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ABSTRACT

An exploratory study examining musicians' perceptual styles was conducted. Musicians described the musical elements they heard while listening to a movement of a symphony by W. A. Mozart. Hierarchical clustering was used to analyze the data. The descriptions revealed individual differences in perceiving the richness and complexity of the music. Different perceptual styles emerged. Some musicians listen to music holistically, reporting on entire phrases and sections, while others listen analytically, giving detailed descriptions as the music unfolds. Some of the major features of the classical musical style (i.e., tonality, rhythm, chords) show little variability among individuals, thus serving as landmarks in the perception of this movement. Individual listening strategies were found to be independent of the musicians major performance instrument and training in composition. The differences among musicians for listening to a musical performance are compared to the differences reported in the literature for story recall and language process.

To understand how individuals process information we must understand how they perceive complex stimuli. For example, in the domain of language processing, it has been shown that subjects tend to report a story according to how they processed text information (Pollard-Gott, McCloskey, & Todres, 1979). In the same context, Thorndyke (1979) proposed that readers have a set of schemata for text organization, and that the application of a particular schema depends in part on the perspective the reader has adopted in approaching the story.

It might be hypothesized that the same kinds of structural organization applied in text comprehension might also relate to the perceptual processes of listening to music. Experience in music teaching led one of us to notice that there are marked differences in the way musically knowledgeable individuals perceive music. Music listening and instruction in the development of listening skills are central concerns of music pedagogy and music theory pedagogy (Carlsen, 1981; Hedden, 1980; Rogers, 1984; White, 1981; Zimmerman, 1971).

Music can be described as a multidimensional stimulus consisting of a "horizontal" dimension (e.g., melody, rhythm), a "vertical" dimension (e.g., harmony), and a "depth" dimension created by the composer in the score and by the musician in the performance. But how do musicians organize the perceptual aspects of music? Do the analytic features of music mirror the perceptual processes of music? Are there important idiosyncratic approaches or styles that are invoked in listening to music? Furthermore, do individuals' primary performance instrument influence how they listen to a musical performance? In this study music perception is defined as the spontaneous descriptions of musical elements given by subjects.

More research experiments have investigated the perceptual capacities of listeners with various levels of musical backgrounds (Flowers, 1984; Pollard-Gott, 1983; Rosner & Meyer, 1982, 1986; Shepard, 1981) than the abilities of those individuals who have reached a very advanced, professional level of musicianship. In one of the earliest studies evaluating subjects' responses to music, Myers (1922) noted that listeners' musical sophistication can influence their mode of listening to music. Comparing how graduate and undergraduate music majors described music excerpts, Flowers (1985) found that graduate music majors used musical terms more frequently than undergraduates. Killam and Baczewski (1985) asked music theorists to write down the soprano line, the bass line, and the harmonic analysis of J.S. Bach's Chorale No. 117 while they were listening to the piece. The results showed that the soprano line was analyzed more accurately than the bass line. The harmonic analysis received the lowest rate of accuracy.

Examining the perceptual capacities of advanced music students can lead us to understand better how they have internalized the musical language. Just as psycholinguists addressed the perceptual capacities developed by native speakers, and cognitive psychologists (Chase & Simon, 1973) investigated the processes of experts in specific domains where processes may become "automatized" (e.g., Logan, 1985), so we may benefit from focusing on the abilities of those individuals who have undergone prolonged and intensive musical training because they have "acquired the language" of music at a level beyond cultural influence or general education.

This investigation addresses how musicians perceive the musical elements of a classical symphony. Aaron Copland (1957) in his book What to listen for in Music explains:

> ... The whole listening process may become clearer if we break it up into its component parts, so to speak. In a certain sense we all listen to music on three separate planes. For lack of a better terminology, one might name these: (1) the sensuous plane, (2) the expressive plane, (3) the sheerly musical plane. The only advantage to be gained from mechanically splitting up the listening process into these hypothetical planes is the clearer view to be had of the way in which we listen. (p. 18)

Specifically, then, this study considers how graduate conservatory students perceive the first movement of W.A. Mozart's Symphony in G Minor, K.550, concentrating on "the sheerly musical plane," and addresses three questions: 1) are there differences among musicians in the perception of music; 2) which musical elements do musicians focus on; and 3) what accounts for the selection processes at different times?

METHOD

Subjects

Eighteen graduate music students of the Juilliard School volunteered to participate in the investigation. They were enrolled in a seminar on the perception of music. None had prior experience in studies of this type. This experiment was run in the early part of the semester. The instructor of the course was careful to see that neither the reading assignments nor the class discussions dealt with the paradigm of this experiment or of potentially similar experiments. Research in individual differences and cognitive styles was not discussed until after the completion of this experiment. The group of subjects included: three violinists, one violist, one cellist, three bassists, one singer, one harpist, one trumpeter, four pianists, two composers, and one composer-pianist (double major). These musicians had a background of at least sixteen years of training. Subjects with such a high level of musical education were chosen because their advanced, professional training assured that they were capable of selecting, naming, and discussing any musical element they heard.

The music selected was the first movement of Mozart's Symphony in G Minor, K. 550. This symphony, given its stature in the literature, was known to all the subjects, thus avoiding potential response bias based on differential familiarity. The recording was a London disc (record number CS 6479), Carlo Maria Giulini conducting The New Philharmonia Orchestra and using the second version of the symphony with two clarinets and changes in the oboe part. The tempo of the movement, *allegro molto*, presents the music at a comfortable rate of presentation. The duration of this movement was eight minutes.

Our aim was to see whether there were differences in how musicians reported listening to the musical elements as they occurred in the presentation of a complex piece. A pilot investigation (Aiello, 1988) found that asking musicians to write down open-ended responses to Beethoven's Violin Concerto elicited a combination of analytical, personal, and inferential responses. Therefore, the present instructions given to the subjects were aimed at eliciting only analytical responses to the music. They aimed to direct the subjects' attention specifically to the musical elements that occur in this movement. The instructions did not ask for the subjects' emotional reactions to the music, nor for their previous emotional associations with this movement. Listening was presented as a perceptual/cognitive task.

