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Learning from Students, Learning from Music: Cognitive Development in Early Childhood Reflected through Musical-Perceptual Tasks

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Abstract

The purpose of this study was to investigate young children's perception of melodic construction in hope of finding clues about their broader cognitive development in non-musical domains. Following Jeanne Bamberger's example of musical-perceptual tasks with Montessori bells, four children aged three to six were presented with a melodic construction task and asked to create a representation of their work. Analysis of data revealed common themes with varied results of (a) eagerness or hesitancy to participate, (b) whether bells were moved or played, (c) exploration of bells, (d) internalization of rhythm, (e) cognitive readiness for melodic construction, and (f) role of visual representation. No cross-case findings could be drawn about broader cognitive development, however specific characteristics of the children and their approach to the melodic construction task are presented. Recommendations for further study center on potential clues a melodic construction task could provide about language construction in individual children.

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Contemporary media proclaims that music may have remarkable side effects on young children, reflecting a widespread belief concerning the peripheral benefits of music education. The Early Childhood Music Summit (MENC, 2000) compiled many of the long-term benefits of music for young children: (a) music is a significant mode of communication for infants; (b) music helps develop cognitive skills like memory, language, reasoning, logic, and arithmetic; (c) music creates important contexts for life skills like cooperating, collaboration and group effort; and (d) music develops rudiments of an aesthetic sense; and music contributes to 'school readiness'. Clearly, music creates highly desirable *extrinsic* benefits. Yet, when music is only a means to an end, its value diminishes and music remains vulnerable on the totem pole of financial priority. The Early Childhood Music Summit appealed to music educators, asking them to advocate for the *intrinsic* qualities of music as an educational focus during early childhood (MENC, 2000).

This shift of focus could alter the value of music education, replacing its current role of enrichment with a new role of direct influence on extra-musical cognitive development. The body of traditional research in music education reveals general knowledge about the musical development of children and its eventual contribution to growth in other content areas. Could qualitative, observational research provide immediate clues about the broader cognitive development of young children? The purpose of this study was to investigate my students' perception of melodic construction in hope of finding clues about their broader cognitive development in non-musical domains.

Literature Review

Jean Piaget proposed that children organize their experiences into generalized,

repeatable responses to environmental stimuli called *schema.* Children integrate new experiences through assimilation and accommodation, thereby maintaining *equilibrium.* Environmental interactions that can be neither assimilated nor accommodated cause *disequilibrium,* which acts as an interim between the current cognitive state and the next higher level of functioning (Buttram, 1996).

Developmental Music Cognition

A great deal of theory and traditional research has accumulated since Piaget's theory of cognitive development, advancing our understanding of musical-cognitive development. However, educators have not always practically applied this knowledge. Hargreaves (1986b) faults both music teachers and researchers, for though teachers may fail to incorporate research results into curriculum, researchers often fail to ask relevant questions teachers can use.

Bamberger (1979) argues traditional academic research rarely holds relevance in the classroom, because what happens when we *do* music gets lost when we *teach* music. As a result, she believes teaching should inform research and not the other way around. According to Bamberger, teachers are in a better position to identify and understand the musically relevant puzzles encountered in the classroom, and although traditional research provides objective results, subjectivity is actually desired in the field of education. Bamberger (1991) argues that research and teaching should be reciprocal, and though interventions are traditionally excluded from experimental situations, 'teaching experiments' incorporate intervention as a fundamental part of the experimental process. These interventions may be planned or improvised on a hunch, either to help maintain a student's interaction with the material or to test a running hypothesis. This allows

continuous ‘reflection-in-action’, rather than a traditional ‘stop-and-think’ (Bamberger, 1991).

Teachers must be willing to take certain cognitive risks involving incongruence between formal knowledge and intuitive knowledge (Bamberger, 1979). This, according to Piaget, is what happens during significant learning. Bamberger (1979) argues that the *teacher* is the one who should be doing the significant learning, especially during these teaching experiments. For instance, when a student responds to an activity in a puzzling way, it is not the student who must learn the correct response; it is the teacher who must form and test hunches about the mismatch between student and teacher assumptions. Bamberger (1994) implores teachers to see children’s so-called ‘wrong answers’ for the creativity and cognitive work they usually represent, which requires teachers to accept children’s formal *and* informal ways of knowing (Bamberger, 1979).

