spirit of seeking for some reason, following Socrate’s advice, and after actually making a similar drawing myself, I came to realize that in clapping a rhythm, actions are, in fact, continuous—that is, our arms

actually move continuously back and forth in a swinging motion with only a momentary stop to make the actual clap sound.

In fact, the children "played" on the paper this continuous swinging motion as if they are clapping. That is, these children did not "extract" the clap sound, the separate and discrete effect of their actions, from the bodily motions that produced these claps. They did not, in short, separate clap from clapping. The result is a kind of pulsing, cyclic line--uninterrupted, unvaried, ungrouped. (see Figure 3.2) But because 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. We thus describe a rhythm as a series of discrete events. 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 to have major significance in the developmental moves reflected in the drawings--that is, from internally experienced body-feel to its externalization in static, discrete, symbolic notations.[8]

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 earliest attempts to draw familiar objects, geometric shapes, or, indeed, in their first spontaneous experiments with crayons and paper. Piaget and Inhelder describe these drawings (called *Stage* 0) as follows:

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

> *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 & Inhelder, 1967, p. 59.].[9]

These youngest children in our sample also appear to be using their crayons to put on paper a familiar, iterative, pulsing movement of their own bodily experience. But 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.

[9] 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.)

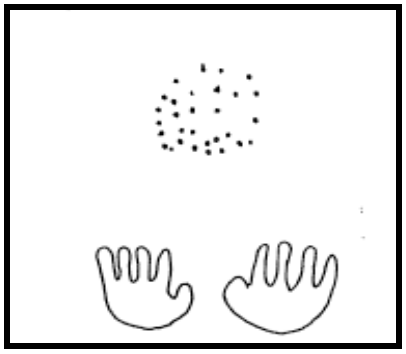


Figure 3.3. Variations on the rhythmic scribble.

When we compare the rhythmic scribble with the dot drawing (see Figure 3.3) the distinction between continuous and discrete aspects of clapping becomes very clear even in these drawings by children of about the same age. While the scribbles show a continuous, essentially undifferentiated swirling line, the dots are clearly discrete—that is, separate and distinct. Moreover, although the dots appear to be randomly arranged on the paper, the way the children made them point up another important difference between these dot drawings and the scribbles. 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 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. 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.

It is interesting to note that 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. That is, in transporting actions directly to paper, the children are not concerned with following some orderly transformation rule 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 actions/events moving through time into static paper-space.

The third picture in Figure 3.3 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. On seeing the first child do this, I again thought it was just rather weird. But once more, on seeing other children doing the same, and on further reflection, the significance became clear: It seems that in responding to the instruction to make a drawing "so you can remember what you clapped," those who traced their hands did not distinguish between the objects that made the claps, their hands, from the "objects" that are made by them, namely the sounds. And once I "let the material tell me," the hand drawing also helped to make more sense of the scribbles and dots. That is, although 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 the feel of their own internal 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 nature of the draw-a-rhythm task apparently triggers at this early age, a non-reflective, direct expression of bodily experience; yet the act of drawing is itself an important step in externalizing, making visible to be seen all at once, that which is otherwise evanescent, invisible, gone except for its remembered reconstruction in body-feel.

Types F.I and M.I:

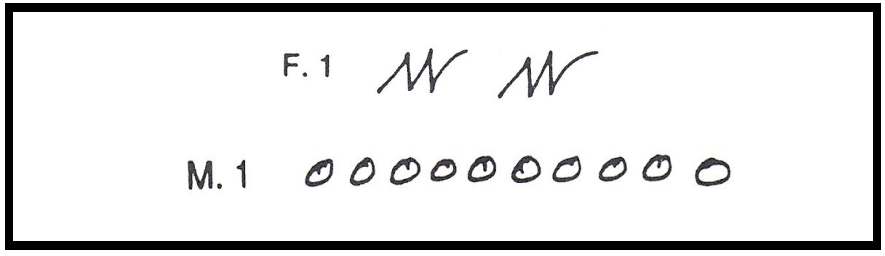


Figure 3.4: An Early Version of the Figural-Metric Distinction

Types F.I and M.I drawings, made typically by children aged 6 and 7, show significant developmental change with respect to the children's growing capacity to reflect on and differentiate the features of their own actions. For example, unlike type 0, both F.I and M.I drawings show the correct number of events, and each includes regulation of movements, in this way coming closer to an adequate description of the rhythm. And yet the two kinds of drawings are importantly different. Indeed, they illustrate the figural-metric distinction in its earliest form.

Type F.I drawings show the beginnings of figural representation. These children capture in their drawings the grouping of their actions into two large

gestures. We see two nearly identical but clearly articulated graphic figures. These are action drawings. That is, the children who made F.I drawings were, like the younger Type 0 children, playing the rhythm on the paper with their pencils. But these children "played" and left a trace of each event: Moving their crayons across the paper in synchrony with the rhythm, first slowly (/\) then proportionally faster (/\/)*;* a pause, crayon suspended in air, then a repetition of the previous actions.

The trace left is a continuous line, but with the continuousness importantly interrupted at the boundary between the repeated figures: two *graphic* figures reflecting the two *rhythmic* figures. Thus the child's "played drawing" leaves a trace of each performed event, but within each figure, no trace of the changes in pace that were actually performed.

