
Title	Characteristics of children's musical inventions using a synthesiser
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Source	Approaching a new millennium: Lessons from the past, 14 – 18 August 2000, Norway

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Citation: Wright, S. (2000). Characteristics of children's musical inventions using a synthesiser. In *D. Apollon, O. Fure & L. Svåsand (Eds.), Approaching a new millennium: Lessons from the past: Prospects for the future: Proceedings of the 7th Conference of the International Society for the Study of European Ideas (ISSEI)*. Bergen: University of Bergen, HIT Centre.

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ABH 2846
EP 942

**CHARACTERISTICS OF CHILDREN'S
MUSICAL INVENTIONS USING A
SYNTHESIZER**

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Characteristics of Children's Musical Inventions Using a Synthesiser

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Abstract

Discrimination of musical concepts and ideas, particularly in early childhood, is closely related to learning through first-hand, trial-and-error experiences using concrete materials. Some researchers (eg, Swanwick and Tillman, 1986) have studied the development of aural discrimination and the process of creating musical order by analysing children's improvisations. However, these researchers have not investigated musical perception and improvisation in relation to other musical dimensions, such as expressiveness, while composing. This paper provides descriptions of preschool, grade 1, grade 3, grade 5 and grade 7 children's compositional characteristics while improvising on a synthesiser. It focuses on children's abilities to incorporate timbral, bodily-kinaesthetic, technical, structural, expressive/imaginative, learned and intuitive dimensions into their musical compositions.

Keywords: composition, children, musical characteristics, development, learned, intuitive.

1. Background to the study

In one of the earliest published studies which focused on the improvised chanting and instrumental improvisations of 2- to 6-year-old children, Moorhead and Pond (1941) suggested that children's improvisations were characterised by asymmetrical rhythm patterns, a steady beat, and simple and compound meters, with a primary focus on the timbral and sound qualities of instruments. Flohr (1985), Reinhardt (1990), and Swanwick and Tillman (1986) have investigated the tonal, structural, and mood aspects of children's improvisations while using Orff-based xylophones. These researchers propose that children's improvisations can be described in terms of developmental stages, generally moving from physical, random responses to that of increasing use of musical structure. Flohr, for example, described the first of three stages as motor energy (ages 2 to 4 years) which is characterised by children using notes of roughly equal duration and repeated pitches; the experimentation stage (4 to 6 years) is characterised by an exploration of new ideas with little regard for the larger context; and the formal properties stage (6 to 8 years) involves structural characteristics, such as tonality and repetition of larger patterns.

Kratus (1991) described the improvisational process as being less stage-related and more multi-levelled, consisting of a sequence of different, increasingly sophisticated behaviours, depending upon the child's level of knowledge and skill, and that children will revert to a lower level when encountering a difficult musical element, a new musical style, or a change in mood. He proposed seven developmental levels: exploration (loosely structured); process-oriented (producing cohesive patterns); product-oriented (conscious of structural principles, such as tonality and rhythm); fluid (applying relaxed and fluid technique); structural (shaping improvisations through a repertoire of strategies); stylistic (incorporating musical characteristics of a given style); and personal (transcending recognised styles to develop a new one).

In their earlier research, Wright and Ashman (1987, 1991, and 1997) examined the relationship between musical elements and the information processing demands related to the making of musical decisions. Using a model of cognition, based on a framework described by the neuropsychologist Alexander Luria (1966, 1973), and operationalised into models of information processing by Das, Kirby and Jarman (1979) and others, Wright and Ashman validated the role of the two coding processes (ie, simultaneous and sequential). They claimed that the Das et al. model is a cogent conceptual framework for understanding the cognitive processing demands of young children's musical skills, especially in their identification and understanding of musical structure.