Bamberger (1991, 1994) also advocates using children’s descriptions as crucial evidence for understanding a child’s musical development. In Bamberger’s (1991) experiments with Montessori bells, children are asked not only to build a melody, but also to make instructions for someone else to play the melody. This type of response is specifically designed to produce a broader scope of children’s cognitive abilities. Bamberger (1994) also draws on children’s verbal descriptions, drawings, and spatial ordering of the bells as possible ways to externally reveal the private and internal nature of inner hearing, approximating a more genuine understanding of musical development (Bamberger, 1991; Bamberger, 1994; Hargreaves, 1986).

Implications for Music Education

Parents and educators are widely interested in the relationship between music

education and growth in outside content areas, especially when considering the relationship between nurturing musical cognitive abilities and growth in general cognitive abilities. Bamberger (1991) calls on teaching experiments and children's descriptions to uncover the global implications of music-specific tasks. Bamberger's teaching experiments reveal a tension between intuitive and formal dimensions. Children's descriptions during the experiments reveal their capacity for their ability to shift between multiple dimensions of understanding, and their tendency to isolate these dimensions. As they develop, children coordinate the dimensions by creating different mental settings, assigning meaning to elements within each setting, addressing the disequilibrium, and eventually moving toward non-contextual classification (Bamberger, 1991). This progress towards cognitive sophistication, Bamberger (1979) argues, is not music-specific; other content areas also require mediation between intuitive and formal knowledge.

Consider, for example, the problem of teaching materials and their frequent inability to truthfully reflect student knowledge. Bamberger (1979) addresses this issue, citing the assumption that mastery of materials equals a mastery of skill. Using music notation as an example, Bamberger argues that materials carry an assumption that a particular system is *the* system; often, a competence with the favored system implies a competence in the domain or even *knowledge* of the domain. Bamberger describes these systems, like music notation, as 'closed-system vocabularies', and contests the notion that only the 'privileged system' is worthwhile teaching material. Bamberger (1991, 1994) believes both formal *and* intuitive dimensions play a crucial role in musical development.

How can we help students coordinate multiple dimensions of cognition when we can't access their individual ways of knowing? Bamberger (1979) suggests music as an

ideal place to start, because music plays a special role as a non-threatening and nearly universal domain. Language and music are both governed by formal and intuitive dimensions, but Bamberger (1979) argues most people are unencumbered by the formal descriptions in music and are tuned in to those invisible 'rules' that characterize music. In language and music, we can learn these rules through formal knowledge or through intuitive knowledge, yet the rules remain consistently present.

Similar comparisons could be made for any content area in which children struggle to coordinate formal understanding with their own intuition. Bamberger encourages educators to use teaching experiments in music to stay attentive to intuitive knowledge, to reflect on knowledge-in-action in an attempt to discover the knowing *behind* the actions, and to accept mistakes as a source of learning. She hopes observing student interaction with music activities will improve understanding about student work across all content areas, which might aid in the design of subsequent 'learning systems' more appropriately matched to students' natural intuition (Bamberger, 1979).

In the spirit of understanding students' intuitive understanding, the purpose of this study was to investigate the perception of melodic construction in hope of finding clues about young children's broader cognitive development in non-musical domains. Specific questions guiding this research were: (a) In what ways do young children approach solving a melodic construction task? and (b) What can be learned about the cognitive development of young children through observing their approach to a melodic construction task?

Method

Participants and Context

The study took place in the Montessori school where I teach music. The tuition-based school serves between 90 and 100 boys and girls ages 2 to 12; students participate in group music classes for 30 minutes twice per week. After I received approval for using human subjects from the Augustana review board, four children from the Pre-Primary class, children aged three to six, participated in the six-week study.

I created a set of pentatonic bells modeled after the Montessori bells in Bamberger's study. Like Bamberger, I chose the Montessori bells because they are easy to play and do not require mallets, and they are all the same size and color regardless of pitch. Since children quickly learn to associate visual characteristics with different sounds, using bells of near identical appearance minimized visual input to the melodic construction task.

Procedure

At the start of the study, I taught the children two short, unfamiliar melodies in the month prior to the melody bell task, during large-group time using Eric Carle's (Carle, 1986) book, Papa, Please Get the Moon for Me. In this book, the following two phrases appear: "up and up he climbed" and "down and down he climbed." Using these phrases, I created an ascending pentatonic melody beginning on middle C and a descending pentatonic melody ending on middle C. The children sang these melodies as the text appeared in the book, and they added vertical upwards and downwards motions first with their arms and eventually with their entire bodies.

