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Accent Structures in the Reproduction of Simple Tunes by Children and Adult Pianists

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This paper examines the influence of three accent structures on the reproduction of simple musical tunes by 5-, 7-, 9-, and 11-year-old children and adult pianists. In the metric accent structure, periodically spaced beats are accented; in the melodic accent structure, events after a jump in pitch interval or after a turn in contour are accented; and in the rhythmic grouping accent structure, the first and last events of a rhythmic group are accented. Four themes were created in which all three accent structures coincided. Three variations were derived from each theme in which each accent structure in turn was moved out of synchrony with the other two. In a fourth variation, all three accent structures were out of synchrony with each other.

Both the children's and the pianists' reproductions were the most accurate when the accent structures coincided and the least accurate when they conflicted. Intermediate results were obtained when the rhythmic grouping and melodic accent structures were displaced, but no deterioration in performance was observed when the metric accent structure was displaced, demonstrating the relatively unimportant role played by intensity variations in these conditions. These results were obtained only for the melody scores—no deteriorations were found in the rhythm scores. For the pianists, fewer errors were made on the accented notes than on the others.

So, the juxtaposition of the three accent structures does indeed influence the perception of musical sequences. When attention is drawn to the same point in time by several different accent structures, the segmentation of the sequence into smaller units is efficient and reproductions are good. However, when attention is drawn to too many points in time, segmentation is less efficient and reproductions are poorer.

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Music consists of the complex juxtaposition of sounds in time. These sounds vary along one or more dimensions. For instance, successive notes are louder (or softer), higher (or lower) in pitch, longer (or shorter) in duration, or have a varying spectral configuration (timbre). All this basic information about the quality of the sound that arrives in the listener's ear must somehow be analyzed so that the listener is able to hear, not a sequence of sounds with varying properties, but music, with all notes fitting or not with those surrounding them. That is, the listener achieves a more global, cognitive analysis that situates the sounds in time relative to each other.

The cognitive psychologist's aim is therefore to describe how the listener makes sense of all this raw data. It is now well established that our ability to analyze information is limited by the quantity and quality (complexity) of the stimulus (see Anderson, 1985, for a review) so the continual flux of information contained in music must be somehow segmented so as to create smaller units of perceivable size and complexity. We are interested in the perceptual and cognitive mechanisms involved in this segmentation. One such mechanism, that of accents, will be examined here. We consider (with Jones, 1987) an accent to be anything that is relatively attention-getting in time—that stands out from other surrounding notes. We suggest that accents play an important structuring role in music perception because they draw the listener's attention to important points in the music, thus segmenting the flux into segments that have a definable beginning and end and allow the listener to differentiate between relatively important and unimportant moments in time. Because attention is limited, the listener is able to select important aspects of the structure rather than being lost in smaller detail.

Psychological studies with nonmusical stimuli indicate that variations in the physical dimensions of sound such as loudness, pitch, and duration do indeed lead to the perception of accented elements on the louder, higher, and longer notes (Handel, 1974; Thomassen, 1982; Garner & Gottwald, 1968). One of the questions asked here is whether variations in these parameters are also used in the segmentation of music. Accents cannot exist on their own, but rather depend on a pattern of foreground and background, with regularly occurring accented notes standing out from the background of the other notes. We shall call this regular occurrence of accented and unaccented events an "accent structure." We propose the existence of distinct accent structures for each of the parameters of sound (intensity, pitch, duration).

So far, all reference to accents has been to the psychological perception of them. However, a parallel concept exists in music theory. For instance, for Cooper and Meyer (1960) an accent in rhythm "is a stimulus (in a series of stimuli) which is marked for consciousness in some way. It is set off from other stimuli because of the differences in the duration, intensity, pitch and timbre, etc. The difference between accented and unaccented beats lies in the fact that the accented beat is the focal point, the nucleus of the rhythm, around which the unaccented beats are grouped and in relation to which they are heard" (p. 8). However, whereas Cooper and Meyer acknowledge the various sources of accents (stress, duration, or melodic charge), they think that the function of accents in organizing rhythmic groups does not depend on their origin, and thus accents should all be treated in the same way. We differ in this respect, wishing to compare the functioning of the various sources of accent.

Three possible sources of accent in music will be examined: metric, rhythmic grouping, and melodic. Each of these originates in perceptual salience in terms of intensity, duration, and pitch, respectively. In the *metric* accent structure, groups were created by placing an intensity accent on one out of every two, three, or four beats (depending on the time signature). In order to convey this in the stimuli, the first note in the measure (or primary accent) was louder than the others, and the secondary accents (the third beat in $\frac{4}{4}$ and the second beat in $\frac{6}{8}$) were played at an intermediate loudness level in agreement with the findings of performance studies (see, e.g., Sloboda, 1983). In the *rhythmic grouping* accent structure, groups were created by increasing the duration of the final note of a group, or by inserting a pause between successive notes. A new group started after a relatively long pause or event. The first and last notes in such a rhythmic group are accented (see Clarke, 1985a,b; Jones, 1987; Gabrielsson, 1973a,b; Monahan, Kendall, & Carterette, 1987). In the *melodic* accent structure, groups and accents were created in one of two ways. Accents were considered to exist on the first note after a pitch jump of more than three semitones, and on the extreme note in a change of contour direction (Monahan et al., 1987; Thomassen, 1982; Jones, 1987; Boltz & Jones, 1986). Examples of each type of accent structure can be seen in Figure 1.

