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Analyzing Cultural Products: A New Method of Measurement

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This research demonstrates a new technique for directly analyzing symbols. I present a full set of newly devised indicators allowing for the systematic measurement of musical symbols. Specifically, musical symbols are approached as symbolic codes; the measures classify these codes along several continua ranging from basic to embellished in design. Statistical tests assure us of the measures' validity. Using them, any piece of Western tonal music based on diatonic scales can be quantitatively measured in a precise and easily replicateable manner. Consequently, musical symbols become an accessible source of sociological data, amenable to all the rigorous research methods that are a central part of the sociological tradition. Potential sociological applications of the measures are presented and discussed. © 1988 Academic Press, Inc.

"Marshall thy notions into a handsome method," writes Thomas Fuller. "One will carry twice more weight packed up in bundles than when it lies flapping and hanging about one's shoulders." Social scientists have historically posed many fruitful notions regarding the relationship between culture, society, and the behavior of social actors . . . notions that link, for example, social class, social solidarity, or power to variations in symbols and rituals . . . notions that link different symbols and rituals to varying levels of social action. (For a good review, see, e.g., Peterson, 1979; Wuthnow, 1987.) These notions are enjoying a new popularity demonstrated, for example, by increased numbers of culture studies in some of sociology's most central journals as well as the development of a "Culture Section" in the American Sociological Association. When it comes to marshalling such notions into a handsome method, however, social scientists fail to agree on the appropriate course of action. Some believe that culture is correctly studied only through a "humanistic approach"—an in-depth focus on a single phenomenon or a limited number of objects. Only such intensive study can capture the richness and complexity of culture. Yet the humanistic approach, while valuable, simply

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does not offer the potential for generalization and testing—both of which are important components of the sociological tradition. So, as Griswold writes "Like slivers of dialectical moments, such bits of local knowledge are rather more tasty than they are scientifically nutritious" (1987: 2).

Some offer a "scientific approach" as a contrast to humanist studies of culture; it operates according to sociology's strong suits, e.g., hypotheses, systematic testing, generalization. Still, the "nutritious" generalizations of such scientists are not always intellectually satisfying; the unique nature of cultural products often seems secondary to their investigations. The scientific approach often

> treats cultural objects as if they were the same as other objects of production and consumption, except possibly for their aura and their related ability to demarcate status positions. An approach to culture that is uninterested in meaning or in how cultural objects differ from porkbellies, seems destined to continue to play a marginal role in cultural, though perhaps not social, analysis (Griswold, 1987: 3).

Is it possible to transform the humanist–scientific duel into a fruitful partnership? Is there a systematic method by which we can analyze cultural products, remaining true to their unique and complex characteristics, while at the same time being able to validate, replicate, and generalize our findings? This work offers a modest first step in that direction.

Scholars of culture write much about the conventions surrounding the creation of symbols (e.g., Meyer, 1956, 1967; Gombrich, 1960, 1981; Becker, 1973, 1982; Rosenblum, 1978). This paper offers a set of tools for analyzing the conventions that comprise the structure of the symbol itself. (By structure, I mean the symbol's design or configuration.) I have used a specific type of symbol—music—to help develop these tools. My approach attempts to combine ideas from traditional music theory, information theory, and semiotics. The resulting indicators allow us to examine musical structure as a set of codes ranging from basic to embellished in design. (This approach to music is supported by many musicologists, most notably Meyer, 1956, 1967; Youngblood, 1958; Cooke, 1959; Moles, 1966; Nattiez, 1972; Ruwet, 1972; Lerdahl and Jackendorff, 1977; and sociologists of culture such as Bergesen, 1979; and Cerulo, 1984, 1986, 1988a. For a good review of the musicology literature, see Bent, 1980: 340–388).[1] The measures make it possible to thoroughly

[1] There have been attempts to quantify music in the past. Some notable examples include Bronson (1959, 1972), Honigsheim (1962, 1979), Csebfalvy *et al.* (1965), Lomax (1969), Halmos (1970), John (1970), Kagen (1970), Scherrer and Scherrer (1971), Lerdahl and Jackendorff (1977), Simonton (1980a,b), and Cerulo (1984). Interesting comments on this literature and additional references are given by K. Peter Etzkorn in Honigsheim (1979). A larger review can be found in Cerulo (1986). For all their undeniable virtues, these attempts, and others like them, suffer some major flaws. First, they usually attend to only

analyze large samples of music in a precise and easily replicateable manner. Equally important, the measures allow us to analyze music while respecting the richness and nuances of the genre. Thus, we acquire a "handsome method" for exploring research "notions" that are central to the sociology of culture. For example, this article approaches variations in musical structure as different communication strategies—different structures conveying different messages. Once providing a method that can capture these structural variations, we can better explore the factors that influence the choice or the effectiveness of a particular strategy. Do social forces influence the structure of musical symbols communicators deem appropriate to convey a message? Are certain structures more effective than others at capturing audience attention? . . . motivating action? Do differentially stuctured musical symbols elicit different audience responses?

This paper begins by presenting the indicators devised for measuring musical structure. After a brief discussion of their validity, I will demonstrate and discuss some of their potential sociological applications.

MUSICAL STRUCTURE AS CODE

Music is a symbolic means of conveying thoughts, emotions, and information. Music's structure is composed of several symbolic *codes:* melodic codes, phrase codes, harmonic codes, form codes, dynamic codes, rhythmic codes, and orchestrational codes (see, e.g., Apel, 1974; Benward and Jackson, 1975; Westergaard, 1975). These codes consist of notes; the notes derive their meaning according to their placement within a larger system. So for example, the note "Middle C," sounded in isolation, has no significance for a listener. In fact, a listener (unless possessing perfect pitch) may be unable to identify that note if heard as an independent unit. It is only when a listener hears "Middle C" with reference to the melody of which it is a part, or with reference to its chordal accompaniment that the pitch takes on meaning.[2] Musical codes,

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a single dimension of one musical element, for example, the repetition of a major theme in a melody. Such a narrow focus presents limited, and sometimes, misleading results. In addition, these previous attempts usually limit their focus to a single musical element (i.e., melody, harmony). This study overcomes these problems. First, it takes a more exhaustive approach to each dimension of music than any of the works cited. Second, I have developed measures for all the dimensions of musical structure: melody, phrasing, tonality, form, dynamics, rhythm, and instrumentation. I have also devised a summary measure of overall musical structure; one indicator which combines the various properties of music just listed. For more detail, see Cerulo (1986).

[2] In fact, one can think of very limited instances in which pitches are sounded as independent units, for example, train whistles or dinner bells. If we concede that such occurrences are, in fact, examples of music and not simply examples of "noise," we must still acknowledge the role of dimensions such as duration of the sound or repetition of the sound in bringing meaning to the pitch.

then, consist of the relationship between notes. They are *a configuration of units*. Different configurations produce different codes. (These ideas are grounded in the works of Levi-Strauss, 1966; de Saussure 1959; Barthes, 1968; Eco, 1976; Leach, 1976; and Wuthnow, 1987.)