After five weeks of reading the story and practicing the melodies, each child came into the hallway with me and sat down at a small table with the five black bells, organized in a random, nonlinear grouping. I asked if the child knew what the bells were, and if the

child knew how to play the bells. Next, I introduced the task by singing the "up and up he climbed" melody together with each participant. Then, I gestured to the group of bells and invited the child to make that melody with the bells by playing them and moving them around. At this point, each child individually worked with the bells for a short amount of time, between five and ten minutes. At the end of this time, I provided paper and crayons and asked each child to write down the song so that another person could come along and play the bells in the same way.

Similar to Bamberger, the melody bell task was reciprocal in nature, so each child had a unique experience depending on his or her interaction with the activity. During each child's encounter with the bells, I took observational notes and videotaped each session. To prepare the data for analysis, I transcribed the videotapes and thoroughly read my observations. I examined my observational notes and transcriptions for each child within the context of my research questions, considering comparisons to both the literature and my observations of the children in the study. I consulted the video data where confirmation was needed to corroborate or disconfirm the notes I made as the teacher-participant during the melodic construction task.

This study rejected a positivist paradigm in favor of a naturalist paradigm (Guba & Lincoln, 1985), which implicates the type of qualitative study Creswell (2007) describes as seeking patterns while maintaining sensitivity to students within their natural learning environment. In accordance with this paradigm, design of the melodic construction task was emergent, analysis of the data was inductive and participant-specific, and discussion of the findings was interpretive, intentionally including the perspective of participants as well as that of the researcher (Creswell 2007). Rather than observing a generalizable

representation of the human experience, the analyses here involved four particular case studies within a ‘single bounded system‘ (Merriam, 2009).

Following is an account of each child’s approach to the melody bell task and the themes that arose from my subsequent analysis across each child’s experience with the task.

Children’s Approaches to the Melodic Construction Task

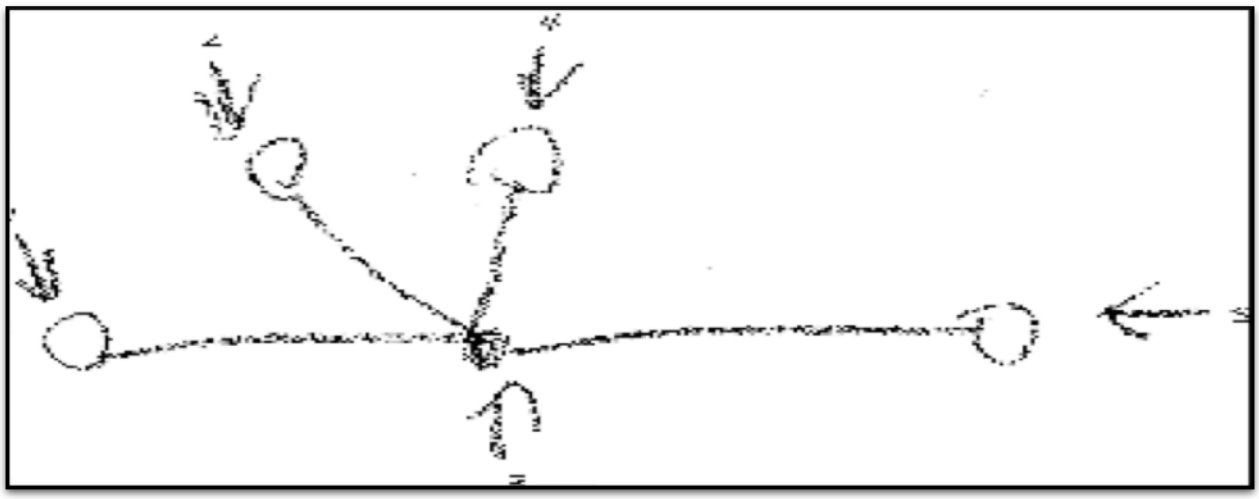
Amy, age four

Amy played the bells immediately, though she did not at first move the bells from their positions. We sang the Up melody together and I asked Amy to try to make the bells “sing” the melody. Amy sang the words from the melody to the tune of the bells as she played them; in this way, she played the bells in sequences of five, including each bell one time in each sequence. She tried moving the bells into a line, but she seemed happiest when the bells were farther apart. Amy said, “This is tricky” and she used a great deal of repetition to gain information about the bells.