The psychological validity of these accent structures in music perception will be examined here. Are they used to segment the flux of musical sound into smaller units and to situate important elements in relation to less important ones? Our argument is based on the following principle: If accents do indeed provide structure to the musical elements extended in time, then the juxtaposition of the various types of accent structure should influence the ease of perception and comprehension of the music. Thus, if the three accent structures coincide, they should reinforce each other because attention is drawn to the same points in time, facilitating perception and hence reproduction. If, on the other hand, the different types

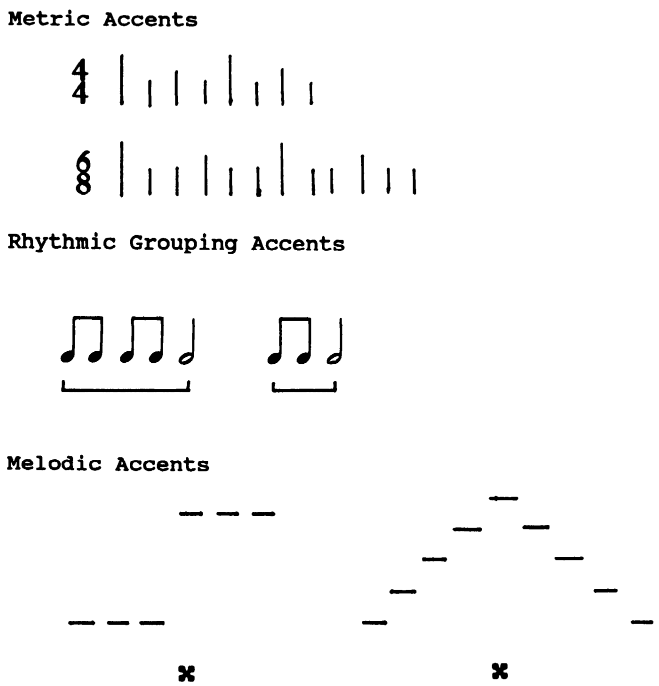


Fig. 1. Examples of the three types of accent structures: metric accent structure, rhythmic grouping accent structure, and melodic accent structure with turns and jumps.

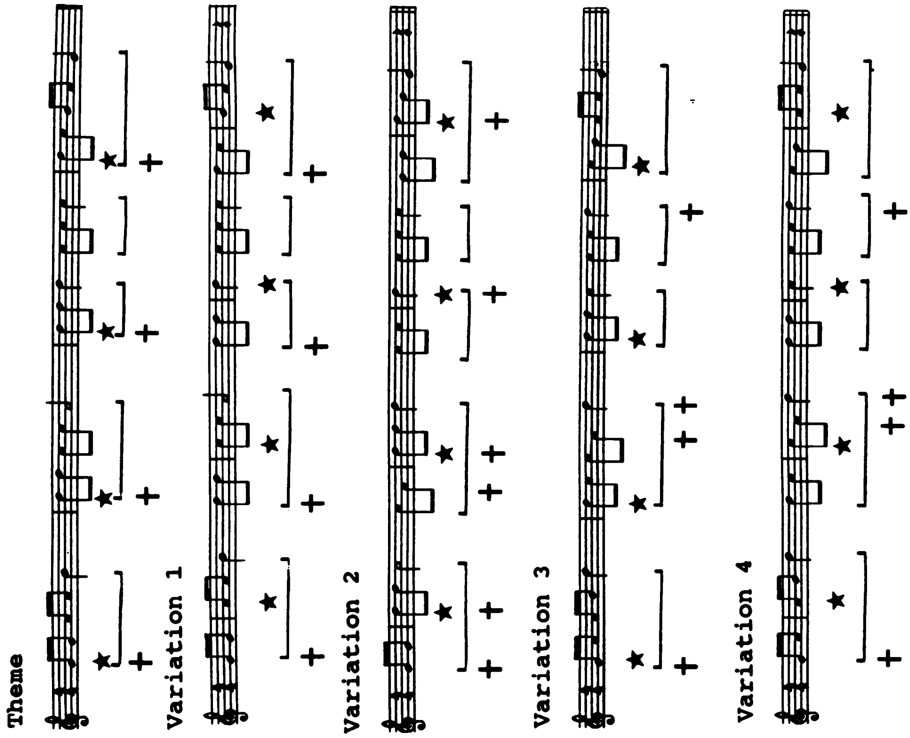
of accent structure are out of synchrony with each other and conflict, attention will be drawn equivocally and to too many points in the music, leading to confusion and the deterioration of perception and reproduction.

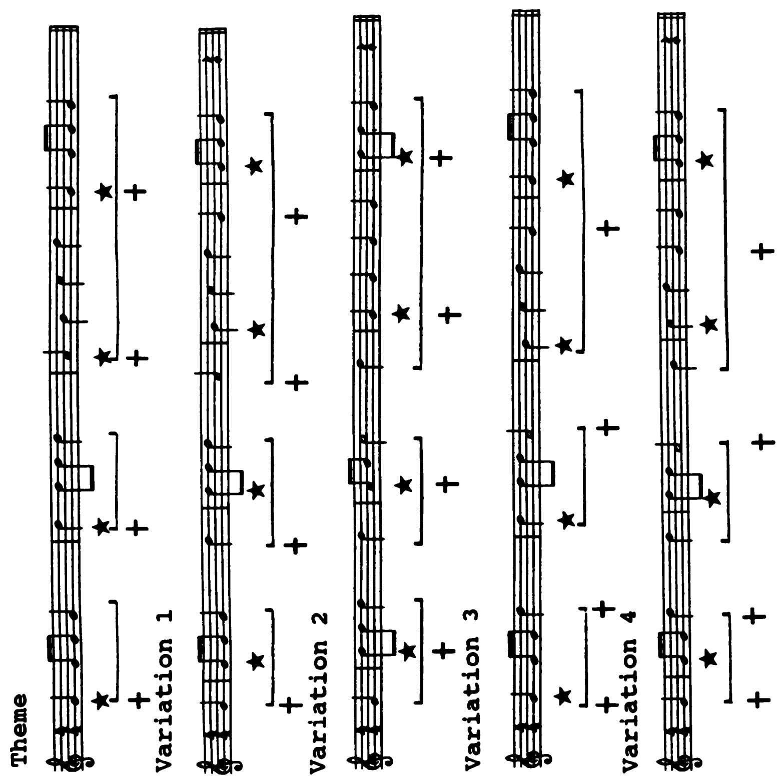
Two studies have already examined certain aspects of this problem. Monahan et al. (1987) used a similarity judgment task to investigate performance with stimuli in which temporal and melodic accents either coincided, were out-of-phase, or were in conflict with each other. The most correct judgments were found for the first situation with a deterioration in performance for the other two. Boltz and Jones (1986) asked subjects to write in musical notation tunes that were presented aurally, in which the temporal and melodic accent structures either coincided or conflicted. Performance was again better in the first case. The present paper takes the problem further in a performance task by investigating the influence of each of the three accent structures.

