

Music and Math: How Do We Make the Connection for Preschoolers?

by Karen Sawyers and Janet Hutson-Brandhagen

Music is organized in mathematical ways: its melodies, rhythms, and harmonies are built on recurring mathematical patterns and sequences. To children, music is play in every sense of the word. In addition, early experiences with music that are successful and fun prepare children to be successful in other areas of learning, particularly math.

Research suggests a connection between children's early music experiences and their math abilities. A 1994 study by Frances Rauscher, Gordon Shaw, and their colleagues measured the effects of music lessons on three year olds. They found that children who received voice and keyboard lessons scored between eight and ten points higher on IQ tests that measured spatial-temporal skills — important components of mathematical reasoning (Rauscher, 1995).

Another study conducted in 1998 by the same group of researchers followed preschool children who received piano keyboard lessons for six months. The children in the piano group showed impressive gains in their performance on spatial-temporal reasoning tasks. However, the children in control groups receiving other kinds of instruction (including a computer group) did not significantly improve. According to Temple Grandin, Matthew Peterson, and Gordon Shaw (1998), these findings suggest that math and science concepts that are difficult to teach can be acquired by children at an early age by using spatial-temporal reasoning in music

experiences. Such early music instruction can “enhance the ‘hardware’ in the brain for spatial-temporal reasoning” (p. 1).

These are just a few examples of evidence that music directly and consistently enhances mathematical thinking, particularly abstract reasoning skills, in young children. Educators and researchers who have tried to explain how music boosts children's math abilities suggest that it has to do both with the nature of music and the ways our brains are organized. “What is it about music that seems to jump-start our brains, especially when it comes to math-related subjects? Experts say that maybe it is because music never stands still. Whether you are playing an instrument or listening to the radio, you are constantly being challenged to process and make sense of the tune and rhythm,” says Cynthia Allegrezza (1999, p. 2).

Neuroscientists and psychologists who have authored studies on music and the mind believe that this intellectual response to music is inborn. Even at infancy, the brain is specifically wired to receive, process, and learn from the highly ordered patterns of sound in music. According to Eric Jensen (1995), “Many preschool teachers would agree that songs, movement, and games are superb neurological exercises. Dee Coulter, director of Cognitive Studies at Naropa Institute in Boulder, Colorado believes strongly in the relationship between patterns found in music and those necessary for proper neurological development. She's found that the combination of auditory and kinesthetic stimuli and teaching approaches make for strong development in language, social skills, self-management, and internal dialogue” (p. 42).

Math and Music: What Teachers Can Do

As research reacquaints us with the many benefits of music, we need to be careful not to take music instruction too far



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with preschoolers. As early childhood educators we know how important it is to meet the children where they are and support them through age-appropriate learning experiences. We should avoid teaching children the fundamentals of music in an overly formal way. Instead, we should provide opportunities for children to explore the world of music in their own way and in their own time. It's important to keep this principle in mind as we set up our classrooms and plan for music activities in the daily routine.

To set the stage for music learning, each classroom needs a music area where there are rhythm instruments such as tambourines, jingle bells, drums, and maracas, and melodic instruments such as melody bells, step bells, and xylophones. Children need opportunities to use these instruments during times of day when they initiate their own activities (such as work time, choice time, or play time) as well as during teacher-planned small- and large-group times.

As we work with children throughout the day there are many music activities that we can provide to develop the music-math connection in very natural ways. The next section of this article describes music and movement experiences that strengthen the following important areas of mathematical thinking for preschoolers: number, classification, seriation, time, and memory skills.

Classification, Number, and Seriation

As preschoolers sort materials into groups and collections, they are using **classification**, the process of grouping things by similarities and differences. Children also work with classification in music experiences, because parts of music are grouped by similarities. According to educational researcher Ann Epstein (2003a & 2003b), the concept of **number** develops as children classify objects and experiences, so children are building math-related thinking as they notice and respond to similarities and differences in the context of music.

Epstein says another important foundation for children's understanding of number is awareness of **one-to-one correspondence**. This concept develops as children match objects one to one, for example, one cookie for each person or one block for each car in a toy train. This concept can also be explored through experiences with steady beats in music, rhymes, and songs. In beat activities, children experience the rhythms of the words or songs while patting, tapping, or

walking to the steady beat, thus matching their pats or steps one to one with the beat. Children become accurate with steady beat after many such experiences. According to movement and music educator Phyllis Weikart, steady beat activities are an important way for children to form cognitive-motor links, connections between children's thinking and their physical abilities. "Steady beat experiences involve movement that is performed in a steady way to a rhyme, chant or song, or to instrumental music. The goal is for children to feel the steady beat under the rhythm of the words or melody. Steady beat is the 'glue' or organizer of rhythm" (2003, November/December, p. 3).

Another way to help children form a cognitive-motor link for the concept of one-to-one correspondence is to use what Weikart calls "Learner Say & Do." In this process, a child chants a word and simultaneously performs a related movement. For example, a child who is marching says the word "march" every time each foot touches the floor. Say & Do means that children say the words that define their actions (Say) and then match the movement to the words (Do).