Musical codes encompass a wide variety of dimensions. Yet, we can begin analyzing their structure by attending to some of their most central elements. My work examines musical codes as they exist on a continuum of basic to embellished design. (In large part, this continuum addresses the complexity of musical codes.) Each end of the continuum represents a different strategy or style of constructing a musical code. *Basic codes* are characterized as highly stable, constant, and fixed. Composers achieve stability by limiting the available range of musical motion. In moving from one point to another, the composer chooses the most direct route. Minimizing movement in this way creates constancy. In basic codes, composers actively refrain from varying and ornamenting simple musical patterns. In so doing, musical structure is fixed, in that numbers of musical combinations are necessarily limited and the range of musical sounds is restricted. Basic codes represent the foundational elements—the building blocks—of music composition. They offer the most concise, direct method of fulfilling the rules upon which Western tonal music is based. (For information on the rules of music composition, see, e.g., Dahlhaus, 1980a,b; and Lindley, 1980. Dahlhaus 1980a:179 states that these general rules are established as early as 1600 and are carried through to the 1900s.) *Embellished codes* embody opposite qualities. They are decorations and distortions of basic codes. Embellished codes present erratic, wandering motion. In them, the composer broadens the alternatives for movement. Rather than minimizing input, a composer utilizes variation and ornamentation. The composer develops, disrupts, or deviates from basic patterns. Hence, embellished codes are necessarily flexible, appealing to a wider range of musical sounds and combinations. Unlike basic codes, embellished codes elaborate, manipulate, and sometimes disrupt the central elements of Western tonal music composition. (For additional support of the basic–embellished contrast, see, e.g., Meyer, 1956, Chap. 6, 1967, Chap. 1; Youngblood, 1958; Moles, 1966; Bergesen, 1979; and Cerulo 1986, 1988b.)

The basic–embellished aspects of musical codes can be quantified. Because of space concerns, this paper limits its illustrations to melodic and rhythmic codes. However, formulae for other musical codes (phrasing, harmonics, form, dynamics, and instrumentation) will be presented in tabular form. In this article, I will apply the measures to a sample of 154 national anthems. However, as we will see in a later section, the measures can be used to analyze other types of Western tonal music based on diatonic scales (i.e., major scales, minor scales, or church modes).

Melodic Codes

Melody is a succession of single musical tones—a series of pitches arranged horizontally on the musical staff. These tones are organized in arithmetical relation to one another and, in general, display a logical and discernable sequence of musical sound. This sequence determines the basic–embellished structure of the melodic code. To quantify this structure, we must attend to the previously stated characteristics of basic and embellished codes. Specifically, we must examine four of the primary dimensions of melody: frequency of melodic motion, magnitude of melodic motion, method of constructing motion—i.e., conjunctness vs disjunctness, and melodic ornamentation—i.e., the decoration of central melody notes (for a more detailed explanation of these melodic properties, see Siegmeister, 1965; Apel, 1974; Benward and Jackson, 1975; Westergaard, 1975; Kerman and Kerman, 1980; and Ringer, 1980).

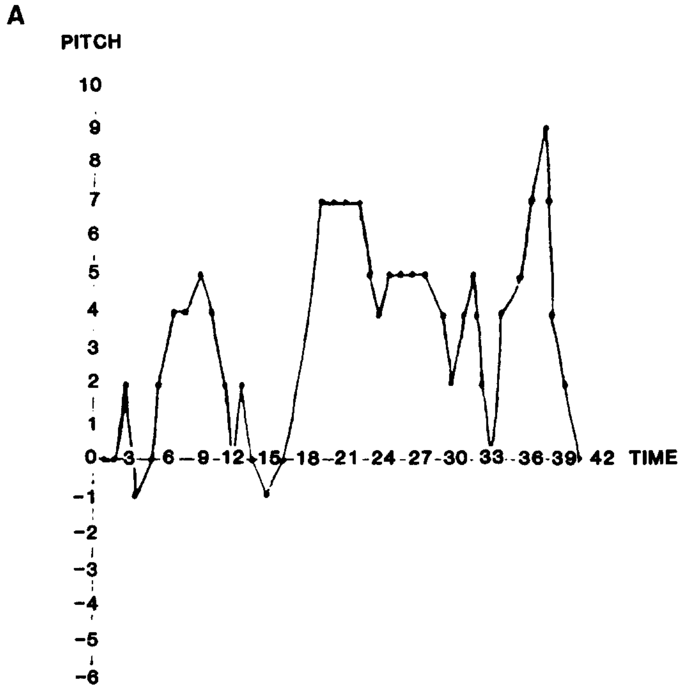
Pitch/Time graphs provide a method for examining frequency, magnitude, method of movement, and ornamentation.[3] Such plots specify two dimensions of the melody: the point in musical time at which the pitch is sounded (measured in single beats), and the location of the pitch—that is its numerical rank on the musical scale (measured according to musical half steps). Figure 1 shows a pitch/time plot of two familiar melodies—Great Britain's national anthem, "God Save The Queen" (perhaps better known in the United States as "My Country t'is Of Thee."), and "La Marseillaise," the French national anthem. In these plots, the X axis represents musical time and the Y axis represents location of the pitch.

Both anthems are written in the key of "G." Therefore, each pitch of the melodies is ranked according to the following values: G = 0; G# = 1; A = 2; A# = 3; B = 4; C = 5; C# = 6; D = 7; D# = 8; E = 9; F = 10' F# = 11; G = 12.

Given this information, we can match the pitch rank of each note with the appropriate beat of the anthem at which it appears. So, for example, we produce the data matrix in Table 1A for "God Save The Queen." We produce the matrix in Table 1B for "La Marseillaise."

Plotting these data gives a visual image of the melodies. The graphs illustrate the melodic lines as a function of pitch with respect to time. Therefore, we can analytically determine the aforementioned characteristics of a melodic code by calculating certain properties of the line segments connecting each two consecutive points of the line. I have devised a number of formulae for this purpose. To calculate the *frequency* of melodic

[3] Pitch/Time plots are used by theorists such as Benward and Jackson (1975) and Kerman and Kerman (1970). However, their use has been purely pedagogical. The tool has never been used for measurement.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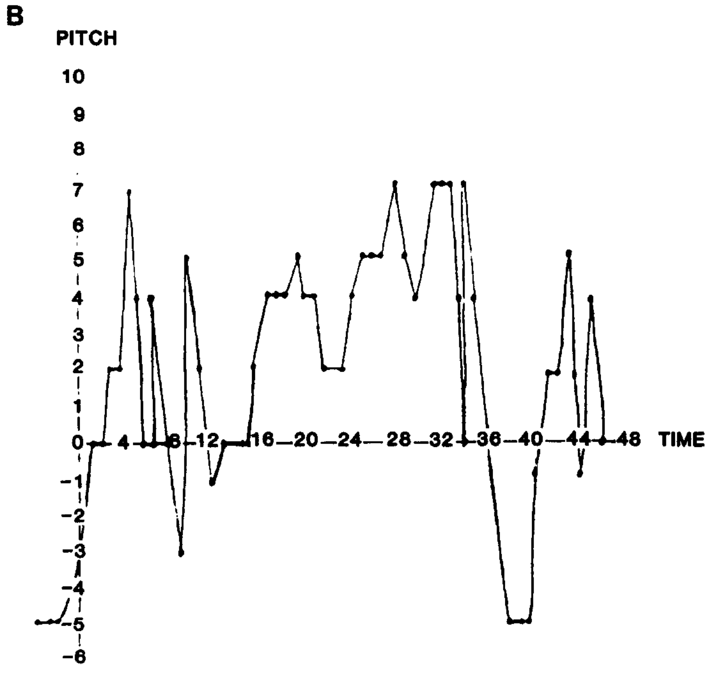
TIME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4 8 12 16 20 24 28 32 36 40 44 48
TIME

motion, we use the formula

$$\text{Freq} = \frac{1}{m}(p + t),$$

where p equals the total number of peaks in the melody, t equals the total number of troughs in the melody, and m equals the total number of measures in the melody.