The instructions were:

"We will listen to the first movement of Mozart's Symphony No. 40 in G Minor, K. 550 twice. During the first hearing, listen very attentively but do not write on your response sheets. During the second hearing, as you listen to the music describe what you are hearing in musical terms on the response sheets. For example, you may refer to: cadences, chordal structure, development of motives, dynamics, embellishing tones, form, harmonic rhythm, harmonic sequences, harmony, instrumentation, interpretation, melody, melodic motives, melodic rhythm, modulations, motives, motive variations, orchestration, registers, rhythm, rhythmic motives, rhythmic variations, style, tempi, themes, timbre, tonality, variations, etc. These items are listed alphabetically and not in any potential order of importance or appearance in the music. You may also describe other musical elements that are not included in this list. At the conclusion of the second hearing, you will have five minutes to go over your descriptions and to write any concluding statements that you wish to make. This is not a music theory exam nor a dictation exam. Your descriptions of what you are hearing will help us to understand better how people perceive music. Thank you for your participation."

While these instructions led subjects to focus on the musical elements of the movement, within this domain subjects were free to give any response they felt appropriate. After the directions were handed to the subjects, questions on the procedure were answered. Subjects wrote the description of what they heard on notebook paper. The music was played at a comfortable listening level over a high fidelity stereo system in a classroom. There was a pause of approximately one minute between the first and the second presentation.

ANALYSIS

To examine whether individual differences could be observed across both musicians and musical elements, hierarchical clustering of the musicians' free responses was employed. This method pairs the responses according to their similarities. As the focus of this study is on comparisons among subjects and not inference to a population, the large sample sizes necessary to accurately make such an inference are less critical here.

While the technical details of clustering methods are more fully described elsewhere (e.g., Dillon & Goldstein, 1983), we can outline some conceptual bases for these analyses. For example, if all subjects had completely unique perceptions of the presented music, no clusters would be obtained because each subject would be dissimilar in all ways to any other subject. On the other hand, if musical training had served to make subjects' responses to the music more uniform, then one general cluster describing the complete similarity among subjects would be obtained. The actual pattern of responses might be expected to fall somewhere in between these two extreme types.

By using this method of analysis, we are able to examine both quantitative and qualitative differences among the responses of the individual musicians. For example, two musicians who mentioned the same musical element with the same frequency would be maximally similar. Differences between two individuals would occur if they named different musical elements, if they named the same musical elements with different frequency, or both. In examining these clustering results, we can observe the degree to which homogeneity/heterogeneity exists among these musicians. At least two pieces of information can be abstracted from these clustering results. First, the global similarity across the musicians' responses can be determined—namely, is there much variability across individuals in the sample? Second, the pairwise similarities between musicians can be examined—namely, are there clusters of individuals who perceive the movement in the same way?

RESULTS

An initial look at these data revealed a breadth of answers in reporting the musical variables across subjects. In other words, despite similarities in background and musical training, the data seem to reflect diverse strategies in listening to music because the subjects used different perceptual strategies in their listening. Across all subjects, a total of 94 musical elements was reported. The number of musical elements used by the musicians in their descriptions ranged from 14 to 63 with a mean of 40.6. 11 of the 18 subjects mentioned less than 40 variables in their descriptions; the remaining seven subjects mentioned more than 40 variables. Each musical element was uniquely coded into one of eight categories: tonality, rhythm, chords, harmonic structure, form, themes, instrumentation, and miscellaneous elements.

Our aim was to see, in broad terms, whether there was uniformity in the subjects' responses. We examined this by looking both at the content of the subjects' responses as well as performing a centroid hierarchical clustering analysis on responses within each category. Recall that, if subjects demonstrated complete uniformity of response within any musical category, we would expect graphs that were flat indicating no differentiation. On the other hand, with complete dissimilar responses across subjects, we would predict a "skyline" pattern with no two subjects' responses being identical.

In each graph, the subjects' initials and their musical specialization are indicated along the x-axis. Greater similarity between two subjects is indicated by their adjacency along the x-axis. The y-axis provides a metric for assessing similarity with zero representing maximum similarity. For example: two subjects who gave the identical set of responses will form a cluster and therefore be next to each other along the x-axis. Their identical responses would be denoted by a zero along the y-axis.

CONTENT OF SUBJECTS' RESPONSES

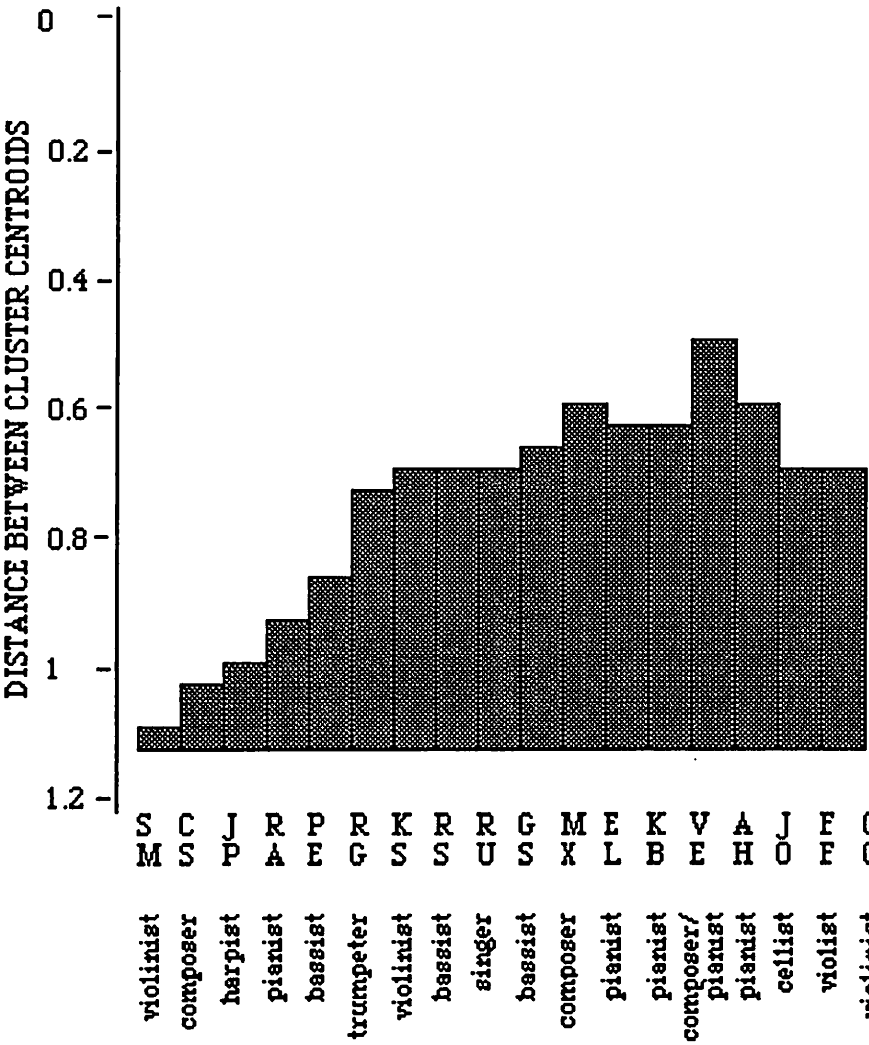
The subjects' data showed a wide range of descriptions. What follows are the beginnings of two prototypical descriptions given by CS, a composer, and by VE, a composer-pianist. These examples illustrate the wide differences with which musicians described what they heard. CS wrote: "minor mode; repeated rhythmic pattern of main motive; sequence; bass movement; winds; cadence; repetition of opening motive; modulation; forte; sequence; large cadence; pause; second theme; contrast to first; winds used more; etc...." CS described isolated events, focusing on relatively brief details. His description seems linear. On the other hand, VE reported: "phrase structure (phrase expansion); motivic connection between themes; rich contrapuntal figuration; cell-structure motives; additive instrumentation; sonata form; development section; highly contrapuntal (imitation) taken from what was hinted at in the exposition; etc...." VE's description reflects a gestalt organization of the listening experience. His comments seem global, cyclical, and based on a longer period of time.