Type M.1

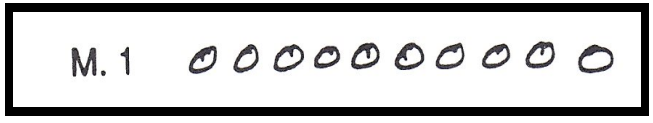


Figure 3.6: A nascent metric drawing

In contrast to F.1 drawings, M.1 drawings show the child's effort to "extract" each separate and discrete clap from the continuous motion of clapping. As we observed these children, we could see them laboriously watching themselves as they tried to "grab" and count up each clap while actually performing the rhythm. This singular focus results, not surprisingly, in a row of discrete "objects," all of which look the same--that is, ungrouped, undifferentiated with respect to size or shape--a simple *count-up.* Thus, in M.I drawings, each clapped event is treated as equivalent except for its position in the sequence. In this sense, a clap is also treated as a *unit*--a thing to count on and to count up. M.I drawings are classified as *proto-metric* exactly because they show the child's

beginning effort toward the mental construction of such a unit. Unlike F.I drawings, then, M.I types are not action drawings in that the drawing itself is preceded by the reflective count-up. The count-up then results in the "unitizing" of each event in the subsequent drawing. However, as we shall see, the notion of what constitutes a "unit" will undergo significant evolution in M.2 and eventually, M.3 prototypes.

Types F.I and M.I, then, show the beginnings of contrasting modes of representation: F.I shows children's focus on structural boundary-making and the beginning construction of figures. Type M.I shows the child's singular focus on differentiating *clap* from *clapping;* counting up their actions they show the beginning construction of discrete "units."

At the same time, both Types F.I and M.I, as compared with Type 0 show important developmental change. 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 reproducing 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 two repeated figures. 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.

Type F.2:

Figure 3.7: Fully Developed Figural Drawing

Type F.2 drawings are reminiscent of Roger’s original figural drawing of the 4th grade "class piece." In the context of the larger collection, they can be seen as clearly including characteristics of both F.I and M.I but again showing significant development. Each event is fully separated from the continuous motion of clapping (like M.I), and we also see the clear articulation of the two repeated figures (like F.I). However, events are further differentiated to show faster and slower motion. As Piaget puts it again in relation to the draw-a-shape task:

> *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).

Thus we now see two repeated graphic patterns but, in general, larger shapes now 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. As Roger put it in 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. The larger figures and their inner grouping are shown in Figure 3.8

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

Figure 3.8: F.2 showing inner groupings

However, as mentioned earlier, 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 large and varied groups of people and what does that tell us about the "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?

As pointed out in the discussion of the "class piece," those who make F.2 drawings are representing not only individual, discrete, local events but also their feel for the grouping of an on-going succession of actions influencing the mental construction of figures. In this context *a figure* is a grouping of contiguous action-events whose beginning and ending boundaries are generated by changes in pace. In F.2 drawings, the 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 events of that figure.

The definition of a figure also 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. The player is both making and following his/her 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.[10]

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, alike graphic shapes form a *visual* gestalt, so temporal events are drawn the same to show that they belong to the same *temporal* gestalt.

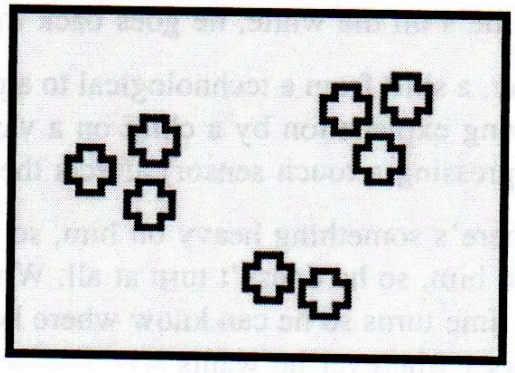


Figure 3.9 Three groups of alike shapes

As evidence, to draw clap 5 as a larger circle visually obscures the temporal gestalt (as we see in drawing M2).

[10] It is precisely our capacity to apprehend a few figures rather than a larger number of discrete bits of information (claps) that makes the string of elements comprehensible. It is unlikely, for instance, that listening to a string of 10 elements all with the same duration could be remembered and reproduced. Reproduction is most likely only possible if there is variation in the durations and if the ordering of variations make it possible to construct groupings or figures within which each element assumes a function. (Our informal experiments with subjects listening to computer generated random durations provide initial evidence for this claim. See also, Miller, 1958).

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 playing the rhythm, Event 5 remains within the boundary of its figure; the player does not listen cross 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 5.

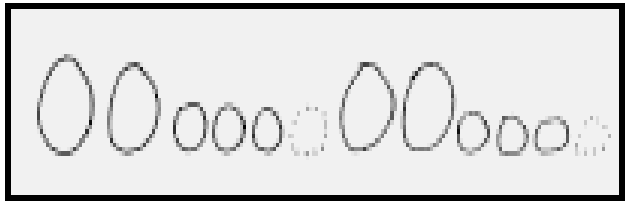


Figure 3.10: A ghost beat

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?”

Thus, in what seemed an inconsistency in F.2 drawings, turns out actually to be totally consistent once one is willing and able to notice the children’s (and adults') perspective: with the focus on figural function, action-events with different figural functions but with what we conventionally see 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.

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. Indeed, they describe 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 person could “remember the piece tomorrow or so someone else could play it.”

Type M.2: Relative Durations

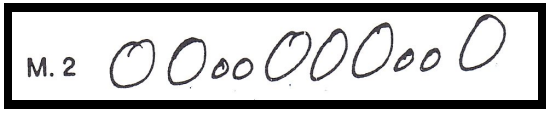


Figure 3.11 Type M.2

Between Type F.2 and M.2 drawings there is a significant cognitive *shift* rather than simply a developmental progression as in the relationship between F.I and F.2. Most noticeably, 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. Thus, M.2 drawings show a shift from a drawing that is closer to reenacting a felt path, to a somewhat more removed approach where the focus is on the relative duration of events.