We devised four short themes in which the three accent structures were closely controlled so that they could be manipulated either to coincide or to conflict with each other. The accent structures coincided in the themes. Three variations were derived from each theme in which each accent structure in turn was moved out of synchrony with the other two: Variation 1 = meter out; Variation 2 = rhythmic grouping out; Variation 3 = melody out. In Variation 4, all three accent structures were out of synchrony with each other. The 20 resulting tunes are shown in Figure 2.

We expect the best results to be obtained when all the accent structures coincide (themes) and the worst results when they all conflict (Variation 4). Intermediate results are expected when one of the accent structures is out of synchrony with the other two (Variations 1, 2, and 3). Of additional interest is the relative disruptive effect of the three types of accent structure. For instance, is the displacement of the rhythmic grouping accent structure more or less harmful than the displacement of the metric accent structure?

The development of these perceptual or cognitive mechanisms is also addressed here. Are these abilities innate, how do they develop with age, and what is the effect of specific training? Trehub (1987) reviews studies on newborn infants that indicate that although the basic auditory perceptual skills appear to function at birth, more complex cognitive skills, such as those suggested here, seem not yet to be developed. Dowling and Harwood (1986) provide a review of developmental issues in music psychology, showing a progressive increase in musical abilities as children grow older. However, evidence exists that perception and cognition do not develop as a single unit but rather that separate skills appear and develop at varying rates (Gérard & Drake, 1990). The effect of specific training on musical skills is less clear. Most studies comparing musicians and nonmusicians show superior results for the musicians, but more importantly they often demonstrate qualitatively different techniques used by this group. For instance, Beal (1985) demonstrated that adult musicians and nonmusicians used different techniques when asked to discriminate musical chords. Musicians use perceptual and cognitive skills specific to the lawful musical structures encountered in their culture's music, and nonmusicians who lack this knowledge base their judgments on the acoustic properties of the chords. Likewise, Davidson, Power, and Michie (1987) have shown that musicians and nonmusicians stream ambiguous musical figures on differing principles. Similarly, Smith (1983) demonstrated that children and nonmusician adults have a different representation of drum rhythms than do adult musicians. The nonmusicians and children tend to group the notes by temporal proximity, whereas the musicians have a hierarchical representation based on a beat framework. A similar distinction has been described by Bamberger (1978), with young children using the former (sequential grouping) and older children progressively using the latter (hierarchical grouping). Morrongiello, Roes, and Donnelly (1989) and Gérard and Auxiette (1989) have shown that even


Theme
Variation 1
Variation 2
Variation 3
Variation 4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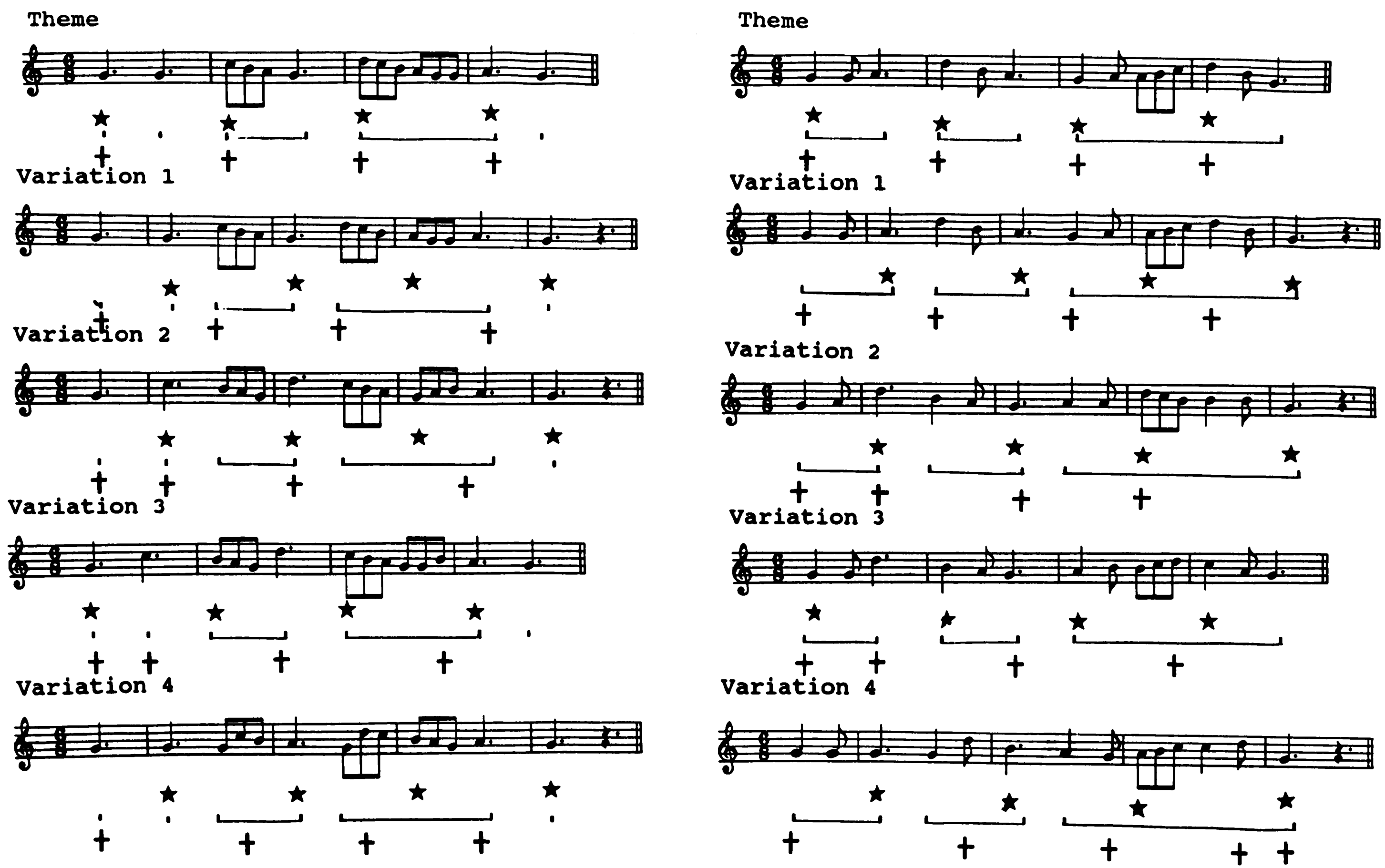