The frequency score indicates the number of directional changes in a melody; it tells us how dynamic a melody is. The higher the frequency statistic, the greater the amount of movement in the melody. Dividing the total number of peaks and troughs by the total number of measures in the melody (measures are groups of beats marked off from one another by bar lines) standardizes this score. The frequency value for Great Britain's anthem is .93; this melody changes direction slightly less than one time per measure. In comparison, "La Marseillaise" has a frequency score of 1.46; its melody is changing direction approximately twice every three measures.

The formula for the *magnitude* of melodic motion is

$$\text{Mag} = \frac{1}{m}\sum_{i=1}^{n} H_i,$$

where H equals the height of the ith peak or the depth of the ith trough, n equals the total number of peaks and troughs in the melody, and m equals the total number of measures in the melody.

FIG. 1. (A) "God Save The Queen"

Freq	=	.93
Mag	=	4.43
Disj	=	8%
Orn	=	1.82
Omc	=	−3.53

(B) "La Marseillaise"

Freq	=	1.46
Mag	=	7.75
Disj	=	24%
Orn	=	1.88
Omc	=	− .86

Full Sample

	Mean	Range
Freq	1.78	.77 to 3.20
Mag	8.66	3.42 to 16.53
Disj	.23	.03 to .53
Orn	2.17	.86 to 6.73
Omc	0.00	−4.07 to 5.38

TABLE 1
Data Matrices for "God Save The Queen" and "La Marseillaise" (Melody)

Note	X axis: Beat of anthem	Y axis: Pitch ranking
Part A: "God Save The Queen"		
G	1	0
G	2	0
A	3	2
F#	4	−1
G	5.5	0
A	6	2
B	7	4
B	8	4
C	9	5
B	10	4
A	11.5	2
G	12	0
A	13	2
G	14	0
F#	15	−1
G	16	0
etc.	etc.	etc.
Part B: "La Marseillaise"		
D	− .31	−5
D	− .25	−5
D	− .06	−5
G	1	0
G	2	0
A	3	2
A	4	2
D	5	7
B	6.5	4
G	7	0
G	7.75	0
B	8	4
G	8.75	0
E	9	−3
C	10	5
A	12	2
F#	12.75	−1
G	13	0
etc.	etc.	etc.

This formula calculates the average magnitude of melodic motion per measure. By calculating the size of each directional change in the melody, we can determine how drastic the movement in the melody line is. The statistic sums the absolute values of the height of each peak and the depth of each trough in the line. Dividing that value by the number of measures in the melody yields a mean score that tells us the average "musical area" covered in each measure. The higher the magnitude statistic, the more extreme the movement in the melody. The magnitude statistic for "God Save The Queen" is 4.43; the average range of melodic motion in the piece is approximately four half steps. In comparison, the magnitude statistic for "La Marseillaise is 7.75. The average range of movement in its melody is nearly twice that of "God Save The Queen."

We can examine two different *methods* of constructing melodic motion: conjunct motion and disjunct motion. Conjunct motion is smooth movement in which notes proceed in successive or nearly successive degrees up and down the musical scale. Conversely, disjunct motion refers to jagged, leapy motion in which notes of a melody are separated by large intervals. To determine conjunct or disjunct method of motion, we use the formula

If $|\Delta P_n| < Q$, the melodic line movement is conjunct.

If $|\Delta P_n| > Q$, the melodic line movement is disjunct.

$Q = 4.0$ if the movement between ΔP_n is in the same direction as ΔP_{n-1}

$Q = 3.0$ if the movement between ΔP_n is in a different direction than ΔP_{n-1}.

ΔP_n is defined as $(P_n - P_{n-1})$; P_n is the pitch of the nth note.

We can classify each interval in a melody as conjunct or disjunct by comparing $|\Delta P_n|$ to the value of Q. (I selected the values for Q based on music theory regarding conjunct and disjunct intervals.)[4] Then we can calculate the total number of intervals falling into each category. According to this formula, 92% of the consecutive melodic intervals in the British national anthem are conjunct, while 8% are disjunct. Therefore, "God Save The Queen" is predominantly conjunct. In comparison, only 76% of the consecutive melodic intervals in "La Marseillaise" are conjunct; 24% are disjunct—three times the number found in "God Save The Queen." Humming the first line of each anthem illustrates the relative jaggedness and leapiness of "La Marseillaise" as compared to "God Save The Queen."

Finally, the formula for *ornamentation* is

$$\text{Orn} = \frac{N\sqrt{r}}{v},$$

[4] We know that four musical half steps equal a major third interval. In general, any interval larger than this is considered disjunct. When melodies are moving in a single direction, large interval leaps—intervals larger than major thirds—are required to break a conjunct melody pattern. Therefore, when melodies are moving in a single direction, $Q = 4.0$; in essence, $Q =$ a major third interval. However, when a melody shifts direction, a smaller interval will be disruptive to listeners. Therefore, I assigned a value of "$Q = 3.0$" to the "opposite direction" condition. For more details see Apel (1974), Benward and Jackson (1975), or Westergaard (1975).

where N equals the total number of notes in a melody, r equals the total instances of ornamentations in a melody, and v equals the total number of verbal syllables in a melody. This formula captures the degree of decoration to the central melody notes. It taps two aspects of ornamentation. First, it gives a ratio of notes to verbal syllables for each melody. (Recall, we are dealing with vocal/instrumental music in this sample; slight amendments to the formula are necessary for nonvocal music.) Second, the formula allows us to give extra emphasis to melodies with many instances of ornamentation versus melodies with few, or just a single instance. (Each time a single syllable is represented by multiple notes of different pitch ranks, we have an instance of ornamentation.) We provide this emphasis by weighting the formula with the square root of the total instances of ornamentation in the melody.[5] (The weight also helps to accurately capture deliberate uses of ornamentation as opposed to other multiple note phenomenon such as ties—ties are slurs that combine the value of two successive, same pitch notes.) In essence, the formula captures both the presence of ornamentation and the frequency with which it occurs. If Ornamentation = 1, the amount of notes and syllables are equal, meaning there is no ornamentation. If Ornamentation > 1, musical notes outnumber verbal syllables, meaning the anthem is ornamented. Ornamentation = 1.82 in "God Save The Queen;" "La Marseillaise" has a slightly higher ornamentation score—1.88.

Rhythmic Codes

Rhythm depicts movement in time and the ways in which that movement is organized. Specifically, it refers to the ways in which long and short notes are arranged in a composition and how each note is accented. This arrangement determines the basic–embellished structure of the rhythmic code. As with melodic codes, we can quantify this structure by attending to the characteristics of basic and embellished codes. Specifically, we examine four of the primary dimensions of rhythm: the frequency with which note values change in a composition, the magnitude of the note value changes, rhythmic density—i.e., the number of notes used to express the rhythm, and rhythmic deviation—i.e., the use of accents or syncopation to alter conventional rhythmic patterns. (For a more detailed explanation of these rhythmic properties, see Apel, 1974; Benward and Jackson, 1975; Westergaard, 1975; Durr, Gerstenburg, and Harvey, 1980; and Kerman and Kerman, 1980).

[5] If $r = 0$, the r is dropped from the equation. Calculations are then based on n/v. I used the square root of r as the weight in this equation so as to control for excessive ornamentation. In pieces with heavy ornamentation (i.e., one instance per measure or more), ornaments may become the norm, and hence, less startling. Using the square root of r helps us avoid overemphasizing the ornamentation in such pieces.