Each event is compared and classified as relatively longer or shorter irrespective of where it falls in the course of the rhythm pattern, and irrespective of its figural membership and function. The contrast can be best understood in terms of the different meanings of "group" in each type. An F.2 group is *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 an M.2 child is more distanced from re-enacting a felt path in that by reflecting on it, she/he can compare and classify events that are distanced in time, thus not necessarily contiguous—e.g., they may be members of different figures and 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.

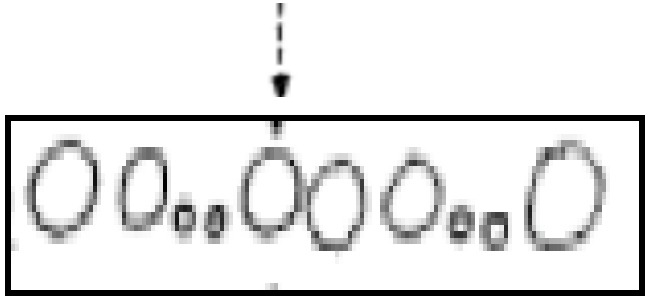


Figure 3.12: Event 5 makes the difference

Indeed, M.2 drawings, in the service of consistency and classifying, actually obscure the boundaries of structural figures. For example, looking at the M.2 drawing (Figure 3.12), above, one sees that Event 5 (marked by an arrow) is drawn as a longer event and that creates a run of 3 alike items. In turn, the visual grouping generated by similarity and proximity has the effect of successfully obscuring the boundary between the first and second figures. At the same time and for the same reasons, the run of adjacent, visually alike elements, creates a new and different bounded visual figure. It is probably this aspect of M.2 drawings—the generating of a new visual figure, that creates the conflicts with the perceived figural grouping of F.2 drawers. The visual grouping 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! [11] [12]

Type M.3: Fully Developed Metric/Formal Drawings

Figure 3.13: M.3, a fully metric drawing

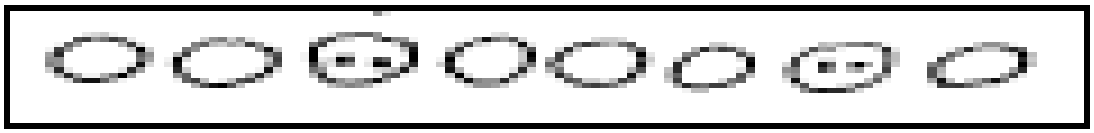
[11] As pointed earlier, the perceptual construction of visual figures in terms of similarity and proximity is the basic tenant of the Gestalt psychologists (see Koffka and Kohler).

[12] 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."

The shift in focus found in M.2 drawings is further developed in M.3 drawings. Whereas M.2 drawings classify events with respect to the relative duration of one event as compared to another, M.3 drawings show the duration of each event with reference to]an unchanging temporal unit. This “fixed reference” metric functions as a general schema in relation to which all events may be consistently measured. Indeed, M.3 children have invented what might be called the beginnings of a formal symbol system, much like standard rhythm notation. 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 (a formal structure), that are generalizable to all instances within the given domain (e.g., to any rhythm), and 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 is explicitly included in the signs associated with the symbol system.

In the case of M.3 drawings, the underlying and invariant unit of measure refers to the underlying “beat.” The beat, in turn, is generated by the actually performed varied durations at the surface of the rhythm pattern. Readers are probably familiar with this underlying unit as what they keep time to or tap their foot to in listening to music. In the M.3 drawing, the large circles represent the beat, as shown in Figure 2.12

Figure 2.14 Events in relation to invariant beat



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

When performed events are equal in duration to the underlying beat, only the circle is shown. When there are two or more performed events (faster, shorter) in the time of one beat, the circle is background with the performed events as dots inside the circle--a particular subdivision of that beat, here, 2:1. As one child said of Events 3 and 4, “You can see there’s two for one, there.” Thus Events 3 and 4 are each half as long in duration or go twice as fast as Events 1 and 2 each of which is equal to the beat or metric unit; the 5th event is again equal to the underlying , continuing, and invariant beat. In standard 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  .

Most interesting, M.3 drawings demonstrate that children who made M3 drawings are, in relation to M2 children, growing in their capacity for reflection: They must not only remove themselves from but also reflect upon their continuing felt paths. That is, since the beat is not itself always being performed, M3 children

must also extract this underlying unit-time from their sequence of actions. Although the beat is being generated by the varied durations they are actually performing, 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. Thus, M.3 children must coordinate the underlying beat and their performed events—i.e., they must map onto one another the varied durations they perform and the fixed 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 expression of a focus on units. It seems plausible that this is an aspect actually found in nascent form in M.1 drawings. On that view, if M.l children construct a unit by treating each clap as equivalent and counting them up, then M.3 children construct an invariant *time-unit* by extracting the beat from the varied durations that they perform.

Thus, we see the transition from 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 representation, *the distinctive quality* of the pattern, the figural groupings and boundaries, is lost. In order to regain that "distinctive quality" we must reintroduce *the precise order in which the identical motion x was repeated.*

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 standard 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 standard 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 must become, as Piaget suggests, *but different aspects of one and the same.*

Chapter 4

The Typology Revisited

In the context of a Strauss's challenge for a chapter in his edited book, "U-Shaped Developmental Growth, I looked back at the 186 drawings for examples that "didn't fit." For the quest, I used the typology as a kind of template or backdrop against which to understand the nature of these examples that did not seem to fit. Revisiting the data, then, I saw the prototypes as focused instances within a continuing generative process. In this new context the drawings that had seemed at first to be "odd" and bothersome "hybrids," came to illuminate and confirm the more distinct "snapshots" of prototypes that made up the original typology.