Fig. 2. The four themes with their four variations (* indicates the metric accent structure, ⌊___⌋ indicates the rhythmic grouping accent structure, and † indicates the melodic accent structure).

a few years or months of musical training in young children (4–6 years old) can lead to qualitative differences in the way they perceive musical stimuli.

This study investigates how the manipulation of the three accent structures affects the perception and comprehension and therefore the reproduction of short musical tunes. The roles of developmental factors and specific musical training were examined by the use of various populations. Two independent experiments were carried out with the same method and materials. The first examined the reproduction of themes and variations by children in a learning task. The children heard the tunes and were then asked to sing them or to tap the rhythm. The second experiment examines the ability of competent pianists to hear and play back immediately the same tunes and variations.

Experiment 1: Children

METHOD

Subjects

Four age groups of 16 children each of ages 5, 7, 9, and 11 years took part in this experiment. All were pupils at a private Catholic school in Dallas, Texas. All had received considerable general music tuition (at least 2 hr a week from the age of 3 with the Kodaly method), as music is highly valued in the school.

Materials and Apparatus

As described earlier, four themes, each with four variations, were composed (Figure 2). In each case, accent structures coincided in the theme, while metric accent structure was out of synchrony in Variation 1, rhythmic grouping accent structure out of synchrony in Variation 2, melodic accent structure out of synchrony in Variation 3, and all three accent structures desynchronized in Variation 4. The stimuli were synthesized on a Commodore 64 computer. All the tunes began on G_4 and were pure tones. The onset-to-onset duration of the quarter notes was 500 msec, making the tunes relatively easy to perceive and reproduce, as this corresponds to the spontaneous tempo of children in this age range (Fraisse, 1956). Each note lasted two thirds of the onset-to-onset duration. Primary metric accents were played louder than the others, with secondary accents played at an intermediate level. The three intensity levels were clearly distinguishable to the authors and to other children in this age range when they were asked directly to listen to the loudness. The stimuli were recorded on audio tape and played to the children over a loudspeaker. A second tape recorder recorded the whole session.

Procedure

All the children were taken out of their class music lesson and tested in individual sessions. Each child heard a theme or variation over the loudspeaker of the tape recorder and was asked either to sing it back or to tap its rhythm with a wooden stick on the table. First they had three trials singing a theme and then three trials singing a variation of a different theme. They then had three trials learning to tap just the rhythm of a third theme, and then three trials tapping a variation of a fourth theme. The different themes and variations were counterbalanced across children. Each child did three such sessions with the same tunes on three separate days spread over a period of a week. Each session lasted about 10 min. Thus, each of four tunes was reproduced nine times by each child.

RESULTS

Scoring

The aim of the scoring system was to obtain a composite score for both the rhythmic and melodic aspects of the reproductions taking into consideration both the local and global features [see Sloboda (1985) for a similar approach]. Details are presented in Table 1.

The scoring scheme provided three dependent variables: the rhythm score for the sung tunes, the rhythm score for the tapped tunes, and the melody score for the sung tunes. The influence of age, trials, and tunes on these three dependent variables will be examined first.

As no significant differences between the four tunes were observed nor were there any significant interactions of tune with other factors, the results were collapsed across tunes. Figure 3 shows the improvements due to age. An analysis of variance (ANOVA) for each of the dependent variables (sung rhythm, tapped rhythm, and melody) by age (four groups) and trials (nine) showed a main effect of age for the tapped rhythm [$F(3,60) = 15.49$, $p < .0001$]. Planned comparisons disclosed improve-

TABLE 1

The Scoring System for Experiment 1

Rhythm score	
Global	
Regular pulse?	1
Metric structure?	1
Organization in groups?	1
Local	
Correct number of groups?	1
Number of groups played correctly?	4
Total	8
Melody score	
Global	
Begin and end on same note?	1
Correct use of scale?	1
Precise 4th or 5th?	1
Local	
Correct number of groups?	1
Number of groups played correctly?	4
Total	8