The first musician, CS, wrote down musical elements as he heard them, analyzing the music in minute detail. His mode of listening is very analytic or fragmented. VE's description, on the other hand, shows that he waited longer before describing what he heard reflecting a holistic, gestalt mode of listening. These two musicians, both composers, differ in how they abstract from the complexity of the music, and in their organization of the time experience.

HIERARCHICAL CLUSTERING ANALYSIS

If the content analysis of the subjects' responses is correct, we might expect these two types to be represented at opposite poles of a clustering analysis. In other words, the dissimilarity in the content might be represented by dissimilarity in the cluster solution. These categories were employed to provide a more fine-grained analysis of musical elements than would be allowed from a simultaneous analysis across the full set of response patterns for subjects. Figure 1 shows the profile of the musicians based on all their responses. As expected, the data of CS, the composer who gave an analytic listening description, and the data of VE, the composer-pianist who provided a gestalt description are toward the two extremes of the graph. The subjects' major performance instrument and training in composition did not seem to influence whether they listened analytically or holistically.

Figure 1. Centroid hierarchical clustering graph based on all subjects' responses. Subjects' initials and musical specialization are indicated.



As previously mentioned, the listeners reported a total of 94 musical elements. For the purpose of analysis, each musical element was assigned to one of the following eight categories based on the responses of the subjects: form, harmonic structure, chords, tonality, rhythm, themes, instrumentation, and miscellaneous elements.

FORM

The data categorized as form included the following elements: section, development of section, exposition, repeat of exposition, closing section, recapitulation, coda sequence, transition, repeat, structure, phrase structure, question/answer, sonata form, balance of form, architecture. The centroid hierarchical clustering graph representing these data is shown in Figure 2.

HARMONIC STRUCTURE

Figure 3 illustrates the centroid hierarchical clustering graph for the responses categorized as harmonic structure. This category included the following elements: harmonic structure, harmonic pattern, harmonic progression, cadence, pedal point, accompaniment, bass line, deceptive cadence.

SPECIFIC CHORDS

Figure 4 illustrates the centroid hierarchical clustering graph for the responses categorized as specific chords. This category included the following elements: chord; arpeggio; inversion; chords: I, VII, V, I; chord: V; chord: VII.

TONALITY

Figure 5 illustrates the centroid hierarchical clustering graph for the responses categorized as tonality. This category included the following elements: key of g minor, key of E-flat major, key of B-flat major, key of D major, key of d minor, key of F major, relative major, major/minor, modulation, circle of fifths.

Figure 2. Responses to overall form.