The significance of these hybrids only became clear as I reviewed the data from the larger sample, the 186 drawings from the second experiment. The new analysis focused on one of the six rhythms the children were asked to clap and draw because it seemed most effectively to differentiate among them. The target rhythm is shown in Figure 4.1:

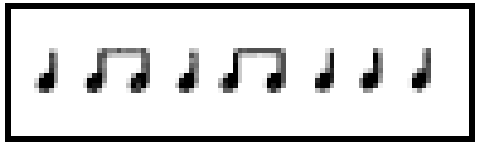


Figure 4.1 The target rhythm

That the target rhythm did differentiate among the children is not surprising since it includes in its internal structure aspects that are both ambiguous and thus somewhat more difficult to hang onto:

- While the target example includes only 9 events in contrast to 10 in the Class Piece, it seems longer and more complex because it

cannot be heard as just two, alike groups--there is no large-scale repetition.

- There is a repeated figure ( ) which is also found in the class piece. But in the target example, this inner figure is embedded such that it occurs in different situations within the whole (e.g., before and after itself) and, indeed, is not always heard/described as repetition.
- The target rhythm cannot be grouped into figures such that each figure includes the same number of beats.

Partly as a result of this asymmetry, we found alternate figural groupings as shown in Figure 4.2. The most obvious result of these different groupings is that **a** and **a'** end with a group of two events and b ends with a group of three events. This was an important clue in distinguishing between the two grouping strategies and also in finding conflicts between them.

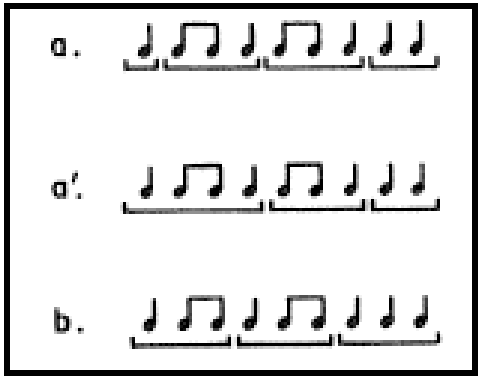


Figure 4.2: Alternate groupings

The Typology Extended to Include Numbering

Figure 8.7 shows prototypical graphics for the target rhythm, prototypical numbering types, and instances of mixed/transitional examples.[13]

[13] There are a whole series of fascinating issues that emerge from the data concerning the uses and function of numerals. For example, ordinal and cardinal numbers, one-one correspondence, what constitutes an equivalent unit, “counting” in contrast to “naming,” and the use of numerals to indicate the time-space unit with which to “measure” proportional relations. However, more of this discussion must remain for a subsequent paper.