Wright (1995) sought clarification of children's development of musical knowledge and skills when being provided with an open-ended task of composing using a musical synthesiser. This allowed for an assessment of both cognitive and emotional/affective domains of music. Data were collected from a range of sources and reported qualitatively. The project described here provides quantitative results from the Wright (1995) study, with some descriptions of children who demonstrate particular compositional characteristics. The paper reports on children's knowledge and development across a three year period, and explores their ability to incorporate timbral, bodily-kinaesthetic, technical, structural, expressive/imaginative, learned and intuitive dimensions into their personal musical improvisations or compositions.

2. Methods

Participants. The participants in the study are 150 children. Thirty were recruited in each of five grade groupings: Preschool (M age=55.8), grade 1 (M age=76.0), grade 3 (M age=99.9 months), grade 5 (M age=124.9 months) and grade 7 (M age=148.2 months). Ten children were drawn at random from three classes/groups at each level, and an equal number of males and females are included in the sample.

The schools were of similar size and located in upper working class and middle class residential areas in Brisbane, Australia. The teaching programs in each school were similar, being prescribed by the Queensland State Department of Education. Discussions with school staff identified no fundamental administrative, philosophical, or practical differences in the way in which instruction was delivered in each school. In all schools, students were involved in musical activities for between 40 and 70 minutes per week. No outstanding differences were found between teachers in terms of their qualifications, musical performance abilities, or philosophies of music education.

Musical Composition Task. Each child was given an opportunity to individually create a musical composition using a Korg X3 music synthesiser, midi-interfaced with a Power Macintosh, using Performer (Mark of the Unicorn, 1993) music software. This equipment captured the complete exploration and composition process of the children, in digital form, and permitted the production of musical scores that previously would have involved hours of musical transcription from audio or video taped recordings.

The synthesiser was programmed to allow children access to four musical patches (sound wave forms producing distinct timbral and expressive characteristics). The patches were selected because of their contrasting sound characteristics. Children's reactions to the patches were examined using a sample of 15 children from a range of ages (not included in this study) to gauge the attractiveness of the sounds, and the range of compositional responses elicited. The titles and a brief description of each patch follows:

- *Iced Rain, Program #G97.* This chorused piano plus reverbed temple block patch has a quick attack, with a key-held sustain and slow decay. While the piano sustains, the temple block begins two octaves higher and chromatically descends—first quickly, then retarding—while diminishing and ending in unison with the piano/temple block. The composite sound decays slowly when keys are released.
- *Bassoon/Oboe, Program #G71.* This emulates these two instruments, with the bassoon in the lower half of the keyboard, and the oboe in the upper half. The attack is quick and the sound sustains as long as the key is held with the addition of vibrato after about a one second delay.
- *Steam Cloud, Program #A90.* This produces a sound similar to a blend of cathedral choir and strings, with a subtle, slow vibrato. The attack is slow with key-held sustain, and the effect of a steamy, breathy hiss begins approximately one second after a key has been held. If held, the steam effect increases in velocity, then slowly fades, leaving only the voice/string sound which decays slowly when released.
- *Split Bells, Program #A45.* This has a quick attack, short sustain, and fast decay, with overtone effects creating sounds ranging from glockenspiel in the top, gamelan/xylophone in the middle, and steel drum/wooden bells in the bottom register.

Procedure. Children were administered the Music Composition Task around the same month each year, over a period of three years. All testing was conducted in a quiet room at each school by a trained research assistant (a primary school music teacher). Training for the administration of the task was conducted by the author, and several trial sessions were undertaken by the assistant and observed by the author to ensure consistency.

Children were given the opportunity to explore the keyboard's four patches and encouraged to use both hands and the full range of the keyboard. After this exploration period, the four patches were reviewed by the tester, and the children selected their favourite patch to "make a piece of music that was their own." During the session, the synthesiser recorded all keyboard events on its internal sequencer (ie, which notes were played, when they started, how long they were held, and the velocity of the depressed keys). Hence,

the musical data were stored in digital format for playback and coding at a later time following their translation into conventional musical notation. Each session was videotaped to observe the children's nonverbal behaviour, and each child was interviewed briefly at the end of the composition about their musical goals, and the extent to which they were realised in the composition.