Seriation, the ability to arrange things in series or patterns, is another foundation ability for math that is developing in the preschool years (Epstein, 2003). Music activities in which children arrange patterns of music and then represent that pattern or sequence with movement enhance children's seriation abilities. Arranging patterns can be done as a whole-body experience. We suggest using a recording of an instrumental song that has three sections (ABC form), such as "Zigueunderpolka" (Weikart, 2003b). Have the children find places on their body (shoulders, knees, etc.) that they can pat in a silent, steady beat using both hands at the same time. Ask for a volunteer to choose where to pat. For instance, Alanna may choose "shoulders." As she pats, the group joins her in patting the beat, repeating the word "shoulders." Ask the children to recall where Alanna patted and do "shoulders" eight times (each section is 16 beats) and then the second movement (for example, "head") eight times. Ask for one more choice and repeat the process. Add the instrumental music, and with the children, carry out the movements to the steady beat for each section of the music.

Teachers can also use recorded music to provide opportunities for children to build their own movement sequences. First, ask child leaders to choose a part of their body — for example, Masahiro chooses "chin," Tatiana chooses "tummy." The group practices this sequence

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of “chin, tummy,” using Learner Say & Do as an aid to memory. Next, children create another sequence — Terrell chooses “knees” and Isabella chooses “head” — and the group practices this sequence with everyone saying the part they are patting. Finally, ask children to recall the first sequence (“What is Masahiro and Tatiana’s sequence?”), then the second sequence. They then put the two sequences together to create a four-part sequence. The children use Learner Say & Do throughout the whole sequence, saying “Chin, tummy, knees, head” as they pat each part of the body.

Activities in which children represent vocal or instrumental sounds with movement are another way to involve children both with classification and seriation. Music is very abstract for young children; but by encouraging them to represent sounds with movement, we bring to life what the voice or instruments are doing. Have children explore making sounds with simple instruments, then ask them to move like each instrument sounds. Once they have explored the instruments and moved like their sounds, they can use classification to sort the instruments by how they are played, the sounds they make, or the materials they are made of, such as metal, wood, or plastic. Have the children use seriation by arranging the instruments from small to large, or according to the sounds they make (for example, from softer sounds to louder sounds, from low pitch to high pitch). This activity can also be done with “found sounds” — using objects that make interesting sounds but are not real instruments, such as bubble wrap; plastic bags; pans, bowls, and other kitchen implements; and plastic bottles filled with rice, beans, or rocks.

Time

As well as engaging children in noticing and creating patterns, activities in which children work with sequences of movement are also opportunities for children to anticipate, remember, and describe sequences of events. Such experiences contribute to children’s developing understanding of **time** and strengthen reasoning skills used in math (Epstein, 2003). Action songs engage children in working with sequences. For example, sing “Old MacDonald” and ask the children to recall how many animals they sang about. Have the children try to recall them in the order used in the song. For preschoolers we suggest using only a few animals in each song.

Starting and stopping is another important experience that helps the young child understand time and that can be used to develop the music-math connection (Epstein, 2003). Have

the children start walking to the beat of a song that you are about to sing, such as “We Walk Our Feet” (Weikart, 2003a, pp. 106-7). Then begin to sing the song and incorporate a suggestion to stop at an appropriate point in the song. (“We Walk Our Feet” ends with “And then we stop.”) Ask children to listen for the “stop” and to stop moving then. You can also do this with familiar songs, asking children to stop their movement at the end of the song.

Experiences with **changes in rate or speed** are another way to expand children’s understanding of time and promote music-math connections. Have the children pat or step to a song you are singing. Then have them step or pat a little faster or a little slower and respond to them by singing the song in that tempo. Talk about how they changed their movement and the song.

Memory Skills

Memorization is a general cognitive skill that comes to play in math, and that can be enhanced through music and movement activities. Singing songs builds children’s memory of their melodies and lyrics. Music is also a tool for memorization — most everyone has learned the numbers 1 to 10 and their ABCs by singing them. According to researcher J. Glausuisz listening to and singing music engages “many highly complex brain functions that are necessary for memory, word sequence, and visualization. Music often has a rhythmic or rhyming quality, making it easier to remember. It is of course, sequenced, which encourages us to try to recall songs we like, thus engaging memory” (quoted in Jensen, 1995, p. 36). Glausuisz says this is probably one of the reasons that learning about music improves children’s spatial-temporal reasoning and proportional math skills.

As educators you know that working with children in the early childhood classroom builds the foundation for the rest of their lives. When you encourage children to explore the world of music and movement, you are developing the thinking skills and fundamental concepts they will later use in learning math.

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Using Beginnings Workshop to Train Teachers by Kay Albrecht

I know! Knowledge often precedes action when it comes to applying worthwhile experiences in the classroom. This topic may be one of those. Plan to spend some time building "knowledge" with your staff as you consider all of the strong evidence of the importance of musical experiences to mathematical understanding. Then, divide teachers into small groups, assigning each an activity to practice and perfect. Complete this session with performances by each group. You can be sure the application of this content will be applied — as soon as the next day!