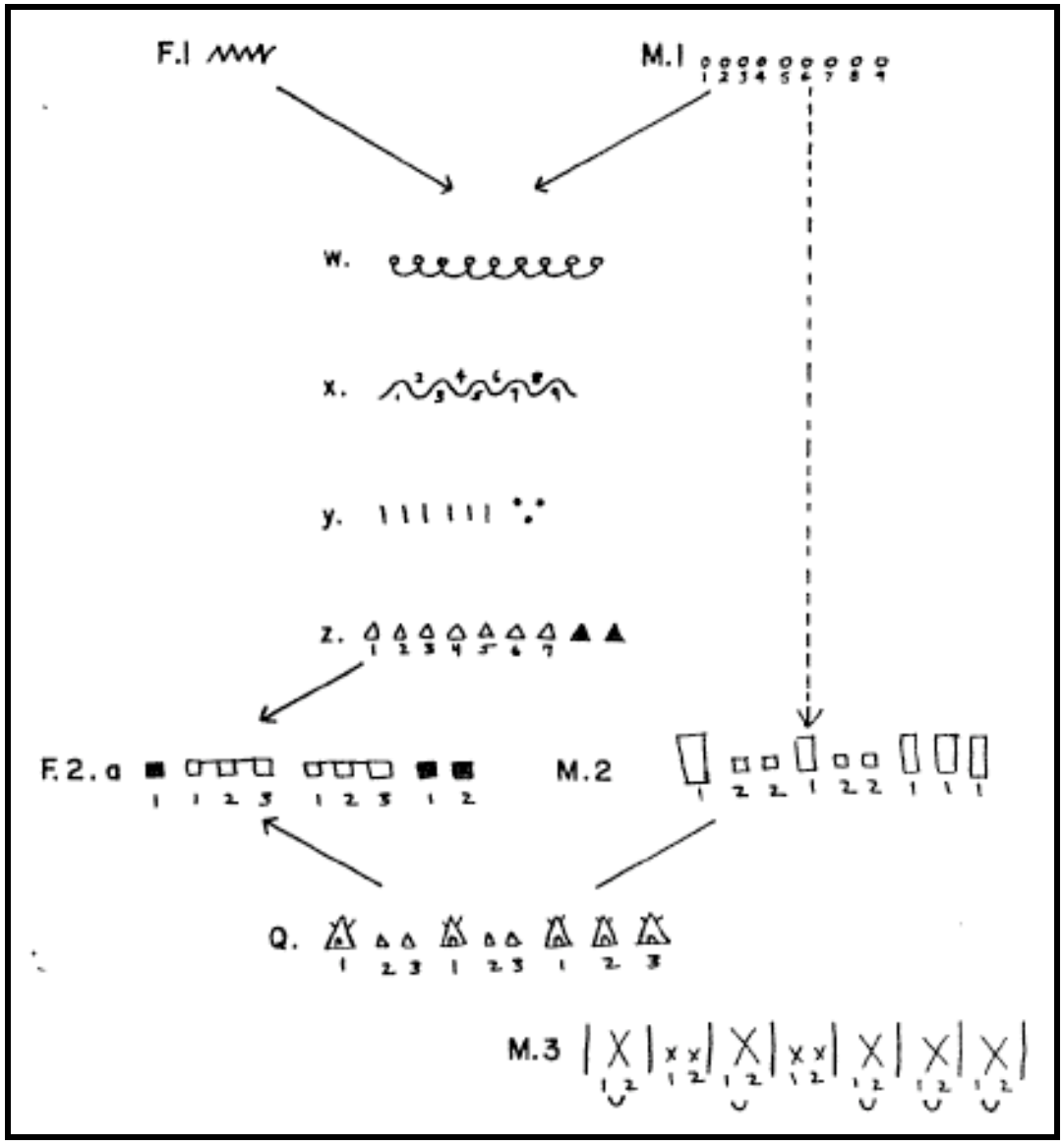

F.1
M.1
W.
x.
y.
z.
F.2.a
M.2
Q.
M.3

Figure 8: Typology of graphics and numbering for target rhythm

The criteria used for distinguishing types of graphics in the original typology were applied to the target rhythm and to the numberings as well.[14] Thus, the salient features in differentiating F.I and M.I graphics in the prototypical examples (see Figure 8) are a continuous, undulating line (in F.I), which was played-drawn on the paper, in contrast to discrete shapes (in M.I) drawn all the same that resulting from a count-up. Notice, however, in this typical example of the new rhythm, the F.I graphics show a continuous line, that is, not interrupted at all to show repeated figures. This is probably because, as previously indicated, repetition was not obvious and because grouping was, as a result, at least ambiguous. Furthermore, these very young F.I children (5-6 year olds) did not, typically, "put in numbers." Given the characteristics of their strategy, this part of the task had little meaning for them--they were apparently "finished" when they had managed to do just the graphics.

In contrast, M.I drawings were, not surprisingly, typically accompanied by a simple count-up in the numbering. M.I numbering matches the criteria for M.I graphics. That is, in the graphics each event is treated as an equivalent entity except for its position in the series. Likewise, in the numbering each clap is treated as an equivalent unit except for its position in the ordinal series. In M.I numbering, then, a clap is a thing to

[14] There are a whole series of fascinating issues that emerge from the data concerning the uses and function of numerals. For example, ordinal and cardinal numbers, one-one correspondence, what constitutes an equivalent unit, "counting" in contrast to "naming," and the use of numerals to indicate the time-space unit with which to "measure" proportional relations. However, discussion of these must remain for a subsequent paper

count on and the boundaries of the count-up are the beginning and ending of the whole sequence. As one child put it, “You just go straight ahead.”

Examples w, x, y, and z show a mix of strategies. Examples w and x were made by 6-year-olds who merged and thus blurred the distinctive features of both F.I and M.I. For instance, Example w includes discrete shapes, but these are also joined together by a continuous, undulating line; Example x shows a continuous line, but, in this case, a count-up of numbers is added, as in Type M.I.

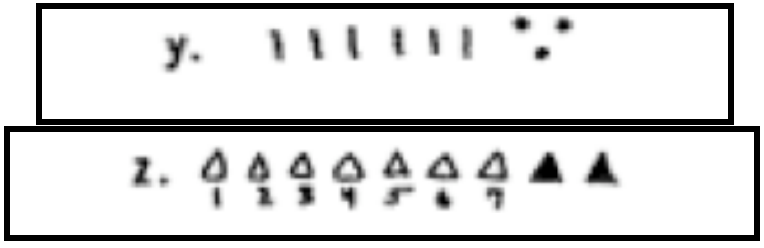


Figure 8 Examples Y and Z

Examples y and z are transitional between M.I and F.2 in that they show, within the graphics, the beginnings of F.2 grouping in what is otherwise Type M.I graphics (and in the case of Example z, M.I numbering). That is, in Example y the last three events are drawn differently from the others and together form a group, thus suggesting F.2.b (please see alternative groupings in Figure 7). In Example z only the last two events are singled out--colored in and left unnumbered--forming a two-element group and thus suggesting F.2.a. These latter examples, then, illustrate the flux of transition from M.I to F.2 because they include emergent features of F.2 within a still present M.I strategy.

Figure 9: An F.2a drawing

The example of F.2a graphics in Figure 9 show figural groupings in the lines that actually join together events that "go together" as in one gesture ( ). In addition, the graphics also partially indicate a change in pace with some but not all longer durations colored in. As in previous examples of F.2 graphics, the distinction with respect to duration is not consistent. As in the prototype F.2 drawings, events that belong to a "faster" figure like events 4 and 7, are drawn like the other members of the figure they share even though they are actually performed as the boundary events and thus "longs." The numbering strategy is beautifully consistent with the graphics and again conforms with the criteria that characterize a felt path: Each clap is a thing to count on--a stepping stone along the felt path--and events are counted up within figural boundaries. Thus, although each clap is a thing to count on, as in an M.1 strategy, the count-lip strategy is significantly different: Numerals correspond to the particular situation (ordinal position) of an event *within each figure separately.*[15]

[15] It is unusual for there to be a figure with but one clap as in the first event in this drawing. Also, the counting in this example is exactly how dancers count their steps—perhaps another instance of a "felt path."

Figure 10: M.2 drawing

The M.2 graphics in Figure 10 typically show longer events as bigger shapes and shorter events as smaller shapes. Consistent with this focus on classifying, M.2 numerals are “names” (Le. they stand for the name of a *class*). Longer events are assigned one numeral (1), whereas shorter events are assigned another numeral (2). As we shall see, the choice of particular. numerals as names may be quite arbitrary-much like the choice of numerals to identify members of a soccer team. In this instance, we might imagine that (1) stands for the “first kind,” whereas (2) stands for the “second kind,” but other numerals may do just as well (see, for example, p.).