Duration/Time graphs help us examine rhythmic frequency, magnitude, density, and deviation. Such plots specify two dimensions of rhythm: the position of each note in the rhythmic code (i.e., sounded at the first beat of the composition, the second beat, midway between the third and fourth beat, etc.), and the length of each note—traditional musicological values are used (i.e., an eighth note = .5 units; a quarter note = 1 unit; a dotted quarter note = 1.5 units; a half note = 2 units, etc.) To construct a duration/time plot of a rhythmic code, we match the length of each note with the appropriate position in the anthem at which it appears.[6] This produces the data matrix in Table 2A for "God Save The Queen;" we produce the matrix in Table 2B for "La Marseillaise."

Plotting these data gives a visual image of the rhythmic code. The graphs illustrate the rhythmic codes as a function of note length with respect to note position. Just as with melodic codes, then, we can analytically determine each property of the rhythmic code by calculating certain properties of the line segments connecting each two consecutive points of the line (see Fig. 2).

So, for example, to calculate the *frequency* of note value changes, we use the formula

$$\text{Rfreq} = \frac{1}{m}(k + g),$$

where k equals the total number of peaks in the rhythmic code, g equals the total number of troughs in the rhythmic code, and m equals the total number of measures in the composition.

The rhythmic frequency score indicates how dynamic the rhythmic code is; the higher the frequency score, the more often changes in note values occur. As with melodic frequency, we divide all values by m to standardize the score. The rhythmic frequency score for Great Britain's anthem is 1.14; note values in this anthem change about once per measure. In comparison, "La Marseillaise" has a frequency score of 2.46; note values in this anthem change twice as often as in "God Save The Queen."

The formula for the *magnitude* of the note value changes in a rhythmic code is

$$\text{Rmag} = \frac{1}{m}\sum_{i=1}^{n} X_i,$$

where X equals the height of the ith peak or the depth of the ith trough, n equals the total number of peaks and troughs in the rhythmic code, and m equals the total number of measures in the composition.

[6] Note that rests are not detectable from these graphs; only notes and the points at which they are initially sounded are considered.

TABLE 2
Data Matrices for "God Save The Queen" and "La Marseillaise" (Rhythm)

Note	X axis: Note position	Y axis: Note length
Part A: "God Save The Queen"		
G	1	1
G	2	1
A	3	1
F#	4	1.5
G	5.5	.5
A	6	1
B	7	1
B	8	1
C	9	1
B	10	1.5
A	11.5	.5
G	12	1
A	13	1
G	14	1
F#	15	1
G	16	3
etc.	etc.	etc.
Part B: "La Marseillaise"		
D	− .31	.25
D	− .25	.75
D	− .06	.25
G	1	1
G	2	1
A	3	1
A	4	1
D	5	1.5
B	6.5	.5
G	7	.5
G	7.75	.25
B	8	.75
G	8.75	.25
E	9	1
C	10	2
A	12	.75
F#	12.75	.25
G	13	2
etc.	etc.	etc.

The magnitude formula tells us how drastic the changes in note values are. The statistic sums the absolute values of the height of each peak and the depth of each trough in the plot of the rhythmic code. Dividing that value by *m* standardizes the score. The magnitude statistic for "God Save The Queen" is 1.29; changes in note value are slightly more than one full beat—i.e., the difference between an eighth note and a dotted quarter note. Since we are dealing, for the most part, with eighth notes, quarter notes, and dotted quarter notes in this anthem, the rhythmic changes do not sound very drastic for the listener. In comparison, the magnitude score for "La Marseillaise" is 2.96—more than double that of "God Save The Queen." The range of long to short notes is comparable to the difference between an eighth note and a dotted half note. These rhythmic changes are much more drastic for the listener.

The formula used to measure rhythmic *density* is

$$\text{Rden} = \frac{1}{m}\sum_{i=1}^{n} U_i,$$

where U equals the number of notes in the ith measure and m equals the total number of measures in the composition.

The density score shows whether a composer maximizes or minimizes the potential beats used to express the rhythmic meter of a composition. (Meter groups beats into patterns.) Composers generally indicate the meter of a piece by using a time signature—i.e., a "3/4" signature tells us that there are three beats per measure, with each beat equivalent to the value of a quarter note. So, for example, if a piece is written in 3/4 time, the rhythmic density formula will show us whether the composer expresses the three beats of each measure using few or many notes. Dividing the total number of notes per measure by m standardizes the density score. Once calculating rhythmic density, we compare the value to the numerator of the anthem's time signature:

If Rden is > the value of the numerator in the time signature, the anthem is rhythmically dense.
If Rden is < the value of the numerator in the time signature, the anthem is rhythmically sparse.
If Rden is = to the value of the numerator in the time signature, the anthem is rhythmically average.

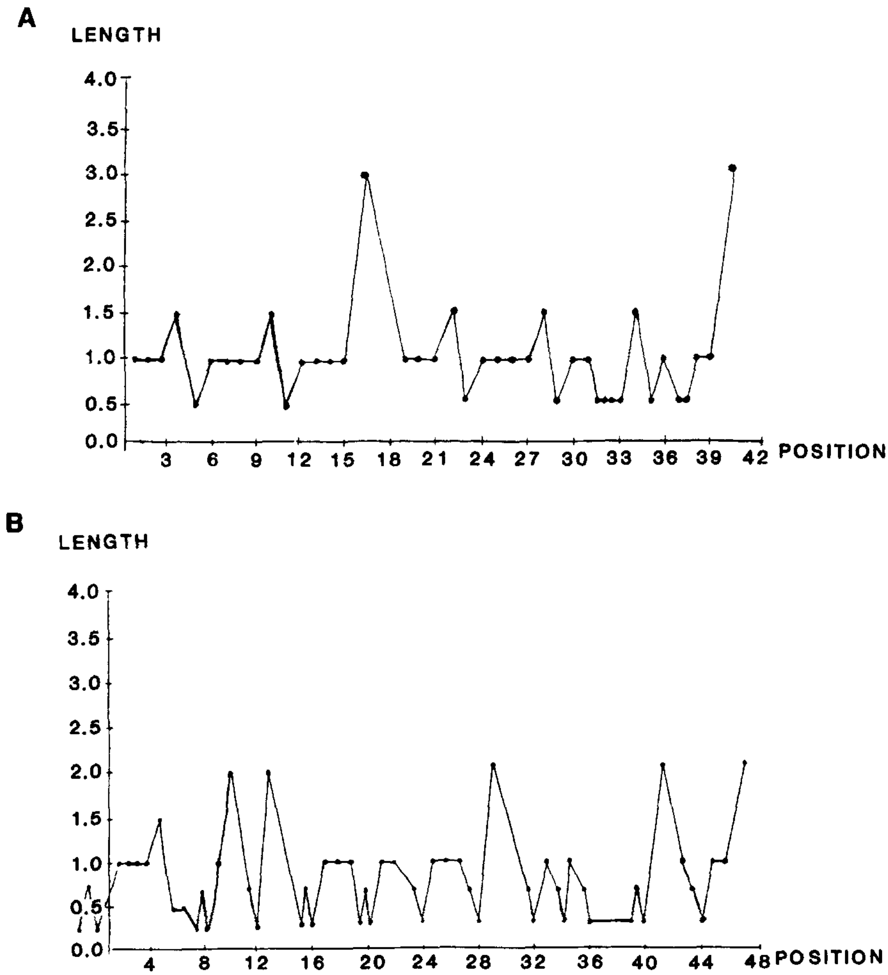
We make this comparison so that pieces with different meters (e.g., 3/4 vs 4/4) can be accurately contrasted. The British and French anthems provide a good example. The rhythmic density for "God Save The Queen" is 2.94, indicating that there are approximately three notes per measure. Since this anthem is written in 3/4 meter, the anthem is rhythmically average. In comparison, the rhythmic density of "La Marseillaise" is 4.82. Since this anthem is written in 4/4 meter, it is rhythmically dense.