3. Coding the Musical Data

Videotaped records were coded and analysed using a 5-point rating scale (1 being the lowest) across seven dimensions:

- *Timbral*. Awareness and responsiveness to the timbral dimensions of the patch (eg, adjusting playing style to each new sound, describing the sound, or using emotional, facial expressions or body language).
- *Bodily-kinaesthetic*. Physicality of playing style (eg, stabbing at the keys on a percussive patch, or slumping hands or arms across the keys on a patch with a slow attack).
- *Technical*. Dexterity of playing (eg, accuracy and control, or use of conventional/functional fingering patterns).
- *Structural*. Musical organisation (eg, rhythmic/melodic patterning, or sense of meter or tonality).
- *Expressive/Imaginative*. Musical changes and/or continuity (speeding up or slowing down, getting louder or softer), and verbal descriptions in terms of character- or event-based aspects.
- *Learned*. A learned approach or orientation (eg, playing familiar pieces or incorporating segments of familiar works into the composition; showing evidence of incorporating knowledge or skills from training into the creative task).
- *Intuitive*. An intuitive approach or orientation (eg, responding to the patches spontaneously; exploring without concern for conscious reasoning).

The coding procedures were developed as a result of several pilot-testing sessions, and the scoring was checked to ensure accuracy. In the main study, four coders rated the children's musical compositions, integrating data from the musical scores and videotaped records. Interrater reliability was established on data from 10 children and reached 90% consistency on the seven dimensions.

4. Results

The Music Composition Task provided a measure of the students' utilisation of the seven musical dimensions while composing. Table 1 shows the means and standard deviations by grade.

Table 1.

Means and Standard Deviations for Participants by Grade Level on the Six Musical Composition Task Dimensions

Grades					
	Preschool	Grade 1	Grade 3	Grade 5	Grade 7
Timbre					
M	2.39	2.51	2.24	3.13	3.04
SD	1.06	0.75	0.71	0.84	0.67
Bodily Kinaesthetic					
M	2.13	1.92	1.76	2.64	2.87
SD	1.08	0.69	0.84	0.66	0.65
Technique					
M	2.41	2.43	2.47	2.94	2.89
SD	0.59	0.46	0.79	0.76	0.72
Structure					
M	2.48	2.84	2.81	3.14	3.07
SD	0.65	0.41	0.84	0.95	0.62
Expression					
M	2.23	2.10	1.92	2.98	2.87
SD	1.17	0.86	0.92	1.29	0.76
Learned					
M	2.06	2.41	2.66	2.81	2.94
SD	0.52	0.39	0.99	0.79	1.51
Intuitive					
M	2.39	2.58	2.65	3.22	2.94
SD	0.91	0.57	0.88	0.82	0.74

One-way analysis of variance was performed to determine if there were grade differences across the groups on the seven Musical Composition dimensions. There were significant differences between groups (Timbre: $F=7.20$, df 4, 144, $p<.001$; Bodily kinaesthetic: $F=10.54$, df 4, 144, $p<.001$; Technique: $F=4.51$, df 4, 144, $p<.002$; Structure: $F=3.86$, df 4, 144, $p<.005$; Expression: $F=6.46$, df 4, 144, $p<.000$; Learned: $F=3.98$, df 4, 144, $p<.004$; Intuitive: $F=5.01$, df 4, 144, $p<.001$). Fisher's pairwise comparisons indicated significant differences on the following:

Timbral, Bodily Kinaesthetic, Technical and Expressive: Between preschool and grade 5; preschool and grade 7; grade 1 and grade 5; grade 1 and grade 7; grade 3 and grade 5; grade 3 and grade 7.

Structural: Between grade 1 and grade 5; and, grade 1 and grade 7.

Learned: Between preschool and grade 3; preschool and grade 5; and, preschool and grade 7.

