BRIDGES
Mathematical Connections
in Art, Music, and Science

Where's the BEAT? Discovering the Musical Rhythms and Accompanying Mathematical Patterns in Poetry

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Abstract

The rhythm of spoken language is the natural gateway to musical rhythm (Campbell and Scott-Kassner).[1] Stories in rhyme comprise an enormous resource in children's literature from which one can first extract the underlying pulse and musical rhythms, and then display the corresponding mathematical patterns using pattern blocks. From one source emerges a foundation for developing notational skill in three disciplines - language, music, and math - translating vocal, aural, and kinesthetic patterns into symbols.

1. Introduction

Humans do not arrive on the planet hard-wired with a biological mandate for acquisition of symbolic representational systems; numerous cultures in the world survive quite nicely without reading or writing. Though not a genetic imperative, it is, in many societies, not only culturally but also economically advantageous to achieve skill in literacy and numeracy.

Given these cultural mandates, a primary teacher concerns herself with biological possibilities. How do children best acquire the symbols of our culture? Is it feasible to deliver instruction in such a manner that symbolic language acquisition is enhanced? Is acquisition of concurrent symbolic languages more than a possibility, perhaps even a recommendation for effective instruction?

2. The Listening Foundation

Thomas Sticht showed in his 1970's research that *reading ability in non-deaf children cannot exceed listening ability*.[2] A child's ability to successfully navigate through text is directly related to the foundation of preceding aural activities. As a primary teacher, one assumes the awesome role of teaching children to read. Whether students are learning to read language, music, or mathematical symbols, the literacy cycle emanates outward from an inner core of listening in the areas of language and music, and from an inner core of visualizing in the area of mathematics (Figure 1). Generally, in all three disciplines, experiences that develop knowledge at the innermost level most often occur before the student moves to the outer levels. The understanding at each level carries forward to subsequent levels. It is neither forgotten nor superseded, melding into the next layer and becoming a part of it.

The earliest sounds one hears are in the womb. Our first understanding of ourselves occurs in the sense of touch, feeling and responding to stimuli in that warm, cushioned environment. From the pulse of her heartbeat and inflections of her voice, a mother provides the first sensory imprints to the growing eight-week-old fetus within her. It feels. It hears. It responds. If one subscribes to Kieran Egan's notion - "we are human beings before we are languaged human beings," then early teaching is most successful when it builds on "body" understanding, on awareness of one's self in time and space, on keen attention to sensory details in the surrounding environment.[3]

Young children, aged four to eight, seem captivated by the sounds of our language, especially the rollicking lines found in verse. They bounce to its beat, skip with its accents, twirl around on its

elongated sounds, dramatizing in large-motor fashion what they know instinctively to do. The music hiding in rhymes demands from them a whole-body response. Their movements not only illustrate the words, but, they also mirror the underlying pulse.

3. From Word Patterns to Rhythm Patterns

The language found in poetry is "tight," not unlike the performance of an accomplished jazz combo. Words that rhyme, create rhythm, and repeat carry a higher value, for their placement in the verse requires an exact fit. By utilizing poetry, primary teachers can reinforce two curricular areas: mathematics and language. In mathematics, they can use the built-in patterns overlaying the pulse. In language, they can use the compact nature of verse.

Most poetry, like music from the classical era, unfolds in phrase patterns of four or eight beats, either in simple or compound duple meter. Proper instruction shows children how to recognize the two levels of these phrase patterns. Feet take the "steady beat" assignment, as they shift back and forth, stepping left and right in time with the pulse. The rhythms of the words are, at first, only spoken, then spoken and clapped, where each clap matches a syllable. As one discovers each pattern - first with speech while walking the pulse, then with speech and clapping while walking the pulse - one feels the beats, silences, sub-divisions, and augmentations. Children soon become skilled at assigning time values to the long sounds, short sounds, and pauses - the same time values used in music notation to convey rhythm.

Pattern blocks, manipulatives in the regular geometric shapes of hexagons (quarters), trapezoids (two-eighths), and diamonds (eighth-note triplets), offer a concrete tool for "mapping" the time values found in a poem's words. For example, the words from *Breadtime*[4] go as follows:

Flour on my fingers	two-eighths	two-eighths	two-eighths	rest
Flour on my nose	two-eighths	two-eighths	quarter	rest
Flour on my apron	two-eighths	two-eighths	two-eighths	rest
Even on my toes.	two-eighths	two-eighths	quarter	rest

Children discover in speaking and clapping the rhythm of the words atop the pulse, of four for each line, that trapezoids best represent two claps per pulse. Trapezoids divide the hexagons in half. Thus "flo - ur" is represented by two blocks, trapezoids, which take up the same space as a hexagon, both aurally and kinesthetically. "Nose" can be represented by one block, a hexagon, because its clap of one matches the pulse. A variety of numeracy skills are reinforced here and readied for use in later mathematical problem solving, especially, but certainly not limited to, fractions and geometry.