Finally, we calculate rhythmic *deviation* using the formula

$$\text{Rdev} = \frac{1}{m}\sum_{i=1}^{n} y_i\sqrt{z}$$

where y stands for the total number of instances in which rhythmic accents or syncopation appears in the ith musical string (a musical string signifies consecutive musical measures in which each measure contains at least one instance of rhythmic accents or syncopation), z stands for the total number of strings of syncopated measures, and m stands for the total number of measures in the composition.

This formula captures two aspects of rhythmic deviation. First, it calculates the actual number of times syncopation occurs in the rhythmic code. Second, it considers the distribution of those occurrences. For example, does syncopation occur in several consecutive measures . . . in every measure? If so, syncopation may seem more normative than irregular. On the other hand, is syncopation concentrated in specific measures of the piece? If so, it will be especially disruptive to the overall



rhythmic pattern. By including the square root of z in this formula, we give added weight to this latter, more disruptive condition. The deviation score for "God Save The Queen" is 0, indicating no rhythmic deviation in the piece. In comparison, the deviation score for "La Marseillaise" is .04; while deviation is present, it exists at a low level.

Behavior of the Melody and Rhythm Measures

Each of the melody measures—frequency, magnitude, method of motion (conjunctness vs disjunctness), and ornamentation—addresses a different element of a melodic code. What is the relationship between the four measures? I explored this question using a sample of national anthems. The sample consists of 154 anthems representing 150 nations. Cartledge, Reed, Shaw, and Coleman (1978) provided the primary source for compiling this data set. That volume represents the most recent and exhaustive collection of national anthems in print. The sample was verified by checking each anthem against a listing given in Mead's (1980) article on national anthems. No discrepancies were discovered. To be included in the sample, an anthem must follow a Western music tradition—that is, employ the diatonic scale. Anthems based on other musical systems, such as whole-tone scales, pentatonic scales, or modal systems, would destroy the stylistic uniformity of the sample, making comparative analysis problematic.

FIG. 2. (A) "God Save The Queen"

Rfreq = 1.14
Rmag = 1.29
Rden = 2.00 (average)
(original value −2.96
in 3/4 meter)
Rdev = .0
Orc = −1.85

(B) "La Marseillaise"

Rfreq = 2.43
Rmag = 2.96
Rden = 3.00 (dense)
(original value −4.96
in 4/4 meter)
Rdev = .04
Orc = .69

	Full sample Mean	Range
Rfreq	2.05	.67 to 4.22
Rmag	2.10	.37 to 8.24
Rden	2.27	1.00 to 3.00
Rdev	.19	.00 to 4.00
Orc	.00	−3.35 to 3.83

Earlier, I defined basic codes as stable, constant, and fixed. In analyzing basic melodic codes, these qualities should translate to low frequencies of directional change, low magnitudes of change, conjunct methods of melodic motion, and low rates of ornamentation. Embellished melodic codes should exhibit opposite qualities along these dimensions. Table 3A supports this conceptualization. The table shows the correlation matrix for the four dimensions of a melodic code. All of the correlations are positive at a statistically significant level, thus indicating a direct relationship among all of the measures. When dealing with national anthems, melodic frequency, magnitude, method of motion, and ornamentation are directly correlated with one another—they move in unison. (The behavior of these measures with reference to other musical genres, i.e., symphonies, songs, operas, etc., is, at this point, an empirical question for future research.) Given this information, it is possible to analyze melodic codes by using a single summary measure reflecting the basic–embellished continuum.

While the four individual melody measures are correlated, some of the correlations are only moderate. This indicates that there is some independence to these measures, making a simple additive method of combining them inappropriate. However, using factor analysis we can

TABLE 3
Pearson Correlations for the Dimensions of Musical Codes

	Melodic magnitude	Melodic method	Melodic ornamentation
Part A: Melody			
Melodic frequency	.73 $P = .001$	.20 $P = .04$	.23 $P = .01$
Melodic magnitude		.40 $P = .001$	.17 $P = .04$
Melodic method (Disjunctness)			.17 $P = .04$
$N = 154$			
	Rhythmic magnitude	**Rhythmic density**	**Rhythmic deviation**
Part B: Rhythm			
Rhythmic frequency	.52 $P = .001$	.53 $P = .001$	.08 $P = .40$
Rhythmic magnitude		.10 $P = .30$	.07 $P = .41$
Rhythmic deviation			.06 $P = .45$
$N = 154$			

construct a weight for each of the individual melody indicators; we can use these weights in forming a single summary measure of a melodic code. To construct such a measure, I standardized the four individual melodic indicators and factor-analyzed them. Based on the loadings from the first factor (which accounted for 58% of the total variance), I assigned a weight to each of the individual melody measures and added them. This formed a summary measure of overall melodic code:

Overall Melodic Code = .89 Frequency + .93 Magnitude + .31 Disjunctness + .31 Ornamentation.

The factors, of course, may vary somewhat if a different sample of music is used—that remains an empirical question. Yet, when comparing the overall melodic codes of "God Save The Queen" and "La Marseillaise," we find that the former is comparatively more basic in design (−3.53) than the latter (−.86). Indeed, were we to hum the melodies to these anthems and review the examples offered in the body of this paper, we could hear this difference.

This summary indicator taps many of the elements to which a musicologist attends when analyzing a melody; it systematically classifies a melodic code as ranging from basic to embellished in design. Low values are indicative of basic codes, while high values suggest embellished codes. (For readers interested in learning more about this technique, see Cerulo, 1986.)

Following the above logic and procedure, I created a summary measure for overall rhythmic codes as well:

Overall Rhythmic Code = .92 Frequency + .59 Magnitude + .74 Density + .08 Deviation.

Readers interested in the basis of this measure will find the correlations for the four rhythmic dimensions in Table 3B. Interested readers should also note that the weights I used to construct this summary measure are based on a factor analysis of the four individual rhythm indicators. I used factor loadings from the first factor which accounted for 51% of the variance. As with melody, this summary indicator taps many of the elements to which a musicologist attends when analyzing rhythm. Low values are indicative of basic codes, while high values suggest embellished codes. (Again, for more information, see Cerulo, 1986.)

Melody and rhythm represent only two components of musical structure. I have developed measures to address other equally important components such as phrasing, harmony, form, dynamics, and instrumentation. Space limitations hinder the full presentation of these indicators. However, these formulae are listed in Table 4. (For further discussion, see Cerulo, 1986.)