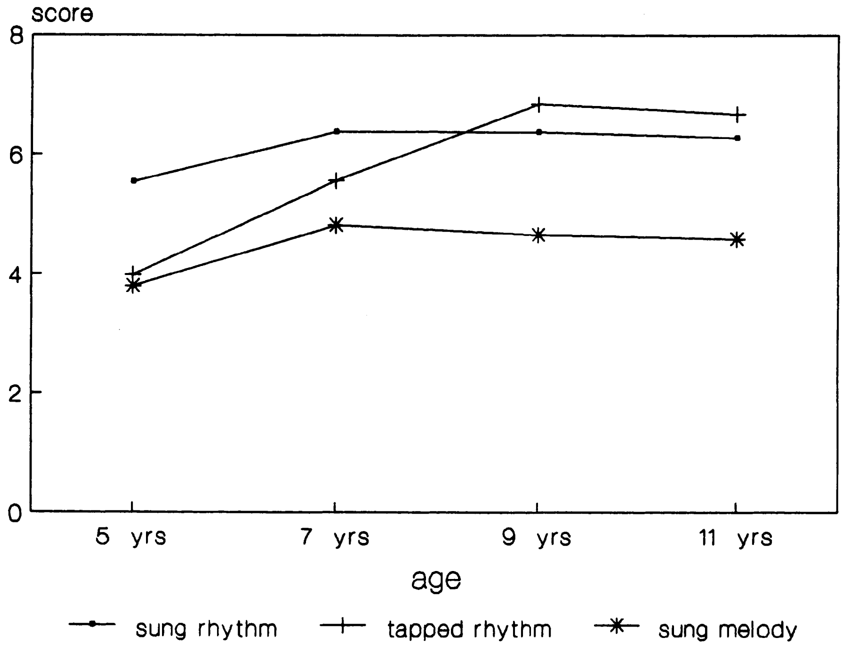

Fig. 3. Improvements with age in Experiment 1 for the sung and tapped rhythm and melody scores.

ments between 5 and 7 years old [$F(1,60) = 37.97$, $p < .0001$], and between 7 and 9 years [$F(1,60) = 35.05$, $p < .0001$], but none between 9 and 11 years. No main effect of age was seen for the sung rhythm [$F(1,60) = 1.59$, $p < .2$], but a planned comparison between 5 and 7 years showed an improvement between those two age groups [$F(1,60) = 4.71$, $p < .03$]. No main effect of age was seen for the melody score [$F(3,60) = 1.24$, $p < .30$] although a slight improvement was seen between 5 and 7 years [$F(1,60) = 3.54$, $p < .06$]. The sung rhythm and melody scores therefore improved between 5 and 7 years, but no improvement was observed at a later age. Tapped rhythm continued improving up to the age of 9 years.

Figure 4 shows the improvements observed over the nine trials (three reproductions × three sessions). The same ANOVA showed a main effect of trials for each of the dependent variables [sung rhythm: $F(8,480) = 25.43$, $p < .0001$; tapped rhythm: $F(8,480) = 20.76$, $p < .0001$; and sung melody: $F(8,480) = 33.80$, $p < .0001$]. A steady improvement occurred with all three scores over the trials. Interestingly, no interaction occurred between ages and trials, showing that repetition leads to the same degree of improvement whatever the age of the child.

In order to examine the main question of this paper, that of the difference between the themes and variations, the scores were normalized for

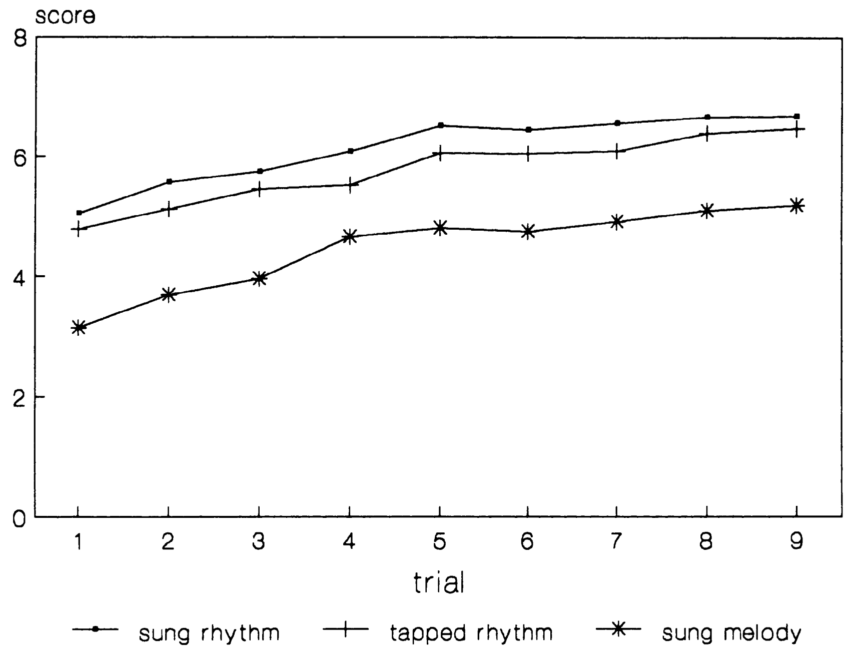

Fig. 4. Improvements over trials in Experiment 1 for the sung and tapped rhythm and melody scores.

each child, and averaged over trials, ages, and tunes to reduce the effect of individual variability.

Figure 5 shows the z-scores for the themes and their variations for the sung rhythm, the tapped rhythm, and the sung melody. An ANOVA on these z-scores by variations showed that differences among themes and variations for *sung and tapped rhythms* were not significant [$F(3,277) = 0.17$, $p < .91$ and $F(3,27) = 2.18$, $p < .11$, respectively]. The rhythm scores remained constant for all variations even though accent structures changed. Rhythm therefore appeared to be a dominant factor, irrespective of the various accent structures that are organized around it. Our hypothesis was not confirmed in that case. However, the differences among themes and variations were significant for the *melody* scores [$F(3,27) = 8.10$, $p < .0005$]. As predicted, the best scores were obtained for the themes, where all the accent structures coincided, and the worst scores were obtained for Variation 4, where all the accent structures conflicted. Performance on Variations 1, 2, and 3, where one of the accent structures was out of synchrony with the others, is of interest. When the metric accent structure was out of synchrony (Variation 1), no deterioration in performance was observed, whereas the rhythmic grouping accent structure (Variation 2) and the melodic accent structure (Variation 3) produced an intermediate effect.