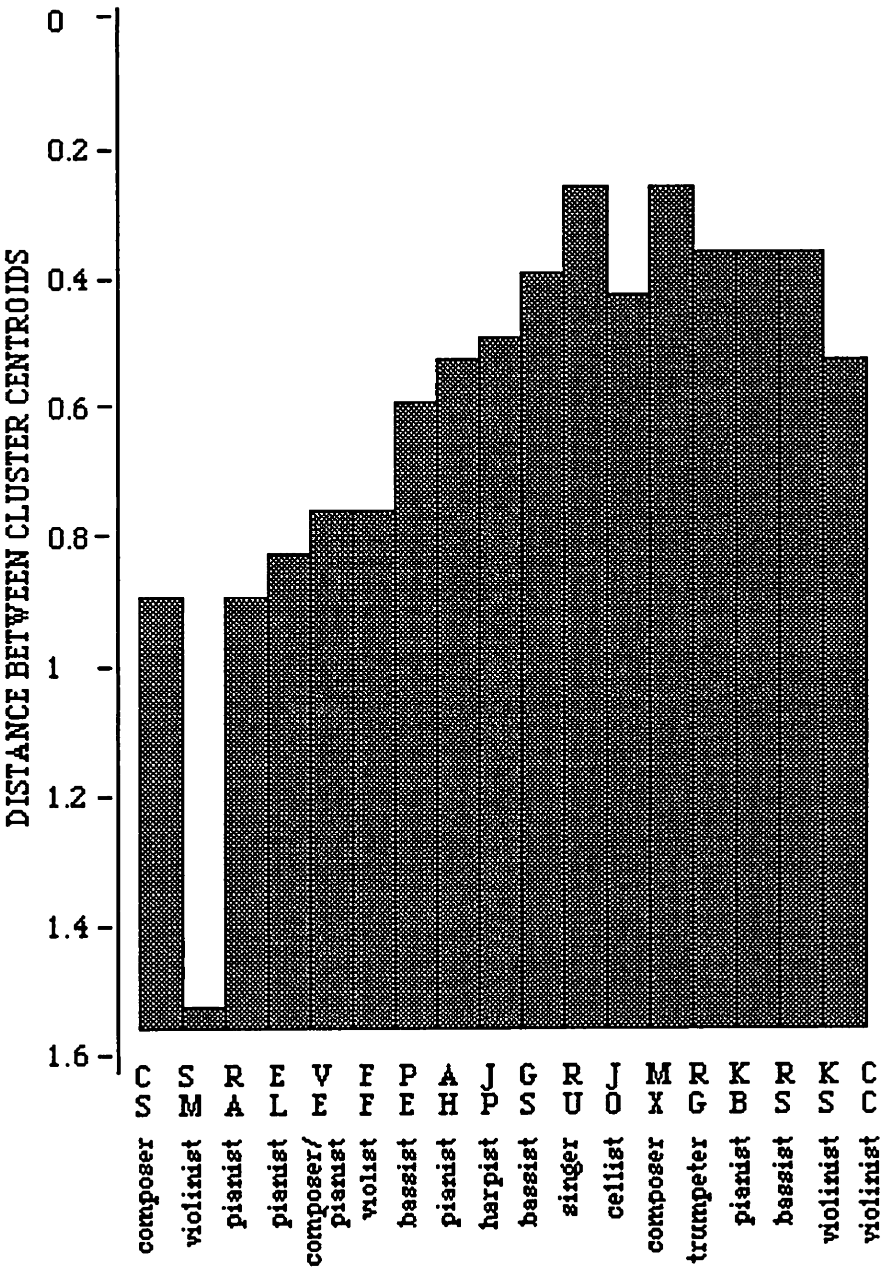


Figure 3. Responses to harmonic structure.

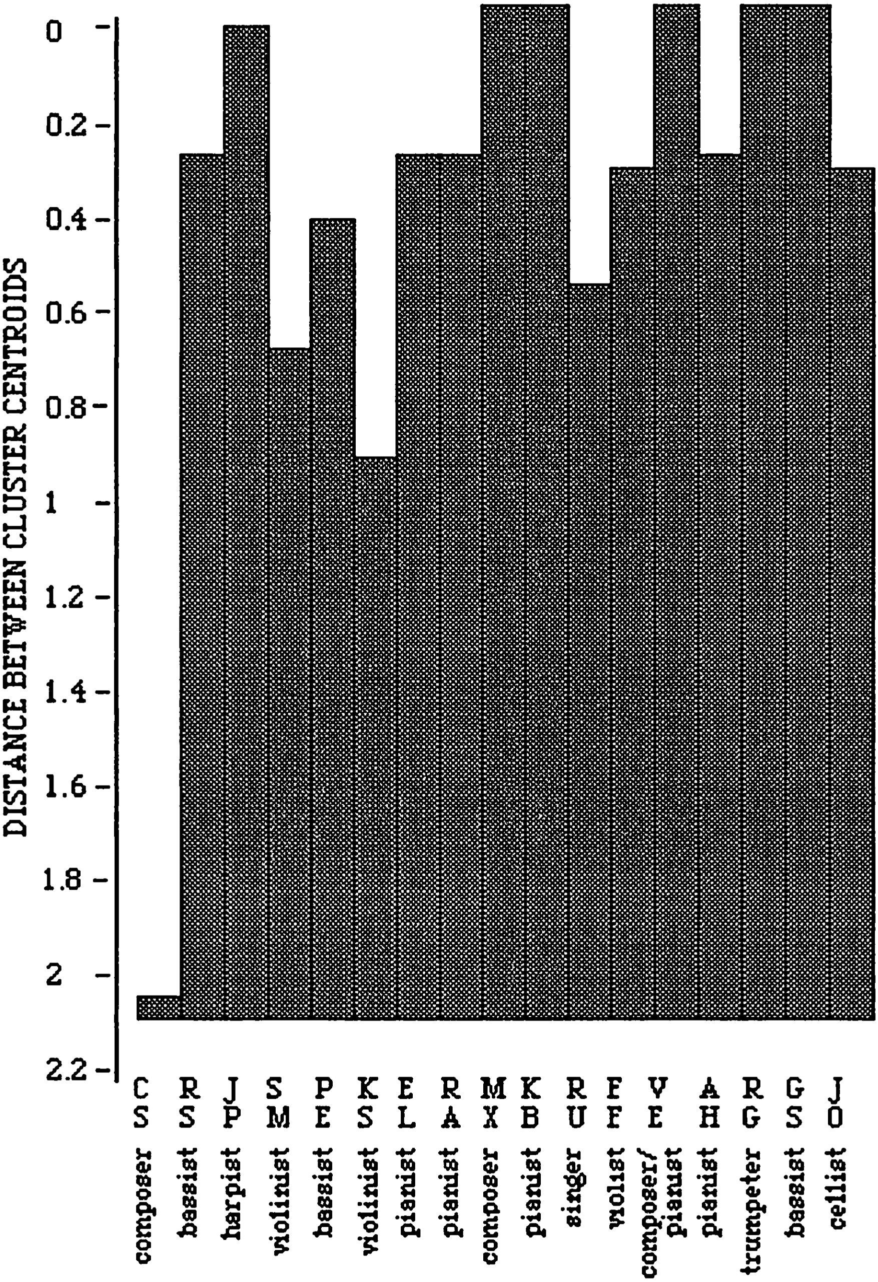


Figure 4. Responses to chords.