TABLE 4
Formulae for the Measurement of Musical Structure

Variable	Formula
Phrase length	$$\text{PLEN} = \frac{1}{p}\sum_{i=1}^{n} L_i,$$ where L equals the phrase length (the number of measures spanned by the phrase) and where p equals the total number of phrases in a piece of music.
Phrase density	$$\text{PDEN} = \frac{1}{p}\sum_{i=1}^{n} D_i,$$ where D equals the number of musical notes per phrase and p equals the total number of phrases in a piece of music.
Phrase frequency	Note: Both phrase frequency and phrase magnitude are calculated with reference to a graph in which the X axis equals a phrase's position in the music (i.e., first, second, etc.) and the Y axis equals phrase length. Both of these measures give us information about the balance of phrases in a piece of music. $$\text{PFREQ} = \frac{1}{m}\sum_{i=1}^{n} T_i,$$ where T equals a peak or trough in the line and m equals the total number of measures in the music.
Phrase magnitude	$$\text{PMAG} = \frac{1}{m}\sum_{i=1}^{n} J_i,$$ where J equals the height of a peak or the depth of a trough and m equals the total number of measures in the music.
Chord structure	Note: This measure compares the use of basic chords with those that are much more complex or embellished. To construct the measure, we must examine the major structural points of a musical piece; we must record the scale degree of each chord appearing at these major structural points. CS = 1, if the major structural points of a piece contain *only* scale degree I and V chords. 2, if, in addition to scale degree I and V chords, at least 15% of the piece's structural points contain scale degree IV chords. 3, if, in addition to scale degree I, IV, and V chords, at least 15% of the piece's major structural points contain scale degree II, III, VI, or VII chords.
Harmonic frequency	Note: Harmonic frequency is calculated with reference to a graph in which the X axis represents the point in musical time at which the chord is sounded (measured in single beats) and the Y axis represents the scale degree of the chord (I–VII). $$\text{HFREQ} = \frac{1}{m}\sum_{i=1}^{n} c_i,$$ where c equals a peak or trough in the line and m equals the total number of measures in the music.

TABLE 4—*Continued*

Variable	Formula
Harmonic dissonance	$$\text{DIS} = \frac{1}{b}\sum_{i=1}^{n} a_i,$$ where a equals dissonant melody note and chord pairs (dissonant pairs consist of major and minor seconds, augmented or diminished fourths and fifths, and major or minor sevenths) and b equals the total number of melody note and chord pairs.
Key construction	STABLE (0) = musical piece remains in one key for its entirety. CHANGING (1) = musical piece moves into one or more different keys.
Musical form	1 = Highly basic: Consists of Strophic Form. This means a single musical stroph is repeated numerous times. 2 = Basic: Consists of Abbreviated Binary Form. This means the musical form contains two different sections—A and B. 3 = Embellished: Consists of Ternary Form. This means the musical form contains three sections: A, B, and a variation of A. 4 = Highly embellished: Consists of Through Composed Form. This means the musical form contains multiple sections, each different from the next.
Dynamic frequency	Note: Both dynamic frequency and dynamic magnitude are calculated with reference to a graph in which the X axis equals the location of the dynamic marking in the score (as measured in single beats) and the Y axis equals the degree of volume indicated by the dynamic marking (ranging from pp = 1 to ff = 6). $$\text{DFREQ} = \frac{1}{m}\sum_{i=1}^{n} F_i,$$ where F equals a peak or trough in the line and m equals the total number of measures in the line.
Dynamic magnitude	$$\text{DMAG} = \frac{1}{m}\sum_{i=1}^{n} G_i,$$ where G equals the height of a peak or the depth of a trough and m equals the total number of measures in the music.
Orchestration	1 = Highly basic: Consists of "a capella" (unaccompanied vocal music). 2 = Basic: Consists of a vocal or instrumental solo accompanied by *one* other instrument. 3 = Embellished: Consists of a chamber work (seven to eight pieces maximum, with each piece assigned a different part). 4 = Highly embellished: Consists of a full orchestral work.

Constructing Overall Musical Codes

We have seen the usefulness of combining the individual elements of each code (e.g., frequency, magnitude, method of motion, and ornamentation when we speak about melody) in order to form a single summary measure (e.g., overall melodic code). Similarly, it will be useful in some analyses to combine all seven summary measures (i.e., overall melodic code, overall phrase code, etc.) in order to form a single measure that reflects overall musical codes.

For national anthems, Pearson correlations for overall melodic codes, phrase codes, harmonic codes, form codes, dynamic codes, and rhythmic codes range from .02 to .61. (Note: overall instrumentation codes were not used in this analysis because the anthems were recorded as piano reduction scores.) The various musical codes vary in direct relation to one another, yet the coefficients indicate substantial independence between each measure. Therefore, I used the factor analysis method previously described in the sections on melody and rhythm, generating the following formula for overall musical code:

$$\begin{aligned}\text{Overall Musical Code} = {} & .86 \text{ Melodic Code} + .09 \text{ Phrase Code} + \\ & .17 \text{ Harmonic Code} + .05 \text{ Form Code} + \\ & .48 \text{ Dynamic Code} + .85 \text{ Rhythmic Code.}\end{aligned}$$

(Factor analysis of overall melodic, phrase, harmonic, form, dynamic, and rhythmic codes provided the weights in this formula. Specifically, they are derived from loadings from the first factor and account for 50% of the variance.) Again, the factors may vary somewhat if a different sample of music is used. Yet, when comparing the overall musical codes of "God Save The Queen" and "La Marseillaise," we find that the former is comparatively more basic in design (−5.51) than the latter (+.13).[7]

Having constructed measures for analyzing musical codes, we must move on to the question of their validity.

VALIDATING THE MEASURES

Musicologists identify different types of anthems: hymns, marches, operatic anthems, and folk tunes. According to Mead (1980: 46–47), hymns and marches are the most prevalent styles of anthems, with hymns being the more musically basic of the two forms. This distinction is widely accepted among musicologists (see, e.g., Andersen, 1980; Schwandt and Lamb, 1980). Hence, these qualitative classifications provide a basis

[7] The most basic musical code in the sample is Great Britain's at −5.51. The most embellished musical code in the sample is Ecuador's at 9.27. The mean of the summary measure for overall musical code is 0.00. Recall that the indicators forming this summary measure were standardized before they were combined; thus, many of the values are negative.

for validating the present measures. If the indicators have construct validity, they should duplicate the qualitative classification made by musicologists. The musical properties associated with hymns should display significantly lower numerical scores than those of marches. The body of this paper presents one such comparison. "God Save The Queen" is a hymn, while "La Marseillaise" is a march. Indeed, "God Save The Queen" had comparatively lower scores on all indicators than "La Marseillaise"—its code is much more basic. Yet, comparisons using a larger sample of anthems would strengthen our confidence in the measures' construct validity.

To test the hypothesis suggested by Mead's work, a subsample of the total population of anthems was selected: anthems identified as hymns and anthems identified as marches. These classifications were derived from the musical instructives on the piece. Directives such as hymn-like, prayerful, solemn, or slow and majestic were seen as indicative of hymns; directives such as tempo di marcia, allegro marziale, or alla marcia were indicative of marches. This method produced a total sample of 77 anthems: 38 hymns and 39 marches.[8] The Appendix lists the countries represented by the subgroups.

Table 5 lists the results of a *t* test comparing the musical codes of hymns and marches. In examining Table 5 we can see that the findings generated by measures introduced in this article duplicate qualitative classifications traditionally used by musicologists. The table shows that the mean values for hymns are lower than those for marches along every musical dimension measured here: melody, phrasing, harmony, form, dynamics, rhythm, and the overall musical code. In every case, hymns exhibit more basic musical codes than marches. This difference in means is statistically significant at the .05 level or better along each dimension with the exception of harmonics and form; the significance level for harmonics and form is approximately .10.[9] Therefore, we can be confident of the new measures' construct validity. The indicators duplicate qualitative classifications traditionally used by musicologists. More importantly, however, they allow for a quantitative, systematic analysis that can be pursued by specialists and nonspecialists alike. In addition, the new

[8] There are certainly other anthems which could be included in these categories. However, directives were not as clearly stated in these cases. Therefore, rather than rely on subjective, nonsystematic classification, such anthems were not included in the sample.