Amy did not seem engaged with the task, so at my suggestion she created her own melody. I asked Amy to make instructions for her melody so that someone else could come along and play it. Amy tried to ‘spell’ the melody using letters, and when I asked what the letters meant, Amy said, “I don’t know” and she withdrew from the task.

To help keep Amy involved, I asked her to play her song again. Amy played the melody six times, then she played a variation of the melody, and then she played the original melody again. Amy did all of this repetition and variation on her own, and she seemed much more interested in experimenting with the bells than with writing anything down.

Amy eventually decided to focus again on her drawing (see Figure 1), and asked if the drawing was okay. I suggested Amy think about the drawing as though *I* would be the one playing from her drawing. Once I said this, Amy changed her drawing strategy from letters to pictures. She drew the five bells and drew arrows to them in the order I should play them. Amy helped me write the numbers one through five next to the pictures of the bells in the order she desired. Then, I played her melody from her drawing, and she



smiled.

Figure 1: Amy's representation.

Kathy, age six

Kathy was very hesitant while sitting at the table. She moved the bells without playing them first and looked to me for approval before and after almost every interaction she had with the bells.

After we sang the Up melody, Kathy moved the bells into a horizontal line and played each bell in order beginning at the left. Then she sat without speaking until I asked her if she thought she had solved the problem; she nodded 'yes'. Though Kathy had not actually created the Up melody, I decided to move on and I asked her to try the Down

melody. Kathy did not move the bells, but instead she immediately played each bell in order beginning at the *right*. After hearing this, Kathy showed incongruence on her face.

Kathy began to rearrange the bells, but she again moved the bells without playing them first. After the bells were in place, Kathy played them beginning at the right side and smiled: it was the Down melody! Since Kathy's previous actions led me to believe she understood the connection between the Up and Down melody, I asked Kathy to try the Up melody. Yet, instead of playing the bells beginning at the left instead of the right, Kathy moved the bells and *then* played the bells beginning at the left. Kathy could hear this was not correct, so she moved the bells back to their previous positions and played the Down melody again, beginning at the right.

Since Kathy showed interest in the task but still struggled with it, I wondered how she might respond to constructing a more simple three-pitch melody. Kathy and her classmates were familiar with a song and book called "Today is Monday" (Carle, 1993) from a unit of lessons that was taught earlier in the school year, and the last phrase of this song contains the words "come and eat it up," sung to the pitches *mi-mi-re-re-do*. I suggested we try the task with the Come and Eat melody instead and I showed her how we could use the same vertical up and down motion of our hands to sing this melody. Kathy and I sang this phrase together several times, and she told me she remembered the song.

I asked Kathy to try to make the bells sing the song, and she used the same strategy she used to create the Up and Down melodies: she played each bell one time. I gave Kathy the hint that this new melody only needed three bells, so Kathy chose two bells and removed them from her workspace. She could not get the three remaining bells to create the melody, so she tried a different combination of three. As Kathy tried different

combinations, she began to exhibit frustration, and she eventually lost interest in the task. Even when Kathy came across the correct combination of bells, she continued to rearrange the bells without indicating that she recognized the combination.

This reaction puzzled me until I noticed in the video that throughout all of these attempts, Kathy continued to play each bell one time, even though she sang the rhythm of the melody with five rhythmic units. Finally, I played the melody for her using the correct rhythm and, all of a sudden, she was happy with the result. I asked Kathy to make instructions for her melody so that someone else could come along and play it, but after a few minutes of sitting and staring at the blank page, Kathy decided she would rather go back into the classroom.

Megan, age five

Megan was very eager to play the bells. We sang the Up melody together, and Megan tried right away to make the bells "sing" the melody. Megan played the bells without moving them, and when I told her she *could* move them, Megan literally moved the bells up and down *as* she played them, evoking the tone by slamming the bells against the table and returning them to their original position. Megan then began to test pairs of bells against each other by playing them back and forth several times. Then Megan tested individual bells, playing each one several times before moving on to the next.

I sang the Up melody again to remind Megan what her task was, and Megan attempted to play the melody by replicating its rhythm using one bell at a time. Then Megan attempted to play the melody by replicating its rhythm using two bells at a time and switching back and forth between them. She repeated this strategy switching back and forth between three bells. Then Megan began to play the rhythm on two bells

simultaneously, and then she switched between two simultaneous bells and one solo bell. Finally, Megan tried playing each bell one time to create a five-pitch melody, and she seemed satisfied with this structure.