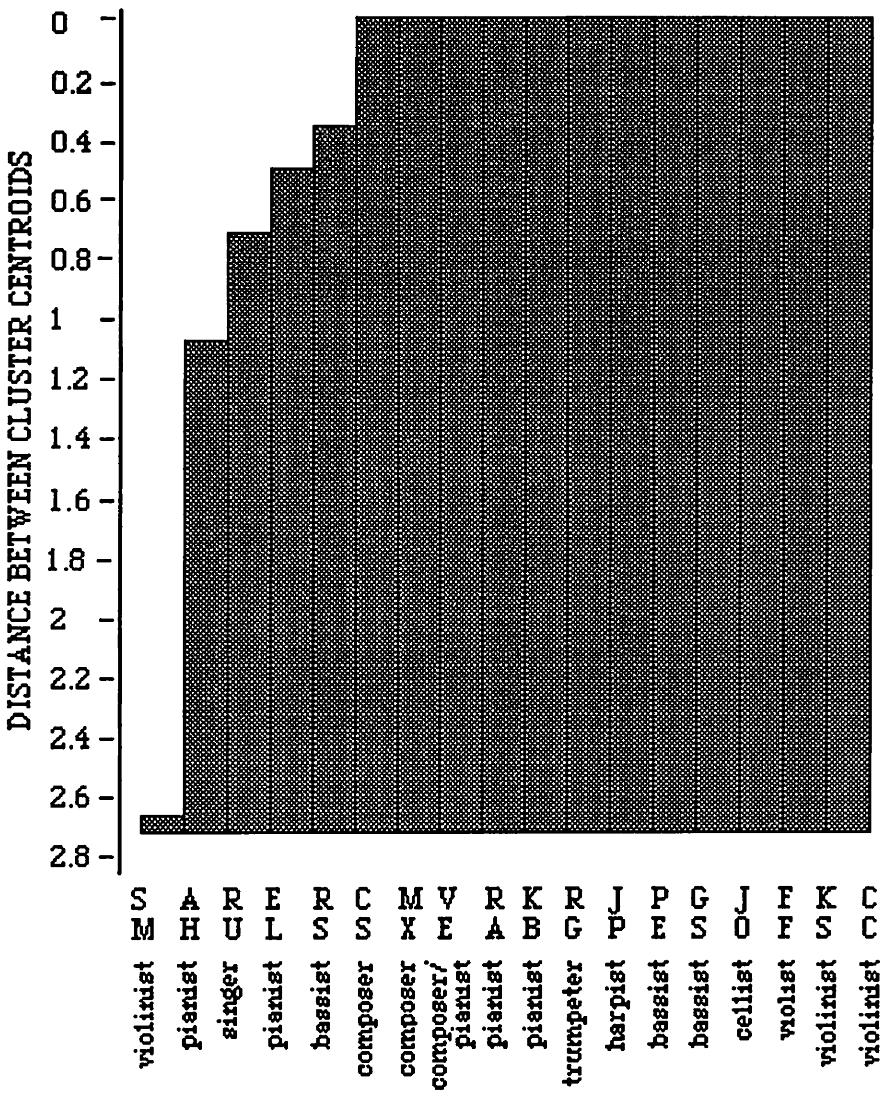
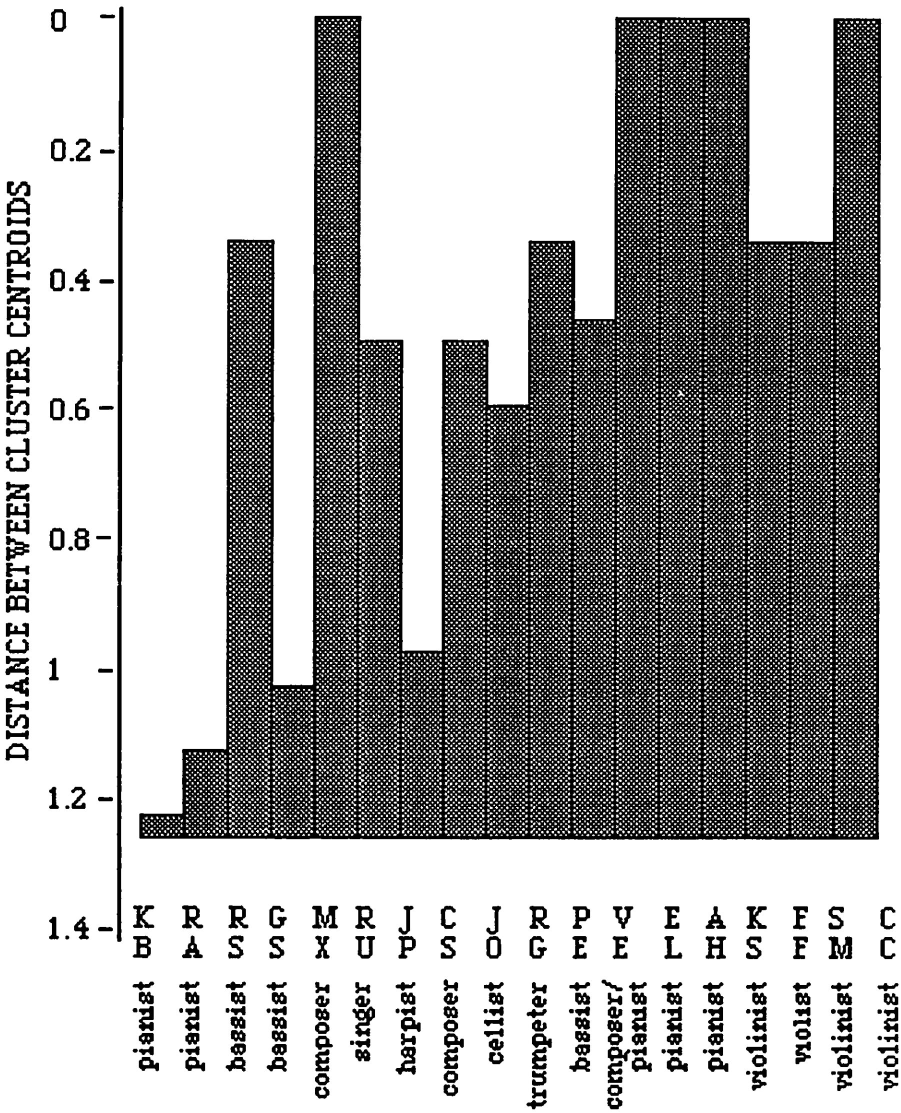


Figure 5. Responses to tonality.



RHYTHM

Figure 6 illustrates the centroid hierarchical clustering graph for the responses categorized as rhythm. This category included the following elements: rhythm, rhythmic motion, rhythmic similarity, rhythmic pattern, harmonic rhythm, up-beat.

MUSICAL THEMES

Figure 7 illustrates the centroid hierarchical clustering graph for the responses categorized as musical themes. This category included the following elements: themes, development of themes, first theme, second theme, third theme, motive figure, cell- structure motives, melody.

INSTRUMENTATION

Figure 8 illustrates the centroid hierarchical clustering graph for the responses categorized as instrumentation. This category included the following elements: instrumentation, open sound, horns, strings, violins, violas, celli, bass, winds, bassoon, oboe, clarinet, flute. The subjects did not report hearing their major performance instrument with a greater frequency than other instruments.

MISCELLANEOUS MUSICAL ELEMENTS

Figure 9 illustrates the centroid hierarchical clustering graph for the responses categorized as miscellaneous. This category included the following elements: emotional quality of the music; phrasing; performance quality; dynamics; texture; feeling/balance; dialogue; rest/silence; length of note; length of phrase; canon; canon entrance; altered material; number of measures; counterpoint; chromaticism; ascending scale; descending scale; minor second interval; tempo; contrast. Although "emotional quality" was not included in the list of musical terms given in the directions, ten musicians mentioned it in describing what they heard.

Figure 6. Responses to rhythm.