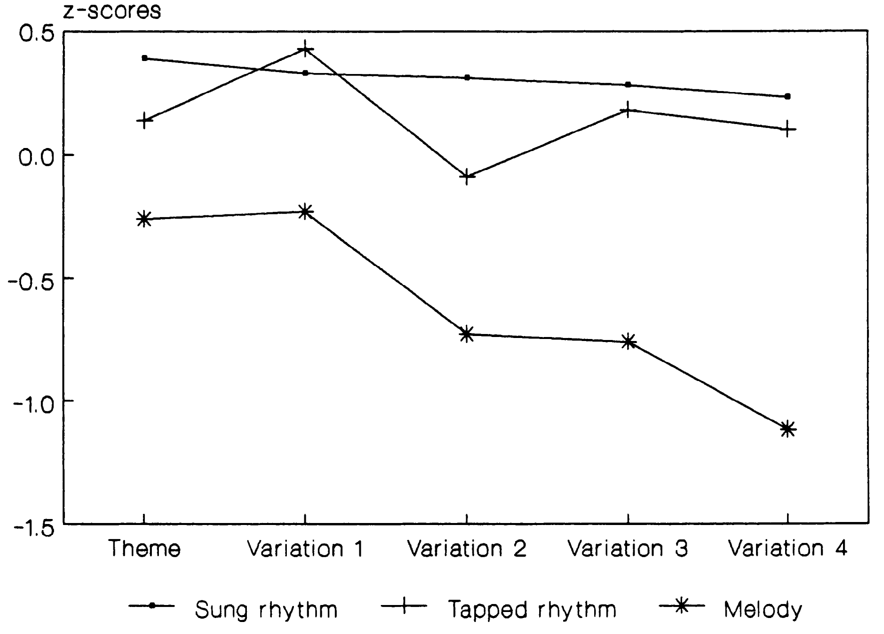

Fig. 5. The z-scores (sung and tapped rhythm and melody) for the themes and variations in Experiment 1.

DISCUSSION

When children were taught to sing or tap the rhythm of tunes, their performance was indeed influenced by the juxtaposition of the accent structures. Lower scores were obtained when accent structures were in conflict than when they are synchronized. However, this was only true for the melody score. The two rhythm scores are unaffected by the manipulation. The implications of these results will be discussed in the general discussion.

Experiment 2: Pianists

METHOD

Subjects

Ten pianists took part in this experiment. They were all music students at Ohio State University, had at least 8 years formal music training (mean, 10 years), and practiced almost every day. They were paid $6 for their services.

Materials and Apparatus

The same stimuli were used as in the previous experiment except that they were generated on an upright Yamaha Disklavier piano controlled by an AT/PC computer, so that the pianist heard the stimuli in exactly the same timbre they were to reproduce. Optical sensors and solenoids in the piano allowed precise recording and playback without affecting the touch or sound of the acoustic instrument. When recording the pianists' performances, the timing resolution was 2 msec for performance recordings, and intensity values were recorded with 7-bit precision, with scores ranging from 0 to 127 and a typical performance range of 30 to 90.

Procedure

The pianists heard one of the themes or variations played over a loudspeaker on a cassette player. They were asked to play it back on the piano. The reproductions were recorded by computer in terms of duration, intensity, and pitch. The tunes were presented in a Latin Square design so that no two variations of the same theme followed each other.

RESULTS

Scoring

The reproductions were scored by computer for the number of totally correct reproductions, the number of rhythmic groups correctly reproduced, and the number of melodic groups correctly reproduced. A group was considered correct only when all the elements in the group were correctly reproduced. A serial position analysis was also carried out by examining the number of errors in each serial position in relation to the type of accents they represented for each tune.

1. Global Analysis

Table 2 shows the number of correctly reproduced tunes for the four themes and their four variations. The task was clearly quite difficult for the pianists because only 32 of the 200 reproductions were completely correct. An ANOVA on the number of correctly reproduced tunes by four tunes and five variations showed a significant effect of tunes [$F(1,9) = 13.112, p < .01$]. Tunes 1 and 3 were reproduced correctly quite frequently (34% and 24%, respectively), but Tunes 2 and 4 were only rarely completely correct (4% and 2%, respectively). There was also a significant effect of variation [$F(4,36) = 3.506, p < .02$], which indicates that the themes were easier than the variations because the success rate was the highest for the themes (28%) and the lowest for Variations 2, 3, and 4 (18%, 10%, and 10%, respectively). Variation 1 (25%) produces interesting results. As the metric accent structure was out of sequence with the other accent structures, a deterioration in performance was predicted. This was clearly not the case. The performance was about as good as for

TABLE 2
The Number of Totally Correct Reproductions in Experiment 2 for the Four Tunes and Their Variations

	Theme	Var. 1	Var. 2	Var. 3	Var. 4	Total
Tune 1	7	6	1	2	1	17
Tune 2	1	1	0	0	0	2
Tune 3	3	2	2	2	3	12
Tune 4	0	1	0	0	0	1
Total	11	10	3	4	4	32

NOTE. For 10 subjects, the maximum score was 10 in each case.

the themes. The performance can thus be separated into two groups: on the one hand, the themes and Variation 1 were reproduced quite well, and on the other hand, the three other variations were more difficult to reproduce. A comparison contrasting theme and Variation 1 against Variations 2, 3, and 4 shows a significant effect [$F(1,9) = 14.005$, $p < .005$]. A significant interaction occurred between Tunes and Variations [$F(12,108) = 2.52$, $p < .01$], due mainly to the foregoing trend occurring only with Tune 1. The scores are generally too low to see any effect in the other tunes.