In view of this consistent M.2 drawing, Example Q (Figure 8) is particularly interesting because it includes features of both F.2b and M.2.

Figure 11: Mixed M.2 graphics and F.2b numbering

Unlike examples w, x, y, and z, where the child seems to slip or slide from one strategy to another, here we see a clear and consistent “switch”: the graphics are clearly M.2 and the second pass numbering is

clearly F.2.b. That is, instead of using numerals to name each event according to its class (long or short) as in prototypical M.2 numbering, numbering is used to indicate F.2b figures (see Figure 8 and pages for further discussion of slipping and switching).

Examples of M.3 graphics were rare (four in all) and the one in Figure 12 was the only example of consistent M.3 graphics accompanied by consistent M.3 numbering. (This example was made by a child who was studying the trumpet privately.)

Figure 12: M.3 drawing

In the M.3 graphics, the proportional relationship between longs and shorts is shown by the large and small X's as contained by the "posts"—the series of vertical lines. The posts mark off a recurring time unit, one large X and two small x's are equal and each is also equal to the time unit marked off by the posts. The numbering (the repeated 1-2. 1-2) stands for the beat-value generated by the faster events. As such the numbers serve to measure the exact proportional relations between long and short events: a single longer performed event (a large X) is assigned two counts, whereas the shorter events are each given a single count. The posts function, then, as the large circles did in the M.3 drawing of the "class piece."

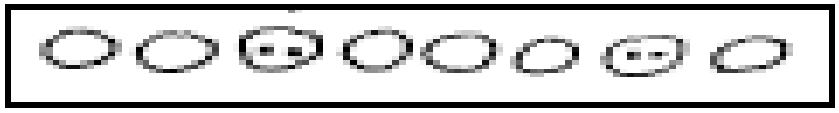


Figure 13: M.3 class piece

In adding numerals, the child thus counts ***on*** the faster beat and counts ***up*** within the boundaries of the slower beat, the unit marked by the posts.

The use of numerals in this example is, then, significantly different from any of the previous examples. Here, consistent with the importance of extracting a unit as in other M.3 drawings, the child is giving a count to (counting on) each unit-beat and the numerals are following his counts. In all the other types a name or a number is given to each performed event --the claps. In this example, each long clap is given two counts since the child has selected as the unit, the rate of the fast events—that is, the long event equals two of the fast events. Thus, as in all M.3 examples, the players in order to construct a unit that is not always being played, must step off their felt path, and remove themselves from their actions; reflecting back on their performance, they extract the beat and use it as the reference for both their graphics and their numbering.

Further Examples of Transition

In revisiting the data from the second experiment, we found a surprisingly large number of drawlngs among 8-9-year-olds that included an incorrect number of events (Hlldebrandt and Richards, Note 2). Perhaps most interesting with regard to transitional flux, we found in this mid-age group an expected *increase* in the number of drawings that

showed differentiation with respect to change in pace, but in the same group we also found a *decrease* in the number of drawings that showed the correct number of events. The tally thus shows a U-shaped curve with respect to this latter dimension (see Figure 11).

Grade	Correct number of events	Incorrect number of events	Percentage correct
2	13	8	62
3	19	22	46
4	23	28	45
5	12	7	66
6	40	4	90

A tally

I will argue that the dip in the correct number of events is evidence of an increase in the capacity for *reflection*. Consider, m this regard, that the younger children who made F.I drawings drew the correct number of events simply as a result of playing-drawing the rhythm on the paper. The drawing is a direct tracing of their actions and thus, inevitably includes all the claps. M.I children, in turn, arrive at the correct number as a result of their singular focus on counting-up their claps; the drawing instantiates the counting process and thus, also, inevitably includes the correct number of claps. However, neither F.I nor M.I children show change in pace. It would seem, then, that as children begin to attend to differentiation in pace (as in F.2 drawings) this new focus is given priority while distracting the child's attention from keeping track of the number of events actually clapped—an aspect that was a natural fall-out of the

earlier strategies. Thus, an increasing capacity to reflect on their actions leads children to new knowledge, while they temporarily lose an aspect of earlier strategies. Or putting it another way, the earlier strategies result in the correct number of events exactly because they are less inclusive; with more aspects of the rhythm included, there are also more aspects to coordinate. As one child who made a wrong-count drawing put it, “I can’t pay attention to all those things at once.” So, what may appear from a simple tally as a drop in performance along a single dimension (correct count-up) is more properly seen as a global developmental surge where the results are not yet fully integrated.

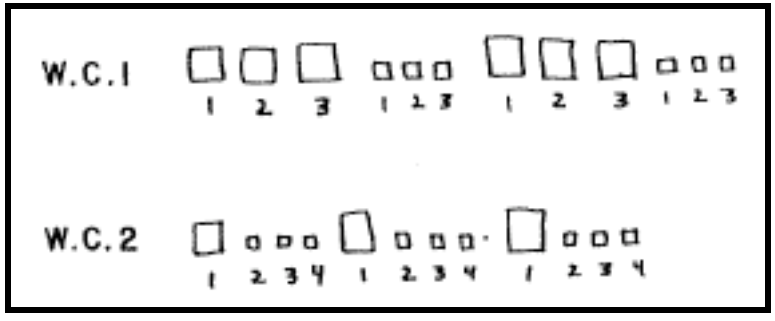


Figure 14: Wrong count drawings

The wrong count examples in Figure 14 provide explicit evidence for this claim. Notice that in both WC.1 and WC.2 drawings, events are clearly differentiated: there are large and small shapes, and also visual groupings. Grouping is reflected in the repeated patterns of shapes and also in the numbering, which is consistent with the graphic patterning. Most interesting, though, both examples include only a *single figure* that is repeated. Each child seems to have focused on finding *a possible figure* and then, as if holding on to it, repeats the same figure across the