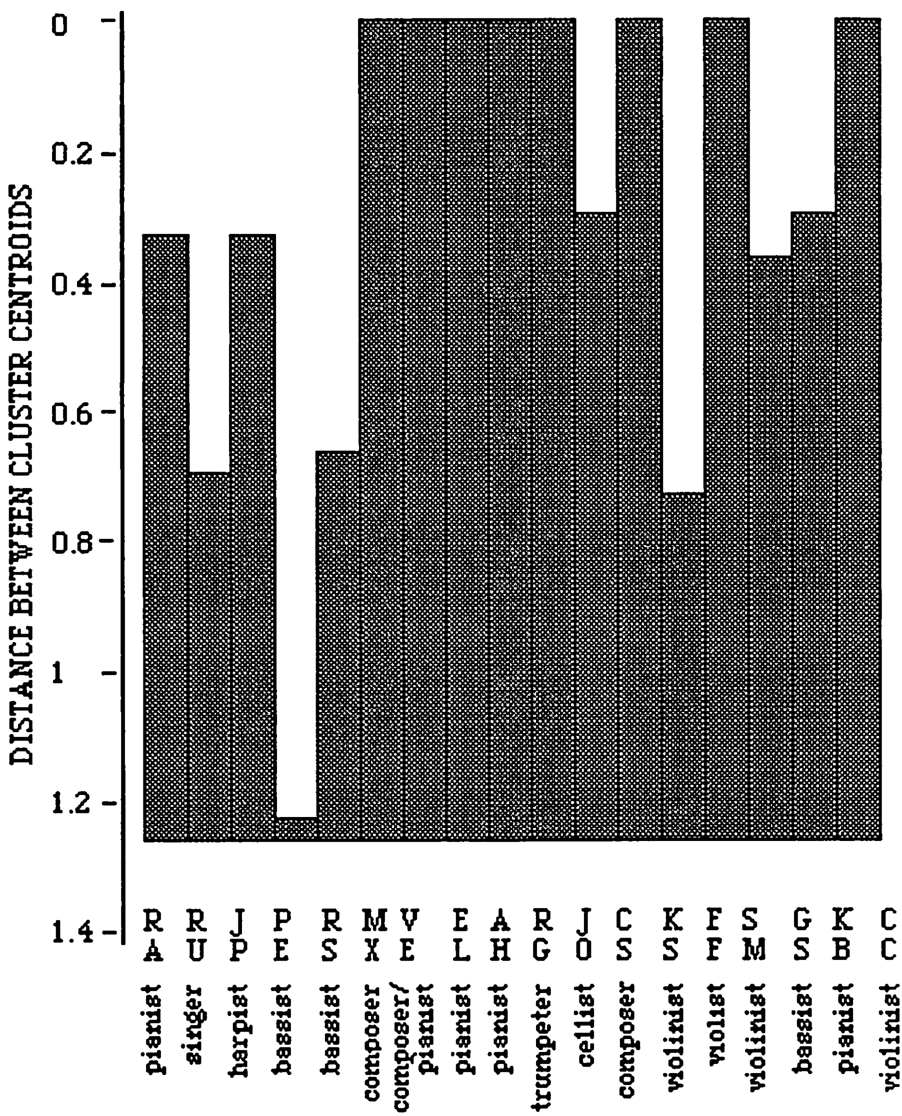


Figure 7. Responses to musical themes.

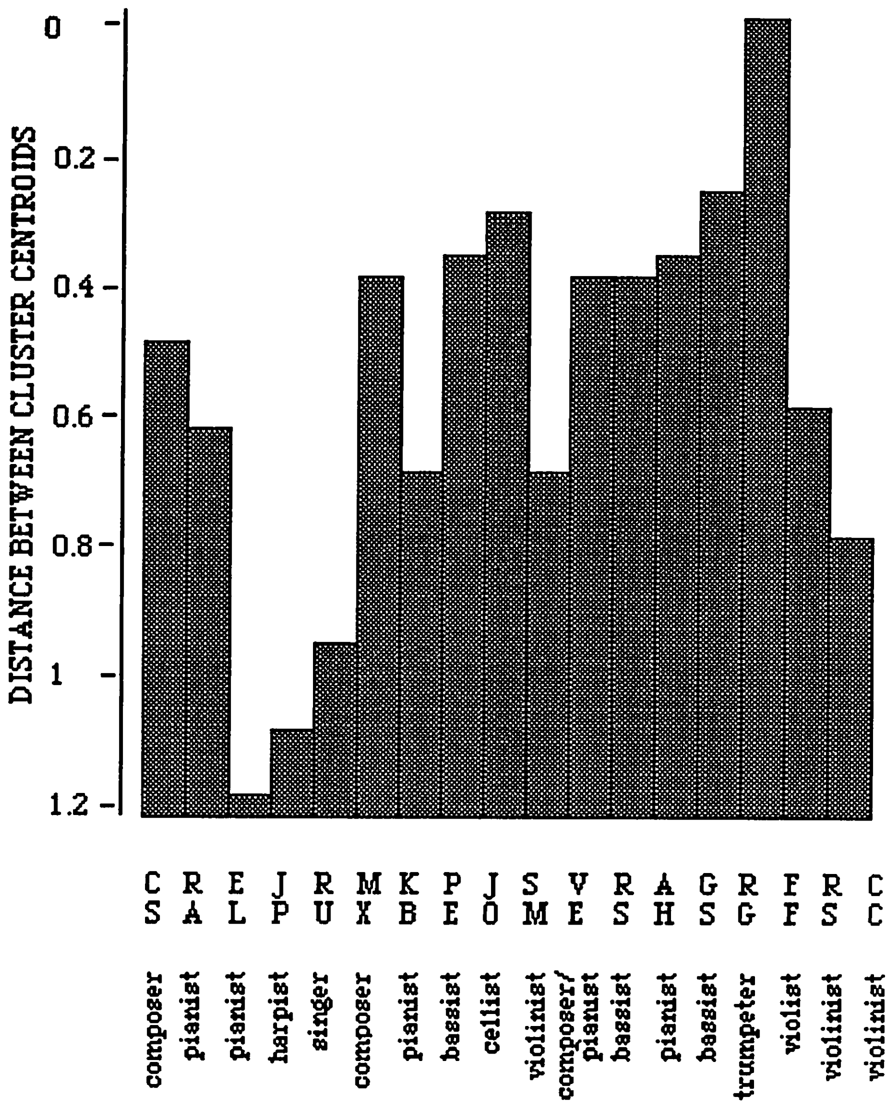


Figure 8. Responses to instrumentation.