Megan continued to play the bells one at a time, but she began to try different sequences. When one sequence would fail, Megan would attempt closely related sequences, such as playing a melody retrograde. During this time, the bells remained in their original formation. Then, Megan remembered my suggestion about moving the bells and she arranged them into a vertical line. Megan played the bells up the line and then down the line. She described this as being like
the vertical up and down motion of her hands when she sings the song.

At this point Megan decided to move the bells into a horizontal line, but she moved them without changing the actual order of the bells. I asked Megan how she knew which side to start on, and she said, “Well, sometimes, I, like, go like this [Megan played the bells from left to right] and then like this [Megan played the bells from right to left].” Megan continued to play her melody back and forth without being prompted. It seemed as though she was testing it out, but she did not change the order of the bells from this last configuration.

Throughout this entire process, Megan never once played the bells in the correct ascending or descending order of the Up or Down melodies. Still, Megan seemed content with the order she had created, so I asked Megan to make instructions for her melody so that someone else could come along and play it (see Figure 2).

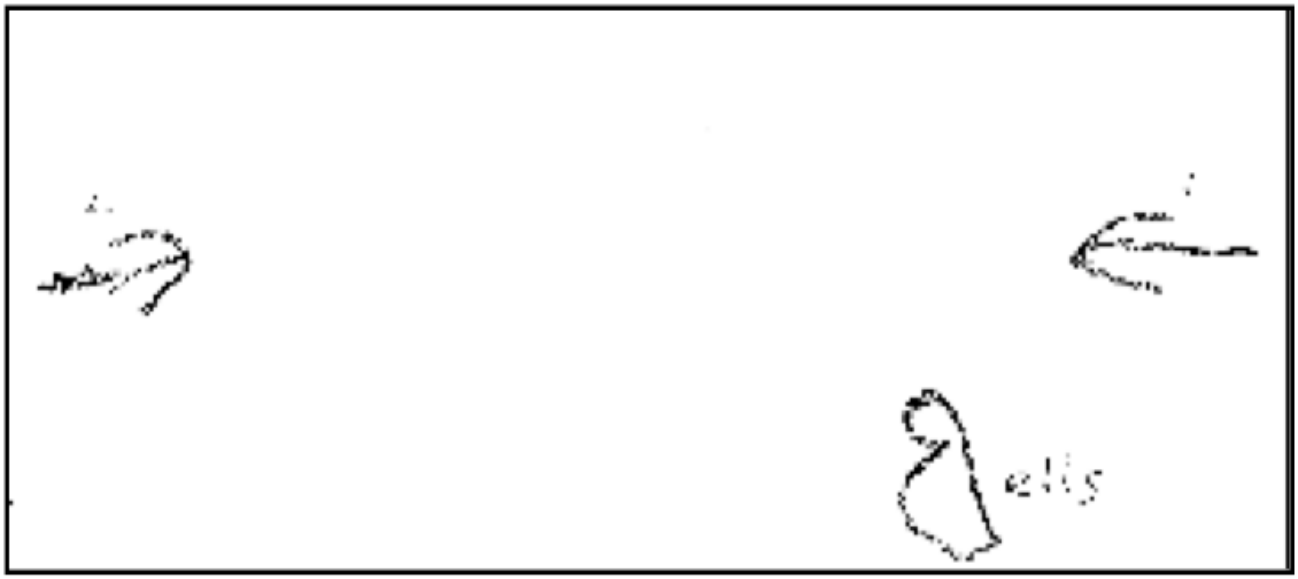


Figure 2: Megan's representation.

At first, she drew only two arrows, but I told her if someone else were going to look at her drawing, they might not know what the arrows meant. Megan decided to write the word 'bells' on the drawing to clarify the meaning of the arrangement.

Claire, age three

Claire was the youngest participant, and she responded to the activity with much more confusion than the other children. After we sang the five-pitch Up melody, Claire tried her best to do what I asked, and she arrhythmically played each bell one time but then was not quite sure what to do. I suggested we try the three-pitch Come and Eat melody instead; however, even after removing the unused bells, the shorter melody still seemed to confuse Claire. After several attempts to explain the task in a different way, Claire became distracted and began to tell me stories, so I decided to change the task.