page. In Example WC.1 we see a possible grouping of threes as in the beginning of F.2.b. However, if we assume that big and small shapes are longs and shorts, respectively, big and small shapes do not here reflect the given changes in pace. Rather, the child seems to apprehend that there *are* longs and shorts and there *are* groupings, but then, he or she uses the arrangement of these two kinds as if they were the total repertoire of possibilities. That is, he or she simply alternates groups of three bigs and groups of three smalls to form a picture of repeated figures. The WC.2 drawing shows repetition of a possible group of fours, as in the beginning of F.2.a'. But in this example the size of shapes does initially correspond to change in pace. (of course, the 4th event is actually a long, but as in the "class piece" examples, it is shown as a short because it is a shared member of a "faster" figure.) In their emergent but still unstable attention to change in pace and figural grouping, these children "grab" *a* figure, but this single figure comes to stand for the whole rhythm.

WC.1 and WC.2 drawings are additionally interesting from the view of transition because they share the principle of iteration with the earlier M.I drawings. In both types, an element is extracted and held constant, repeated the same across the page. But it is the difference in the nature of just what is taken as an "element" that is significant. In the M.1 drawings, there is a singular focus on each clap as an element; in contrast, there is a focus on the grouping of claps as an element in these transitional drawings. But significantly, in neither case do the children find a unit of measure, as Piaget puts It, a "mobIle unit that can [sub-

stitute] for any other event in the series." Instead of a temporal unit of measure (the beat), they have found a unit of apprehension--a flgure---removed *it* from its unique place in the temporal sequence, and treated it to iteration. Both M.I and these transitional drawings seem to reflect a struggle between *qualitative* experience on one hand, and the effort to externalize this experience in some *quantitative* way, on the other. [16]

These, then, are examples of the dialectical relation between actions and description: Reflection on *actions* leads to the graphic description; reflection on the *description* provides new information--information probably quite inaccessible except through a reflection process such as this. Olson's comments on the usefulness of writing to thinking about spoken language can be compared to the usefulness of description to thinking about our actions in performing rhythm patterns:

> *Writing systems provide the concepts and categories for thinking about the structure of spoken language rather than the reverse. Awareness of linguistic structure is a product of a writing system not a precondition for its development…. In each case the development of a functional way of communicating with visible marks was simultaneously, a discovery of the representable structures of speech* (Olson, 1994:76).

[16] Indeed, if we use the term *rhythm* as Piaget does--that is, *cyclic iteration,* -then we can see Type M.I drawings and these wrong-count drawings as an expressIon of different kinds of elements treated as "a rhythm." We could then look at the moves from Type 0 to M.I, to these repeated figural drawings, to M.3 drawings, as reflecting a change in focus on just what kind of element is thought to be "a rhythm"--a body motion in Type 0, the clap in M.I, a figure in WCI and WC2, and. the beat In M.3.

By way of summarizing the developmental moves and the distinctions between figural and metric strategies, it is useful to place the findings in the context of action and reflection on these actions. In the early F.I drawings we see, quite literally, reflection-*of*-action as these young children play-draw their actions on paper, leaving a trace behind that "holds still." But looking *at* the trace, reflecting *on* it, permits the children to see their actions in a single glance, to individuate them, and to see, in some sense, their "total time" compared, for example, with that of another figure.

Type F.2 drawings, as descriptions of a felt path, involve actions of reflection-in-action, or shaping a description on the spot. [12] That is, through reflection-*in*-action, boundaries are anticipated, and events are described only as members of a currently updated figure. In the second pass, assigning numbers that seem to fit, the children use their own graphics as a reflection of their felt path experience. They number every action, evaluating them situationally and qualitatively, again in terms of a present figure. In actively shaping a description, children focus sometimes on changes in pace ("these get faster") and sometimes on figural boundary functions, as each becomes salient. Reflection-in-action, then, could be said to result in drawings that show the means-end relations between figural and durational features as they are interactively experienced: changes in pace (means) are transparent to the results, namely the construction of figures (ends).

Type M.3 descriptions can be seen as reflection-*on*-action. Instead of actively anticipating figural boundaries, the children remove themselves

from their immediate, situational experience to construct and hold onto, through time, a recurring “mobile unit” (the beat) at a chosen level of the metric hierarchy. In addition, the regular interaction of beats at each level determines strong and weak beats and these, in turn, determine the *quantitative* value given to surface events. Performed events are thus reflectively evaluated with respect to their relationship to the metric hierarchy as fixed reference.

But this capacity to construct a unit, and with it, the capacity for measurement of durations (or as Piaget says, “the ‘arithmetization’ of time”), results in a description that obscures the figures that are such a powerful factor in performance and in apprehension. The two aspects of the rhythm--qualitative and quantitative--are *not,* as Piaget suggests, “fused into a single whole” in these metric descriptions. The two aspects remain separate and distinct features found *either* in figural *or* in metric descriptions.

It is only in relation to M.2 graphics that we see, in one picture, the two faces of the rhythm. The capacities made explicit in M.2 graphics, then, turn out to be those that facilitate passage between figural and metric relations. Classifying of durations serves as the means by which a child may move either to figural or metric ends. In this situation we seem to have *reflection-on-description.* As children reflect on their own M.2 graphic descriptions, they find in them either the possibility for constructing *metrically constrained figures* or the possibility for constructing *the metric grid*. In short, reflection-on-description results in multiple descriptions!