Even this very crude dependent variable gives some support for our hypothesis, indicating that when the accent structures are out of sequence, performance is lower than when they coincide. Once more, no effect is seen when the metric accent structure alone is manipulated.

2. *Group Analysis*

The percentage of rhythmic groups and melodic groups correctly reproduced were considered to provide a finer analysis. A rhythmic or melodic group was considered correct if all the elements in the group were correctly reproduced. Figure 6 shows the relative difficulty of the tunes as indicated by the rhythm and melody scores. An ANOVA on the number of correct groups by two scores (rhythm or melody), four tunes, and five variations showed that the differences were not significant for the tunes for the rhythm scores [$F(3,27) = 2.724$, $p < .50$] but that they were for the melody scores [$F(3,27) = 37.03$, $p < .0005$]. In the tunes that were not reproduced so well (Tunes 2 and 4), the performance of both the rhythm and melody deteriorated but the melody was affected more [interaction $F(3,27) = 4.371$, $p < .05$].

Let us now examine the main question. Figure 7 shows the relative difficulty of the themes and variations for the rhythm and melody scores

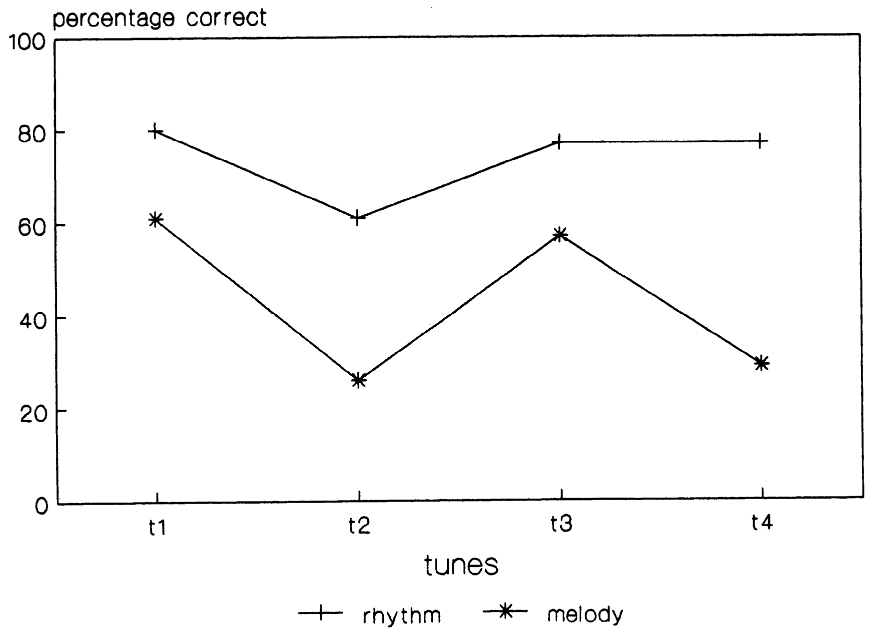

Fig. 6. Percentage of correctly reproduced rhythmic and melodic groups for the four tunes in Experiment 2.

averaged over tunes. An ANOVA by score and variation shows an interesting interaction between the two factors [$F(4,36) = 15.39, p < .001$]. The rhythm scores were unaffected by the variations [$F(4,36) = 1.49$, $p < .75$] while the melody scores deteriorated significantly when the accent structures conflicted in Variations 2, 3, and 4 [$F(4,36) = 28.095$, $p < .0005$]. As in the global scores, the best scores are obtained for the themes and much lower scores are obtained when either the melodic or the rhythmic grouping accent structures are out of sequence. No deterioration in relation to the theme is obtained for Variation 1 (metric accent structure displaced) and a planned comparison between theme and Variation 1 showed no significant effect [$F(1,9) = 1.373$, $p < .85$].

3. *Serial Position Analysis*

We have proposed the hypothesis that accents enable the listener's attention to be drawn to important points in the music. If this is the case, highly accented notes should be reproduced correctly more often than are unaccented notes. The following analysis has been carried out to test this hypothesis. A serial position analysis examines the percentage of correct reproductions of each note in each serial position in relation to the number of accents it represents. So if a note was only a rhythmic grouping accent

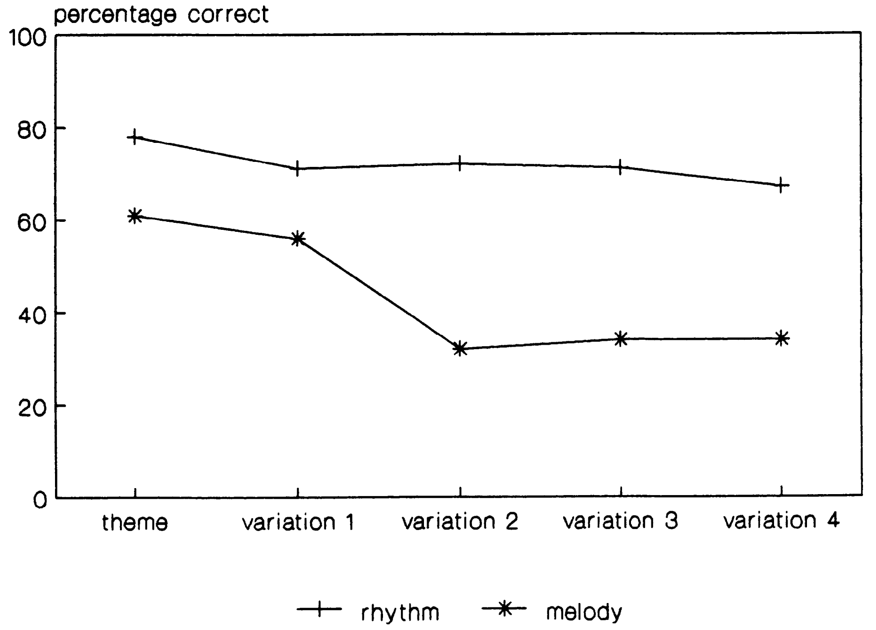

Fig. 7. Percentage of correctly reproduced rhythmic and melodic groups for the themes and variations in Experiment 2.