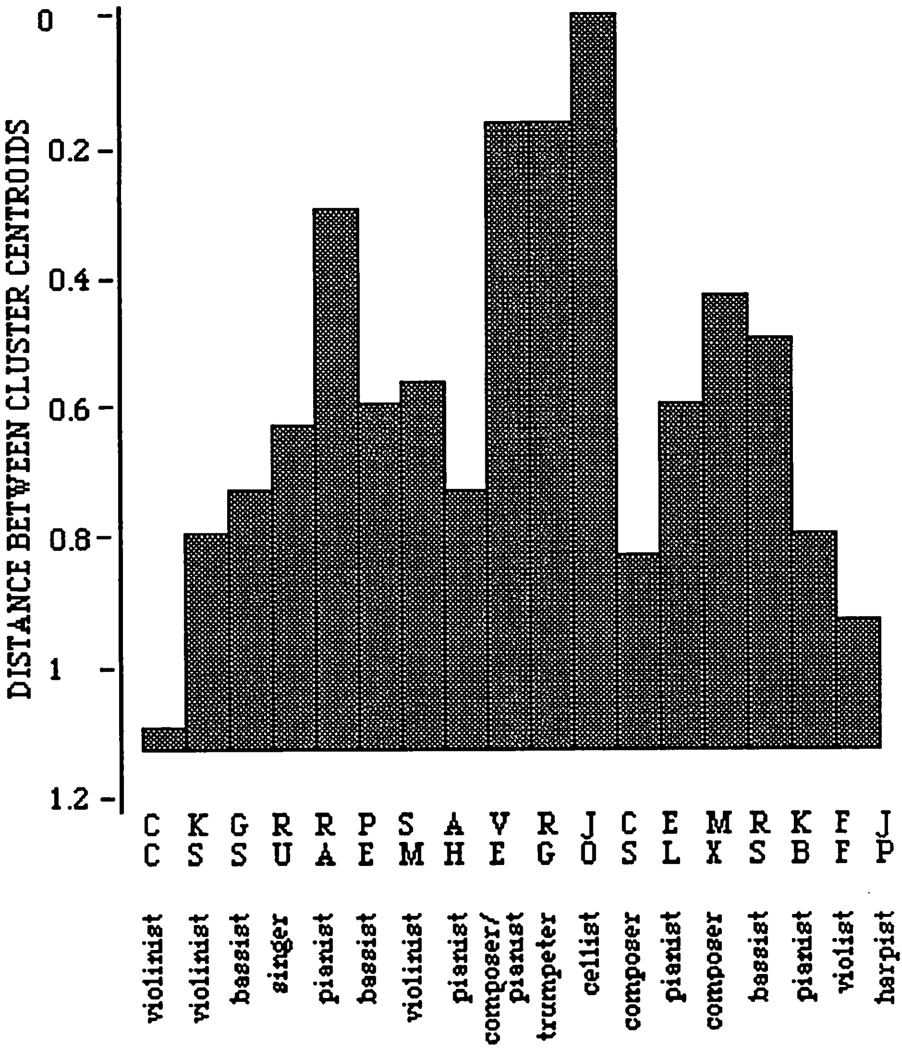
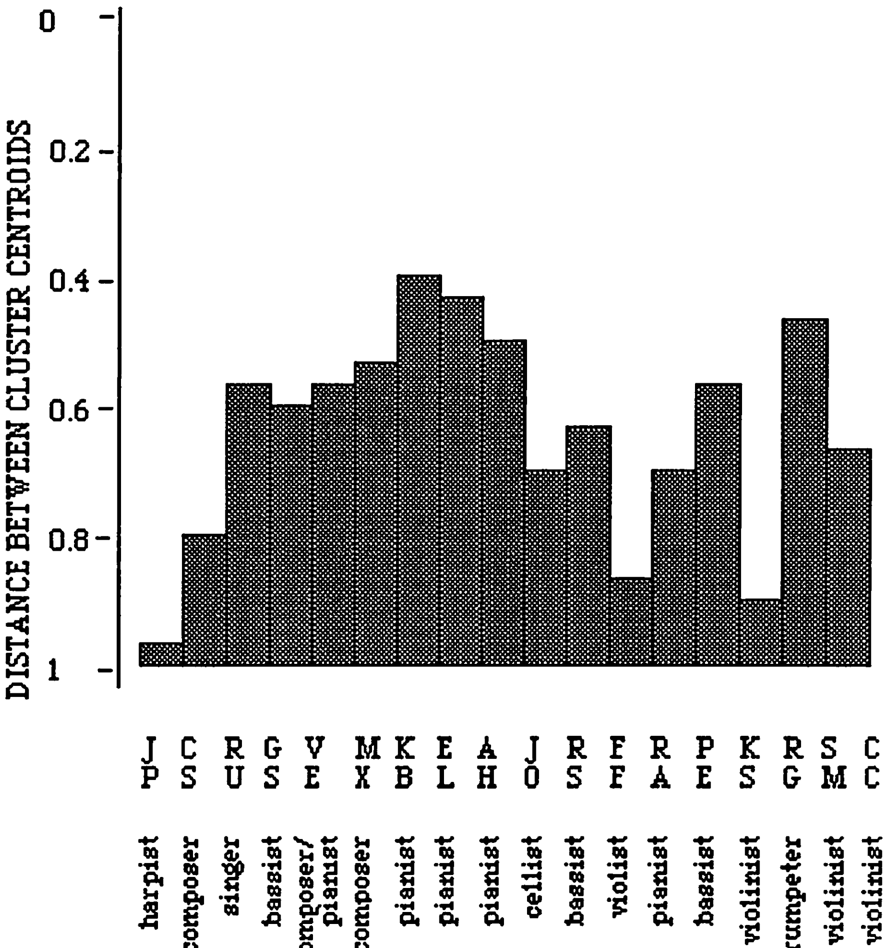


Figure 9. Responses to miscellaneous elements.



To get another perspective on the relative homogeneity or heterogeneity of the subjects across the eight major categories, Table 1 presents both the standard deviations of the observations and the root mean square distance between the observations. These quantities give numerical indices of the extent to which subjects are relatively homogeneous or heterogeneous along a given dimension, with larger numbers indicating greater heterogeneity. As can be seen from Table 1, the root mean square distance is smallest for "primary" musical elements in the classical music style (e.g., tonality, rhythm, chords) and grows more heterogeneous for other elements (e.g., instrumentation and miscellaneous elements).

Table 1. Root Mean Square Distances.