[9] Both of these findings deserve comment. First, anthems are generally written in song form—a musical format with a rather confining nature. Therefore, it is not surprising to discover minimal variation between the various styles of anthems. Second, the minimal variation discovered in harmony confirms other research findings (Cerulo, 1984). Harmony may be too tightly bound to the jurisdiction of personal style or the influence of a strict musical tradition, thus making it resistant to the forces of a particular musical genre or social event. This deserves further investigation.

TABLE 5
Results from *t* Test Comparing Musical Codes of Hymns and Marches for a Sample of National Anthems

	N	*X*	*t* value	One-tail probability
Melodic code				
Hymns	38	−1.04		
			−3.75	.001
Marches	39	.58		
Phrase code				
Hymns	38	− .25		
			−2.63	.005
Marches	39	.68		
Harmony code				
Hymns	38	− .32		
			−1.14	.10
Marches	39	− .05		
Form code				
Hymns	38	− .01		
			− .97	.11
Marches	39	.20		
Dynamic code				
Hymns	38	− .32		
			−2.85	.003
Marches	39	.83		
Rhythmic code				
Hymns	38	−1.39		
			−6.78	.001
Marches	39	.91		
Overall musical code				
Hymns	38	−2.31		
			−5.76	.001
Marches	39	1.74		

measures allow dichotemous categories like basic versus embellished codes to be analyzed on a continuous scale. Given these points, the indicators render music an extremely accessible source of social science data, amenable to all of the rigorous methods that are central to the social science tradition.

While I have pursued the question of validity by analyzing national anthems, the measures presented here should apply to other types of Western tonal music based on diatonic scales, even those musical forms that are much more difficult to classify and compare upon hearing—symphonies, concerti, opera, ballet, folk songs, and pop music.[10] Using

[10] Note that the effectiveness of these measures is currently restricted to written scores. At the present time, the method is not adaptable to performance improvisations that stray from a written score.

these measures, even musically complex forms can become accessible to any researcher. Consider the following example. Beethoven wrote a set of variations on "God Save The Queen." By definition, a musical variation is an elaboration of a given melody (Walker, 1980: 536). In essence, musical variations are a good example of embellished codes. Consequently, if the measures presented here are accurate, we should expect that Beethoven's variation on "God Save The Queen" will exhibit higher values on these musical dimensions than the original hymn. Figure 3 presents pitch/time plots for the melody of "God Save The Queen" and Beethoven's first variation on that melody. Below the graphs, I have listed the comparable values for melodic frequency, magnitude, method, and ornamentation. As we can see, Beethoven's variation is two to three times more embellished than "God Save The Queen."

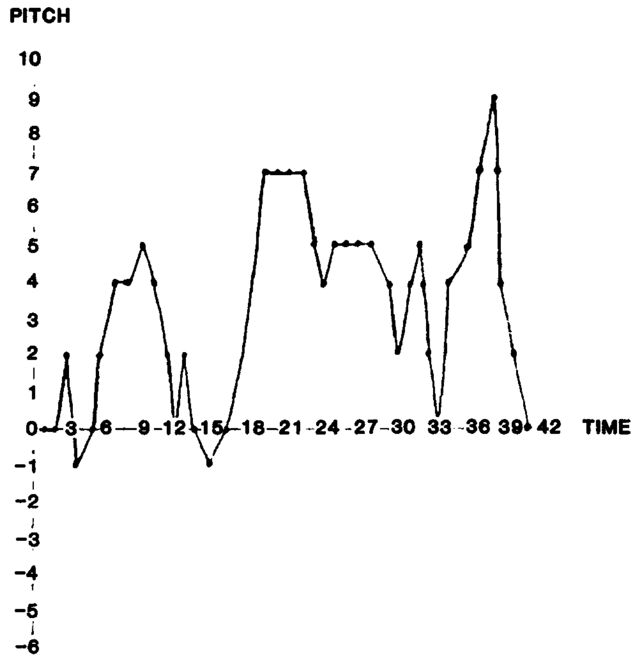
Figure 4 presents duration/time plots for the rhythmic codes comprising "God Save The Queen" and Beethoven's first variation of the anthem. Beethoven's rhythmic code is similar to that of the original hymn in terms of rhythmic frequency and rhythmic magnitude. However, his use of rhythmic density and rhythmic deviation is much more embellished than the original anthem. As we might expect, Beethoven uses approximately 50% more notes to express the meter. He also adds a significant amount of rhythmic deviation to his piece. Overall, then, the Beethoven variation is more rhythmically embellished than the original anthem. (Note: findings were similar for other Beethoven variations on this theme; due to space constraints, I confined my presentation to the first variation.) These examples increase our confidence in the validity of the new measures. More importantly, they suggest their versatility.

The measures presented in this article allow us to directly analyze musical structure. Using them, we can begin to answer some of the questions posed earlier in this paper.

APPLICATIONS

Like verbal language or visual images, music is a symbolic means of conveying information—it is a message. Yet, we have seen that the structure of this message can vary. What accounts for this variation? To be sure, some of it can be attributed to music's historical development or the personal biography of composers. Yet, as sociologists, we have good reason to suspect that social, political, and economic factors play a major explanatory role as well. We have seen, for example, that social class or location in the power structure can influence one's choice of linguistic codes; social solidarity can influence one's choice of visual/color codes (see, e.g., Douglas, 1970; Bernstein, 1975; Bergesen, 1979, 1984; Corner, 1986). In general, the literature suggests important links among communicators, their social circumstances, and the structure of a message (see, e.g., Burt, 1987; Rogers, 1972). Using the measures presented in

A


PITCH
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6
5
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1
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-1
-2
-3
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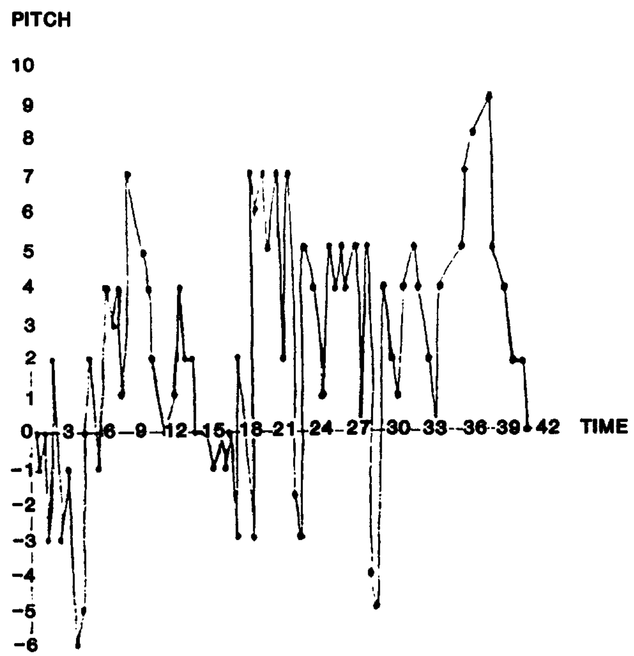
12
15
18
21
24
27
30
33
36
39
42
TIME

B


PITCH
10
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39
42
TIME

this paper, we can pursue this issue with reference to musical symbols. We can specify the type and degree of variation that occurs in musical codes relative to changes in social, political, economic, and historical conditions. For example, this paper deals with a sample of national anthems. In reviewing the nations which these anthems represent (see Appendix), we can explore the social factors that influence a government's decision to produce or adopt a hymn versus a march . . . a basic code versus an embellished code.