then it would be coded as one accent, but if it was both a rhythmic grouping and a melodic accent then it would be coded as two accents, and so on. Table 3 shows the percentage of correctly reproduced notes depending on how many accents they represent. Several different comparisons can be made. First, these results reflect the trends already observed—the theme and Variation 1 have a higher percentage than do Variations 2, 3, and 4, showing once again the disruptive effect of desynchronized accent structures. Second, the percentages vary with the number of accents the note represents—the fewer the accents, the higher the percentages. Moreover, they increase as the number of accents decreases.

DISCUSSION

When pianists were asked to play back simple tunes presented aurally, performance was higher for tunes in which the accent structures coincided than for tunes in which they conflicted. As for the children, the rhythm scores were unaffected by desynchronization whereas melody scores deteriorated. Again, no deterioration was seen when only the meter was out of synchrony. The serial position error rates confirmed these results and also supported the hypothesis that accents have the effect they do because they draw attention to important elements in the music.

TABLE 3
Percentage of Correct Reproductions of Notes in Experiment 2 as a Function of Number of Accents Corresponding with the Note for the Theme and Four Variations

	No Accents	One Accent	Two Accents	Three Accents	Mean with Accents	Mean
Theme	68.7	–	62.5	87.5	75.0	72.9
Var. 1	63.9	70.5	80.8	–	75.6	72.7
Var. 2	46.3	66.7	51.2	–	58.9	54.7
Var. 3	52.9	47.5	63.3	–	55.4	54.6
Var. 4	48.0	60.3	93.75	–	77.0	67.3
Mean	56.0	61.2	70.3	87.5	72.3	

General Discussion

Two experiments that used the same material, on different populations and with different methods and analyses, have provided converging evidence on the role played by various accent structures in the perception and reproduction of music.

The first conclusion that can be drawn is that accent structures, as we have defined them, do play a role in the perception of these simple musical stimuli, because their manipulation leads to systematic changes in performance. In both studies, and in all the analyses, performance was best when all accents coincided, and performance deteriorated when they were out of synchrony with each other.

The second important point is that this deterioration in performance did not operate across the board. The rhythm scores in both experiments were unaffected by accent desynchronization; only the melody scores were affected. That is, the temporal structure provided by the rhythm remained intact, but the subjects became confused concerning the pitches of the notes. Therefore it appears that melody is more fragile than rhythm. Rhythm provides a relatively rigid framework on which the more variable melody can be constructed. In the case of difficulties, it is the melody that breaks down first.

Third, we saw in both experiments that the three accent structures did not have the same disruptive effect. Performance indeed deteriorated when rhythmic grouping and melodic accents were out of synchrony, but not when metric accents were displaced. This could be due to the nature of this accent structure, which is conveyed to the listener by variations in intensity. Various explanations can be given. First, perhaps the variations in intensity used were not large enough and the subjects simply did not hear them. This seems unlikely because independent listeners were able to identify the three intensity levels when asked to do so directly. Second, meter is conveyed by pianists, not only by variations in intensity but also, to a lesser degree, by variations in the temporal domain (Sloboda, 1983). It is possible that variations in intensity alone do not suffice to convey meter. Third, the absence of disruptive effect for the metric accent structure in the first experiment ties in well with the results of a series of experiments showing how relatively unimportant this dimension is to young children (Gérard & Drake, 1990). Although this explanation is the most satisfying psychologically, it does not explain the same effect observed with the adult pianists, who should surely be able to perceive and use meter (see Sloboda, 1985). It therefore appears that intensity accent taken by itself is a relatively superficial feature. Young children tend to ignore it, and music in general plays with its displacement.

The serial position analysis in Experiment 2 shows that accented notes are reproduced correctly more frequently than are unaccented notes. As we hypothesized, accents may help listeners structure music in time by drawing their attention to important points in time. This does indeed seem to be the case.

One objective of these two studies was to examine the relative importance of accent structures in two very different populations. On the one hand are children, who have a relatively limited musical background with a general, nonspecific training, and on the other hand are pianists, who have received highly intensive training. What differences could we expect between these two populations? As described in the introduction, Monahan, et al. (1987), using a similarity judgment task, investigated performance with stimuli in which temporal and melodic accents either coincided, were out-of-phase, or were in conflict with each other. The most precise judgments were found for the first situation, and this was true for both the musicians and the nonmusicians. The musicians performed better overall than the nonmusicians did, and a few other differences were observed, but the general principles of conflicting accents leading to lower scores was equally valid for both groups.

Two types of musical skills can be described—abilities related to the perception of physical sound and abilities related to the integration of the sounds into a whole. The former would be available to everyone who hears music, whereas the latter would require more specific training. As the perception of accents created by changes in intensity, duration, and pitch has been described in the general population, and because the accent structures as we have described them in music are derived from these basic principles, we would expect the same principles to apply both for children and musicians. However, a better integration of the various dimensions resulting from music training would be expected. We have indeed observed the existence of the same principles in the two populations, and interestingly, the same melody/rhythm differences are seen in both cases. So it would appear that the integration of these accent structures is a relatively fundamental skill, perhaps not particularly affected by musical training. More detailed analyses of the type of errors observed for the two populations are underway, and they should give additional information about the various psychological processes involved for the two groups.[1]

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