First, I played the Come and Eat melody and asked Claire imitate me. Claire was successful at this and seemed to gain interest. I asked Claire to make up her own melody, and she played a few bells. I asked her to repeat the melody, and she played a new

combination of bells. Eventually Claire came up with a melody that used all five bells, and she was able to repeat that melody consistently. Then I asked Claire to make instructions for her melody so that someone else could come along and play it.

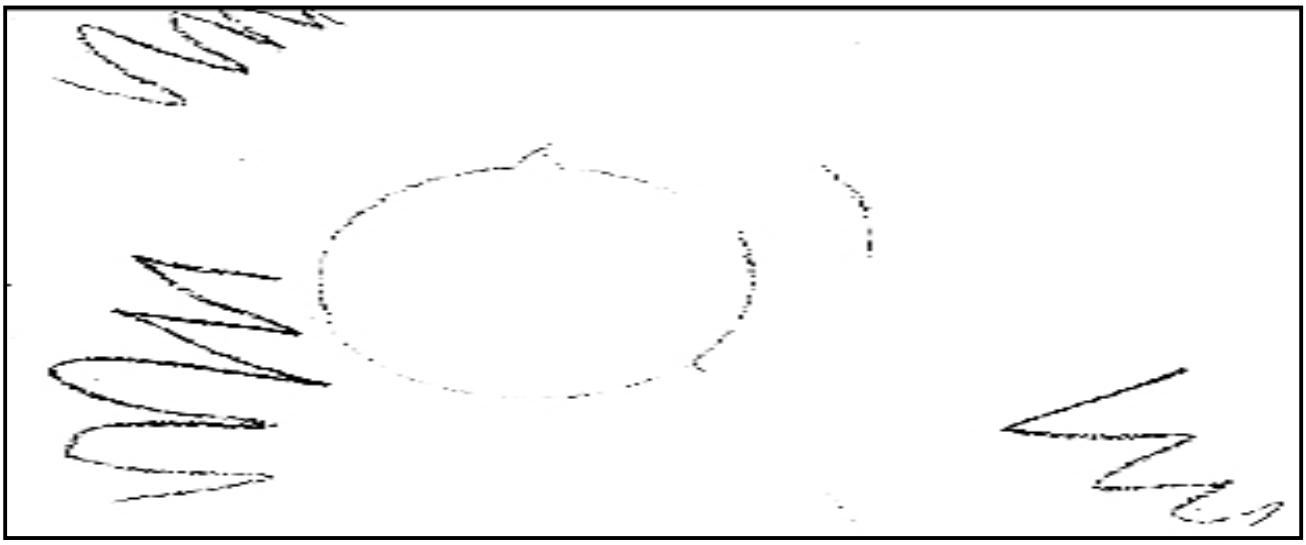


Figure 3: Claire's representation.

Claire took me quite literally as she picked up a bell, placed it on the paper, and started tracing it with her crayon (see Figure 3).

Discussion

Limitations

As Bamberger (1991) models, in order for teaching experiments to be directly applicable, they should be conducted within a preexisting teacher student relationship. For this reason, I designed my own teaching experiment with current students who know me as their music teacher. However, outside of this study, I teach students in groups, and the design of this particular study required interaction with *individual* students. As a result, the preexisting teacher student relationship was partly compromised, and the context of the experiment may have limited the study.

Interpretation of Musical Understanding

The analysis of data revealed themes of: (a) eagerness or hesitancy to participate, (b) whether bells were moved or played, (c) exploration of bells, (d) internalization of rhythm, (e) cognitive readiness for melodic construction, and (f) role of visual representation.

Eagerness to participate varied as some children acted shyly and others did not. A spectrum of eagerness emerged, spanning one participant (Amy) who played the bells without being asked, two participants (Megan and Claire) who played the bells after being invited, and one participant (Kathy) who needed an invitation and a demonstration to play the bells at the outset, plus encouragement to continue playing the bells throughout the task. Physical interaction with the bells also varied with regard to formation. Again, individual responses emerged ranging from one participant (Amy) who moved the bells but kept them clumped, to another participant (Megan) who used a clump and several lines, to a third participant (Kathy) who used a only horizontal line. The fourth participant (Claire) did not move the bells even after being given permission.