Intuitive: Between preschool and grade 3; preschool and grade 5; and, preschool and grade 7; grade 1 and grade 5; grade 1 and grade 7; grade 3 and grade 5; grade 3 and grade 7.

The results of the pairwise comparisons of groups would suggest that there were general improvements across groups, particularly where there was more than a one-year difference in their grade levels. However, there were no significant differences between grades 5 and 7 in any of the dimensions, which would suggest that there is a levelling out in musical composition ability at this stage.

A factor analysis was conducted for all of the groups combined using two factors, as these were the only reasonably large eigenvalues (see Table 2).

Table 2.
Factor analysis of the Musical Composition Task Variables

Variable	Factor 1	Factor 2	Communality
Intuitive	0.790	0.439	0.817
Timbre	0.878	0.260	0.839
Bodily Kinaesthetic	0.837	0.202	0.741
Expressive	0.869	0.249	0.817
Learned	0.104	0.910	0.838
Technical	0.486	0.705	0.733
Structural	0.547	0.660	0.736
Variance	3.3971	2.1236	5.5206
% Var	0.485	0.303	0.789

Rotated (varimax) factor loadings identified two main factors: Intuitive, timbre, bodily kinaesthetic, and expressive loaded on factor 1; and, learned, technical, and structural loaded on factor 2. The results indicate that musical intuition was related to sensitivity to timbre, and utilises an expressive and bodily kinaesthetic approach to musical composition. In contrast, a learned approach to music utilises technical and structural aspects.

5. Conclusions

Musical composition is a complex cognitive and affective endeavour involving a number of artistic processes across a range of musical dimensions (see Wright, 1994). While the link between affect and cognition via musical endeavour has been acknowledged by philosophers, educators, musicians and psychologists for centuries, studies which explore the complex integration of analytic, aural, physical and expressive processes of musicianship are rare in the literature. Computer technology provides an opportunity to help unravel the abstract relationship between musical dimensions and compositional processes to give practical insight that can be applied to a number of fields of study.

The research described herein illustrates, across a three-year period, children's ability to incorporate timbral, bodily-kinaesthetic, technical, structural, expressive/imaginative, learned and intuitive dimensions into their musical compositions. The results illustrate significant pairwise comparison differences between groups on each of the seven Musical Composition dimensions, with improvements across groups, generally where there was more than a one-year difference in their grade levels. However, there were not significant differences between grades 5 and 7 in any of the seven dimensions, which would suggest that there was a levelling out of ability after about the age of ten years.

The data illustrate that children respond differently to timbral, bodily-kinaesthetic, technical, structural and expressive/imaginative aspects during musical composition, and that two different styles of responding to composing are involved: Intuition (timbral, bodily kinaesthetic, and expressive) and Learned (technical and structural). The data illustrate that some children's approach to composition centre on some musical dimensions in preference to others. Preliminary qualitative analyses of three grade-one children illustrate these two different approaches to musical composition in relation to each of the seven dimensions, clustered by Intuitive and Learned. (Pseudonyms are used to maintain children's anonymity).

Intuitive

Timbral

- Mary had access to an organ at home and made numerous comparisons between the sounds she had heard on that instrument with the patches on the synthesiser. She described each of the patches, claiming, for example, that Bassoon/Oboe was "pretty close to a trombone"; after playing Split Bells, she commented, "A piano is it? I don't know what the other (sound) is."
- Paul appeared to be very sensitive to the timbral aspects of the instrument and quickly adapted to the slow attack of Steam Cloud, looking intently and his hands and breathing deeply, and smiling. When asked which patch was his favourite, he responded, "I like the space one" (i.e., Steam Cloud).
- Adrian appeared to respond to the timbral aspects of the patches predominantly from a technical perspective. For example, when playing a low note in Iced Rain, he commented, "Can't even hear that one," and with Steam Cloud he said, "There's nothing" and put his ear close to the key to see if he could hear the sound better.