Musical Category	S.D.	Root Mean Square Distance Between Observations
Tonality	0.62	2.78
Rhythm	0.91	2.88
Chords	0.85	2.95
Harmonic Structure	1.05	3.65
Form	0.69	4.01
Themes	1.13	4.55
Instrumentation	1.19	5.81
Miscellaneous elements	1.01	6.69

Table 1 seems to suggest that subjects perceived with greater homogeneity the elements of the classical musical style that are the most stable, such as tonality, rhythm, and chords.

DISCUSSION

There are marked individual differences among conservatory students in the way they listen to music. These differences are both quantitative and qualitative: there are both differences in how much information the musicians abstract from the music and in the way they process the information. Since the subjects were free to describe any musical elements they heard, their selections and descriptions reflected their individual listening strategies. The directions asked the listeners to focus exclusively on the musical elements. At any given moment in the music, many different musical elements and combinations of elements occur simultaneously.

Let us say, for example, that at the very same moment you could focus on the melody played by the violins, on the repetition of a rhythmic figure played by the bassoon, on the entrance of the brass, etc. As people listen, their attention is selective. It shifts from one element to another. What the subjects report reflects which musical elements they choose to focus on. Their answers reflect their individual choice of focusing on the melody, for example, rather than the repetition of the rhythmic figure played by the bassoon, or the entrance of the brass.

Therefore, although the directions clearly asked them to focus on the musical elements as they occur in the music, which elements they reported and how they reported them was a matter of selective attention. Consequently, selective attention was strictly based on the individual's choice among the musical variables in the music and the full amount of information available in this example. It is relevant that this attention mechanism appears to be unrelated to factors such as the musicians' primary performance instrument.

The centroid hierarchical clustering graphs in Figures 1-9 based on both the qualitative and quantitative responses of the subjects' reflect a wide diversity of responses. Further, root mean square distances, another measure of response variation across individuals, show that tonality, rhythm, and chords are the elements musicians perceived in the most homogeneous manner in this performance. To what can we attribute these results? Possibly to the fact that, in this movement, the listeners perceived that tonality, rhythmic patterns, and chords offered more meaningful landmarks that the other musical elements.

This result is consistent with the importance that music theory of the Classical period places upon a well defined tonality, clear rhythmic patterns, and clear chordal functions. Although we theorize that other styles of music (e.g., twelve-tone) would show a different ranking order in how musicians perceive musical elements, at this point we should interpret the present results as being relevant only to the performance of this movement. Future research might consider the generalization of this finding to other kinds of music where these landmarks may not be as relevant.

Content analyses of the descriptions provided by CS and VE, both composers, support the hypothesis that trained musicians differ in their approaches to music listening. Some heard isolated features of the musical patterns, while others were sensitive to a holistic, gestalt interpretation of the music. Some musicians listened analytically, reporting single musical elements as they heard them, and by jotting down individual terms. Others listened to complete units, "chunking" the music, describing what they heard over an entire phrase, or over a section. It seems almost as if the latter subjects looked back and reflected on a whole, a complete unit. These differences may be due to differences in their perceptual strategies. The listening experience reported by the analytic listener and gestalt listener are remarkably different.

These findings can be related to observations made by other music researchers. Bamberger (1978) reported that two adults of moderate musical background who were asked to compose a simple piece of music at a computer showed different strategies in performing the task. One subject composed the piece almost motive by motive, phrase by phrase; the other, instead, sketched first a beginning and a finale, and then filled in the middle part. In addition, Bamberger (1977) observed that children asked to line up Montessori bells so they could play a simple nursery tune did so using various internal strategies of representation. Schmidt (1984), using freshman level students enrolled in music theory classes, investigated the relationship among aspects of cognitive style and the perception of melodic interval identification, chord type identification, and melodic dictation. His findings suggest that some cognitive style tests may help predict student performance in listening exams. With reference to language processes, Shannon (1984) found that, in studying room descriptions, subjects tended to give focal or global evaluations. Kintsch and van Dijk (1978) have proposed a model of text comprehension and production that can be described at the local micro-level, and at a more global macro-level.

PEDAGOGICAL IMPLICATIONS

Listening to music is at the core of music theory teaching. To most effectively teach students how to listen, it is important to know what they are hearing. Their listening responses give us a valid beginning. The results of this investigation show that there is wide diversity in how advanced music students report listening to music. The diversity of their responses shows that musical elements and musical form can be perceived in different ways.

Robert Gauldin and Mary Wennerstrom (1989) have recently pointed out that experimental findings in music perception and theories of music cognition may influence music pedagogy. As teachers we can benefit from observing the perceptual diversities among our students. Being aware that music can be perceived according to a variety of listening styles can help us develop new ways of presenting, discussing, and teaching musical elements and form in music theory, music appreciation classes and in applied instrumental instruction as well. Appreciating individual responses in listening to music can help us teach a piece from different perspectives.

Using a shorter and less difficult musical work, the basic paradigm of our experiment could be duplicated with students who are not as advanced as the musicians in this study. It would be sufficient that subjects had a vocabulary adequate to name events in the piece they were listening to. The results could be discussed as part of a lesson or unit in aural skills. For instance, the same composition could be played twice and students could be asked to focus on and report different musical elements each time. While discussing the results with the students, we could further expand their horizons of what the musical elements in the piece are, what the form of the composition is, and what can be extracted from the music.

The musical elements that students report and how they report them show us what is important to them. What might they have missed in their listening that we should point out to them? How can we help them to listen with greater awareness? As students see that there is no uniform way of listening to music, they may become more ready to explore listening to other musical elements or other combinations. Illustrating various ways music can be reported may offer students possibilities of grouping elements differently, listening at differing levels, and with differing emphases.

We agree with Prince (1972) that listening is a dynamic process with many variables in a constant state of change. Aaron Copland (1957) writes: "We all listen to music according to our separate capacities." (p.18). "The intelligent listener must be prepared to increase his awareness of the musical material and what happens to it. He must hear the melodies, the rhythm, the harmonies, the tone colors in a more conscious fashion" (p.22).

In summary, this inquiry into the listening strategies of musicians shows that a high level of musical training does not lead to a uniform way of perceiving music. Music education and training broaden students' base of musical knowledge and provide them with the "language" for describing what they hear, but musicians can utilize this knowledge selectively, according to the particular musical elements they choose to attend to. In listening to music, musicians focus on different musical elements and perceive the complexity of music according to individual cognitive strategies. These results suggest that further research in the individual differences shown by musicians will help us not only to understand music perception better but also to broaden our understanding of cognitive processes at large.

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