When a child understands the inherent rhythm of a word pattern, through listening, chanting, reading and rehearsing it, he or she will naturally apply vocabulary knowledge and syllable knowledge to intuit new possibilities. Enhancement of literacy skills occurs as new words substitute for those of the original patterns. A child may transfer knowledge learned while building one pattern of a poem to similar patterns in the same poem or to new patterns in another poem. Youngsters operate with ease among these facts, organizing them and generalizing their traits and characteristics.

4. Whole-body Learning

Music is the only curricular area where whole-body learning is not only encouraged but also necessary. It is possible to enjoy and even appreciate music at the listening level. Few, though, can appreciate or derive meaning from music at the visual level, termed "audiation" by Edwin Gordon; staring at symbols in a music score causes most people visual anxiety.[5] Until there is audible music, words and/or melody across time concurrent with rhythms across time there is nothing to which to respond.

Once there is organization of sound our ears are activated, our humming or singing is activated, our toes "keep time" with the pulse, our arms swing, our hands clap, or our fingers drum the rhythm. Our entire bodies enveloped with sound respond across modalities. In a seemingly microscopic moment of time we experience an inclination to move. To do so requires more than listening skill, more than a visceral reaction. It requires an underlying knowledge of both melody and rhythm.

Langston Hughes said it well - *There is no rhythm in the world without movement first.*[6] Until there are at least two beats there is no forward progression of the pulse in time. One drum beat or one clap does not a rhythm make. Like the proverbial tree falling alone in the forest, a single beat has a meaningless existence unless neighboring beats join in to form a pattern. As a pattern is revealed one longs for it to proceed forward - to the next downbeat, the next cadence, or point of repose.

The rhythm, rhyme, and repetition of poetry provide a vehicle for acquisition of literacy and numeracy skills where the whole is worth more than the sum of its parts. In the process of dis-assembly, students grapple with a poem's metric structure, in both musical and mathematical terms. Next, in re-assembly, they distinguish among possible rhythmic interpretations of the words. Finally, in review, they articulate the individual merits and combined strengths of each curricular area traveled - from language to music to math and back again to language.

Jorge Bolanos' statement in *Chaos Theory* - "mathematics can be, and is, a powerful source of poetry" inverted to *poetry can be, and is, a powerful source of mathematics* furnishes a fitting summation.[7]

References

[1]Campbell, P.S. & Scott-Kassner, C. (1995). *Music in Childhood: From Preschool through the Elementary Grades*. New York, NY: Schirmer.

[2]Sticht, T.G. (1974). *Auding and Reading: A Developmental Model*. Alexandria, VA: Human Resources Research Org.

[3]Egan, K. (1997). *The Educated Mind: How Cognitive Tools Shape Our Understanding*. Chicago, IL: University of Chicago Press.

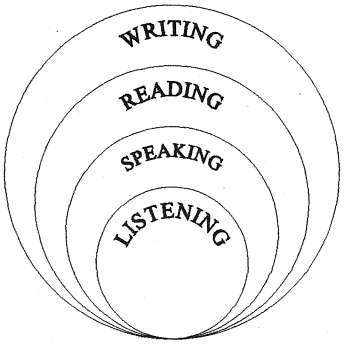
[4]McKay, T.G. "Breadtime." In *Ladybug*. November, 1996. Peru, IL: Carus Publishing Company.

[5]Gordon, E.E. (1987). *The Nature, Description, Measurement, and Evaluation of Music Aptitudes*. Chicago, IL: G.I.A. Publications, Inc.

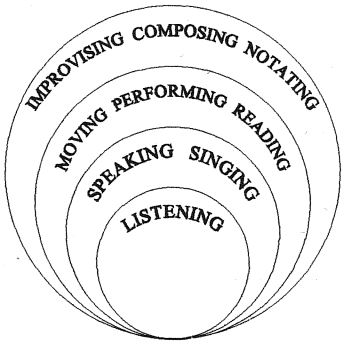
[6]Hughes, L. (1995-renewed). *The Book of Rhythms*. New York, NY: Oxford University Press.

[7]Bolanos, J.C. (1998). Chaos Theory and The Fall of the Aztec Empire. In Reza Sarhangi, (Ed.), *Bridges: Mathematical Connections in Art, Music, and Science*. Arkansas City, KS: Gilliland Printing.

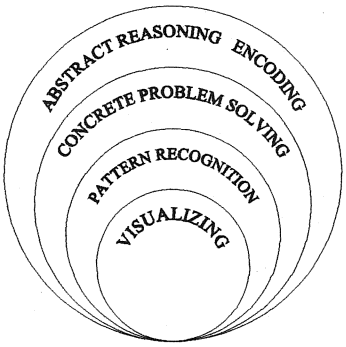
SYMBOLIC ACQUISITION COMPARISON



LITERACY CYCLE



MUSICAL LITERACY CYCLE



NUMERACY CYCLE

Figure 1 BFM 1999