Both eagerness and physical interaction with the bells seemed to vary according to personality rather than cognition, as did each participant's first exploration of the bells. At first, Amy played the bells without moving them, Kathy moved the bells without playing them, Megan slammed the bells onto the table to create sound, and Claire played each bell once and then stopped. Kratus defined this exploration as the first stage of musical creation in which children engage in the motor movements of an instrument to discover what sounds they cause (Kratus, 2005). If the children in this study had more time and experience manipulating the mechanism of the bells, the next stage of creating and

recognizing meaningful patterns (Kratus, 2005) may have emerged.

One theme that did seem to reflect cognitive development was internalizing the rhythm. The data show that three of four children either sang or spoke the text to achieve rhythmic accuracy during attempts at constructing the melody. This held true regardless of how many individual pitches participants included in the five-note sequence. The only child who did not internalize the rhythm of the text (Claire) was the only child who did not make progress in constructing the melody. For three of four participants in this study, the recognition of rhythm served as a prerequisite for recognizing melody, confirming elements of hierarchical song learning theory (Updegraff, Heileger & Learned, 1938; Moog, 1976; Petzold, 1966).

Each child's interest in the task also seemed to reveal cognitive development, as some children were intent on building the target melody while others were more inclined to create their own melody. The data show that three of the four children seemed confused or at best disinterested by the melody bell task. The only child who seemed interested in the actual given task (Kathy) was six years old. This finding is supported by the conclusion that, by age five, children begin to acquire a concept of tonality (Bartlett & Dowling, 1980), and that, tonality strengthens around age six or seven (Zenatti, 1969; Bartlett & Dowling, 1980; Imberty, 1969; Riley, McKee & Hadley, 1964; Riley, McKee, Bell & Schwartz, 1967). No child in this study related the words of the song (Up and up he climbed or Down and down he climbed) to the ascending or descending pitches of the pentatonic scale. This finding is substantiated by research suggesting that children in first grade have difficulty applying language descriptions like 'up' and 'down' to their knowledge of pitch direction (Pflederer & Sechrest, 1968; Pflederer-Zimmerman, &

Sechrest, 1970; Hair, 1977).

Kathy showed interest in the task, yet she demonstrated behaviors that suggested that she was struggling with it. Although Kathy could recognize instances of the melody she was seeking to play on the bells, she seemed unable to intentionally create the desired phrases. Kathy's current cognitive state kept her from succeeding at this task, but her struggle, or disequilibrium, foreshadowed a higher level of functioning (Buttram, 1996).

The importance of this observation comes from noticing a lack of struggle on the part of every other child. Amy and Claire (ages four and three, respectively) lost interest in the task very quickly and decided instead to create their own melodies. Even Megan (age five), who appeared to be searching diligently for the ascending and descending melodies, turned out in the end to settle on a melody of her own creation. Kathy (age six) was the only child who struggled, but she was also the only child who demonstrated the ability to recognize the given melody. The other children appeared to be unable to engage in the task; therefore, there was no reason for them to struggle. Difficulty with a task is likely a sign, not of inability, but of cognitive readiness (Bamberger, 2002).

The children also created visual evidence of their cognitive process in this task by creating instructions for performing their melodic product. Two of four children (Amy and Megan) used numbers, letters, or words to represent the bells, and arrows to indicate an order for playing them. As Bamberger modeled, this response to the melodic construction task approached a more genuine understanding of internal cognitive processes (Bamberger, 1991; Bamberger, 1994; Hargreaves, 1986). Each child uniquely adapted the task: Amy's notation was for an invented melody, and Megan created instructions for her attempt at the melodic construction task. In addition, one child (Claire) used the

opportunity to trace a bell on her paper, and another (Kathy) declined to create instructions altogether. The notation of musical sounds is thus a distinct musical behavior that can include drawing the source of the sound, using abstract symbols, and grouping or pattern-making.

Discussion

This task may give insight into the development of melodic cognitive processing for each child, but how does that translate to the development of cognitive processing in outside content areas? Many intellectual faculties are important to development across domains and could provide possible frameworks for future study. Bamberger connected the privileged systems between both music and language, and she effectively argues for the legitimacy of multiple hearings. If we are to understand how our students uniquely perceive certain elements in disciplines like language, then supplementing language-specific understanding with tasks that encourage broader cognitive understanding can only reinforce our efforts. Understanding student's representations of musical information can only enhance our interpretation of students' broader representational skills, not just with language, but also in other disciplines. Through observational research, teachers can discover meaning of immediate use. In turn, this meaning serves to provide a holistic picture of the broader cognitive development of the individual children we serve.

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