Bodily-kinaesthetic

- Mary enjoyed playing chord clusters, particularly with the two patches having slow attacks. With Steam Cloud, she used the back of her hand, and held the note clusters while listening to the effect.
- Paul experimented with using his full palm across the black keys and enjoyed playing flat-handed glissandos from the top of the keyboard to the bottom.
- Adrian was very systematic in his experimentation of the keyboard, rather than being bodily-kinaesthetic in his approach (see technical).

Expressive/Imaginative

- While Mary's initial response to Steam Cloud was "Sky," as she continued to explore the patch she referred to it as "That's like snake." However, there was little other evidence of imagination or expression in her playing.
- When hearing Iced Rain, Paul's face lit up and he said, "Someone has lifted the lid off the cave!" He described the lowest notes of Steam Cloud as sounding "like space" and the highest ones "like a war ship coming down." Paul's composition had a decisive finish involving a held cluster, and he lifted his hands gently and suspended them above the keyboard as he listened to the decay, then he looked up and smiled.
- When exploring Steam Cloud, Adrian said, "I reckon this sounds like Terminator—like the part when the Terminator is chased on his own motorbike." When asked to find a way to bring his composition to a close, Adrian paused for several seconds, then played a few descending skips, finishing with the lowest note on the keyboard.

Learned

Technical

- Mary announced her playing intentions, such as "These 3...; these 4 (keys)" or "Then right up to ... (highest note)." She applied 1-3-5 fingering patterns to create some arpeggios. When playing her first note using the slow attacking Steam Cloud, she said "It won't work." She quickly learned to hold the key down and explored note clusters.
- Paul began using his index fingers only, accidentally discovering dissonance when playing on the cracks between two notes, which he explored further using his index and middle fingers. He often began an ascending melody slowly, speeding up at the end of the phrase and finishing with an assertive slap of the full hand.
- Adrian predominantly ascended or descended sections of the keyboard, note by note, shifting from left hand to right at the centre. With experience, he explored crossing hands, and the simultaneous ascent of his left hand with the descent of his right, commenting, "One of them makes one sound, the other makes the other."

Structural

- Mary ascended the full keyboard on each of the white notes, and descended in three groupings of about 6 notes on the black keys, covering the upper, middle, and bottom ranges of the keyboard. She also explored some octaves, sometimes with both hands simultaneously, sometimes alternating hands.
- Paul repeated simple rhythmic ostinati and incorporated the black notes quickly. He appeared to enjoy the long sustain of Steam Cloud and alternated his hands, using a "four finger press" technique, converging toward and expanding from the centre of the keyboard.
- After a brief period of exploration, Adrian gestured to the black keys and said, "Um, can I use those? What are these ones like?" After being encouraged to try the black keys he commented, "But why do they have them—why can't they just have them (gesturing to the white)?" When encouraged to contrast the black and white keys, he said "It's all the same... See? Same." When an explanation was given in terms of higher and lower pitch, Adrian equated this information with size, saying, "Because that one's shorter," and followed his exploration with playing the highest, then the lowest and then a middle key on the keyboard, giggling at the end.

The summaries above provide examples of ways in which the data will be further analysed to illustrate individual and group trends across age and gender. In addition, the Intuitive and Learned components will

be analysed in relation to children's performances on two other musical tasks: their ability to use non-traditional symbols to notate a clapped rhythmic pattern (crotchet, crotchet, quaver-quaver, crotchet; repeated); and their ability to simultaneously move puppets to the strong and weak beats of music in 3/4, 4/4 and 5/4 meters (Wright, in preparation).

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Acknowledgments

This project was funded through an Australian Research Council (ARC Large) grant with co-investigator Professor Adrian Ashman, from The University of Queensland.

Thanks to: Ruth Hubbard, Research Assistant in the Centre for Applied Studies, for assistance with data analysis; Nikki Cox, Senior Research Assistant, for data collection/compilation and project coordination; and Ronda Davidison-Irwin, Naomi Moss, Sue Brady and Biddy Seymour, for assisting with the coding the Musical Compositions Tasks.