But it should be emphasized that what we are seeing in children's drawings at varying moments in their development and learning is the current state of the child's capacity to *describe* (i.e., to externalize some aspects of the phenomena while being inattentive or unable to descriptively access others); and, at times, it is the struggle between internal experience *(knowledge-in-action)* and its externalization that emerges. At the same time, the data lends credence to the notion that it is in the very nature of descriptions, and of symbolic representations in particular, to "undo," through consistent, "one-at-a-time" specificity of referent, dimensions that, in real time, are experienced all at once. Musical apprehension, then, might be described as the apprehension of figures, which only after-the-fact are describable as resulting from some particular discrete set of interacting features. If so, is description doomed to distort experience? And yet, it seems clear that the process of making descriptions results in reflection and in learning--for example, learning to attend to, to differentiate, and to classify properties; to compare events that are distanced in time and thus to remove them from their unique situational embedding.

> *Rather than viewing writing as the attempt to capture the existing knowledge of syntax, writing provided a model for speech, thereby making the language available for analysis into syntactic constituents, the primary ones being words which then became subjects of philosophical reflection as well as objects of definition. Words became things!...Writing thereby provides the model…for the*

> *introspective awareness of speech as composed of grammatical constituents, namely, words…. Ironically, learning to read is learning to hear speech in a new way.* Olson, 1994: 76, 85

But still, it is just the particularity of events that so characterizes the experience of even a simp!e rhythm and certainly a complex work of art. Perhaps it is the capacity to play with the tension between the *invariant* partIcularity of properties together with the *unique* particularity of their contextually embedded function that characterizes fully developed musical intelligence--that is, the fully apprehending listener-performer. This capacity to group in various ways, and to group these groupings so that each enriches the other, "learns" from the other, is what we have termed elsewhere, the *figural-formal transaction* (Bamberger and Schon, Note 1)

Educational Implications

These findings take on significance for education when we recognize that serious conflict between figural and metric descriptions occurs most often when we as observers pit one against the other and when this dispute takes a normative turn. For example, metric-formal descriptions are too easily considered to be the "right answer." Figural graphics and figural counting, in turn, are quite reasonably seen as "wrong" or certainly as "less adequate." Indeed, figural thinking accounts for a definable class of common errors that are prevalent among students who are learning to read standard rhythm notation (Bamberger, 1978, Note 2). But for

teachers of these students, the difficulties often remain a puzzle: “What’s the problem; it seems so obvious?”

It seems likely that the teachers’ bewilderment stems in large part from what I have called the *wipe-out phenomenon.* That is, once musician-teachers have internalized the rules of metric notation, they have also quite intuitively come to see and to hear rhythms in this way. Thus, when confronted with something that looks like a description/notation (e.g., a figural drawing), they are systematically inattentive to those features that do not match their internalized expectations. They simply cannot “see” the features that are guided by the rules of figural description any more than figural drawers can “see” in standard notation those features that are guided by the rules of metric description. Thus, on one hand, for teachers viewing a figural drawing, the intuitions associated with description are violated, and on the other, the intuitions associated with musical performance are thought to be inexpressible in a description. The relations found in figural descriptions remain, in effect, not there at all.

Musicians do use figural rules, but they are used tacitly. Figural rules are used, for example, in what we hear as “playing musically:” Actively shaping a phrase and the feelingful projection of coherence. But the figural rules that guide the construction of apprehended coherence and musical performance result in on-the- spot moves that, understandably, leave the rules mysterious, labeled “intuitive,” even valued as such. To examine the criteria that generate these valued intuitions, to describe them as rule-driven, even to talk about them, is

seen in some sense as immoral, embarrassing. Instead, if disputes do occur within this magical sphere of “intuitions,” each musician stands firm, saying, as if there were no more to say, “1 hear it that way,” or even “Well, that’s the way I feel it!”

The failure of educators to recognize and appreciate students’ efforts to describe their figural experience seems to be an instance of worlds that have become opaque to one another--one, mysterious, indescribable; the other, “objective” and uniformly expressible in a symbolic notation. As a result, potentially enlightening conflicts between the two are rarely confronted. Instead the disputes between figural and metric ways remain tacit barriers, especially to effective teaching.

Perhaps this is to be expected since, when ways of doing and seeing that have been opaque to one another become, for some reason, mutually transparent, restructuring of one’s trusted “intuitions” often occurs. With this restructuring come the moments of transition that, as we have seen in the drawings themselves, are associated with flux, confusion, and even the risk of temporary failure. But they are also the moments of most significant learning.

In fact, the findings in this study can themselves be seen as resulting from a kind of ongoing reflection-in-action; by revisiting the data, we found that the data could “speak back,” leading to a restructuring of intuitions associated with interpretation (see, for example, Bamberger, Note 5).

The ideas presented in the previous pages suggest that the focus in research and in teaching should turn to a better understanding of the

means through which we learn to integrate and thus to enrich both our powerful figural strategies and the equally important formal strategies and descriptions that we univocally associate with “adult” thinking. It would then seem important to design experimental situations in which to observe and rigorously describe the cognitive work involved in constructing such transactions. In turn, it follows that we should put more emphasis on the development of ways of teaching that will encourage children to reflectively but freely move back and forth between these ways of apprehending. Moreover, we should stimulate such reflection by encouraging individuals to risk confronting and making use of the inconsistencies and incongruence that often results from externalizing experience. For by inventing descriptions, we are sharing experiences that otherwise remain solitary and too often inaccessible to growth and change.

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