National anthems are, after all, official patriotic symbols, representing a nation's mood, desires, and goals (see, e.g., Griffith, 1959; Nettl, 1967; Mead, 1980; Cerulo, 1986a,b). They are modern totems—signs that distinguish one nation from another. Every nation adopts a national anthem. The phenomenon began in central Europe and South America during the 19th century nationalist movements. In the 20th century, Eastern countries, as well as new independent nations in Africa and elsewhere, followed suit. The function of national anthems is highly similar across nations (e.g., Mead, 1980: 46; Nettl, 1967: 1–50). Ruling bodies use them as a tool for creating bonds and reinforcing goals among their citizens. For example, Reed and Bristow tell us that "Malta's national anthem was conceived as a hymn to Malta in the form of a prayer. It was intended to unite all parties with the strong ties of religion and love of country" (1985: 289). Similarly, Great Britain's national anthem, "God Save The King," was written as a celebration of solidarity, glorifying Admiral Vernon's victory at Portabello (Nettle, 1967: 37). It was adopted by King George II as a tool for retaining loyalty to the crown during the Jacobite threat. As the anthem spread through London and the surrounding areas, it was thought to "calm popular feeling and encourage the already strong support for the King" (Griffith, 1959: 26).

While the function of national anthems is similar, their musical structure is not. We witnessed some of this variation in the earlier comparison of hymns and marches. We can think of these variations as different communication strategies—different codes representing different *methods* of

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FIG. 3. (A) "God Save The Queen"

Freq = .93
Mag = 4.43
Disj = 8%
Orn = 1.82

(B) Beethovan's "Variation I"

Freq = 3.36
Mag = 14.00
Disj = 29%
Orn = 3.41

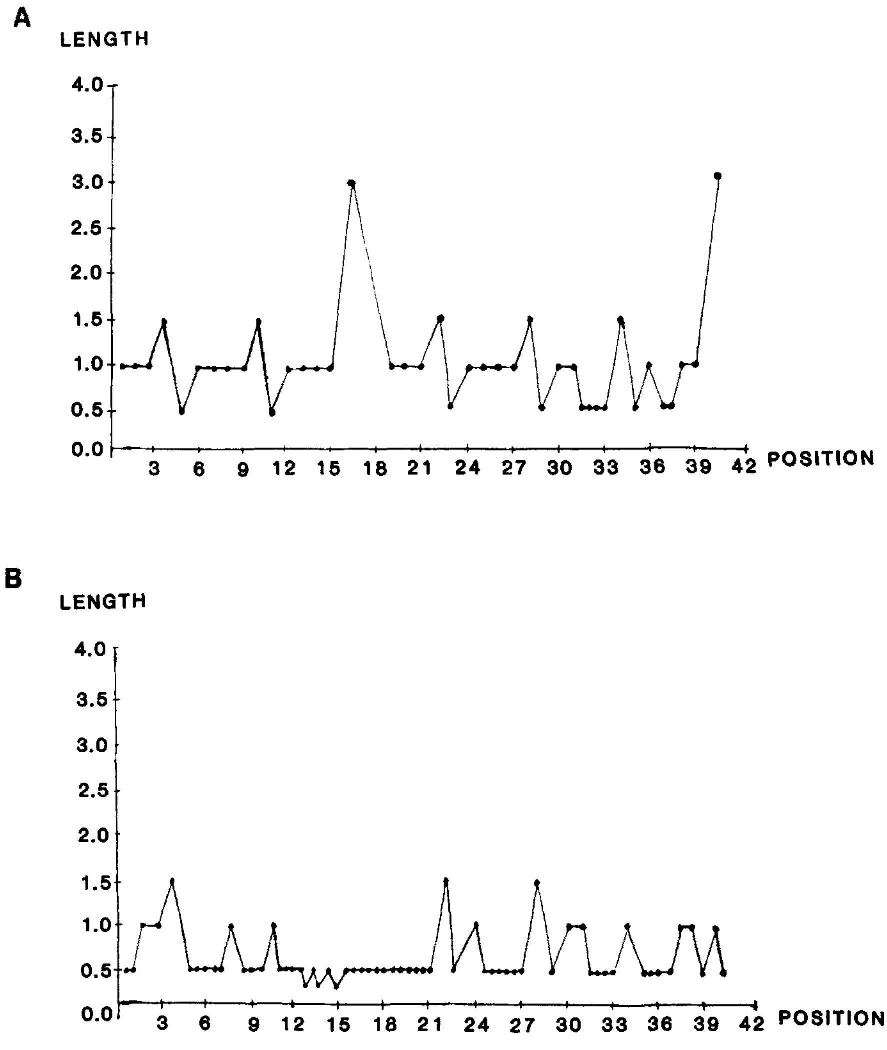

FIG. 4. (A) "God Save The Queen"
Rfreq = 1.14
Rmag = 1.29
Rden = 2.96
(average)
Rdev = .000
(B) Beethovan's "Variation I"
Rfreq = 1.74
Rmag = 1.00
Rden = 4.50
(dense)
Rdev = .210

conveying information. What factors influence the communication strategy political elites choose? What moves political elites to compose and/or adopt anthems with basic melodic codes versus those with embellished codes? Many studies suggest that senders choose their communication strategies according to the strategies used by those around them, their own structural position, and their socialization (see, e.g., Burt, 1987; Rogers, 1972). With regard to national anthems, then, we can develop several hypotheses. First, it may be that political elites compose or adopt anthems with musical codes similar to those of the nations around them. Geographic region may influence the structure of musical codes. Second, the structure of the symbols by which nations represent themselves may well be a product of the world-system which holds nations together. Specifically, we might expect that nations occupying central, powerful positions in the world-system have anthems with basic musical codes. These nations, in essence, may be establishing the conventions upon which anthems are based. Conversely, less central nations may have anthems with embellished musical codes. In order to "stand and be counted," such nations may have to break convention; distorting the normative style may be the most effective way of calling attention to their message. (This hypothesis is suggested by Cerulo, 1988b). Third, political elites may be apt to compose and adopt anthems with melodic codes similar to those of their mother country's anthem. Anthems may reflect cultural "leftovers" of colonization.

In addition to these social factors, we must consider certain characteristics of music in this analysis as well. First, it is important to consider the period of musical style in which an anthem is written or adopted (i.e., Baroque, Classical, etc.). Some musicologists argue that music is a developmental art; each musical stylistic period is, in part, a reaction to or distortion of the stylistic period before it (see, e.g., Apel, 1974; Dallin 1977; Grout, 1980). If this is true, we might expect that the anthems having the earliest composition and adoption dates will display basic codes. These pieces establish the musical conventions for national anthems. As time progresses and the anthem as a genre evolves and becomes more developed and intricate, composers may write and leaders may adopt increasingly embellished anthems—they will, in essence, elaborate on the basics. Second, the strictest test of these hypotheses requires us to control the analysis for the influence of anthem genre—i.e., hymn vs march. As previously illustrated, genre can affect the structure of musical codes.

To examine these propositions, I used the sample of 77 national anthems described earlier. Additional data were collected on the nations represented by these anthems so that each nation could be classified according to geographic region, structural position, socialization, musical style period, and anthem genre:

To code *geographic region,* nations in the sample were clustered and labeled according to nine regions: Africa, Australia, Eastern Europe, Far East, Near East, North America, Scandinavia, South America, and Western Europe. This enabled me to construct a series of dummy variables, each representing one of the nine regions.

Structural position was operationalized as a nation's position in the world–system. Three positions were specified: core, semiperiphery, and periphery. Nations were assigned to one of these positions with reference to the year in which their anthem was composed and the year in which it was adopted. (Some nations change status from one period to the next.) Classifications were based on data collected from Wallerstein (1974, 1975, 1980), Chirot (1977), Snyder and Kick (1979), and Bollen (1983).

Socialization was operationalized by referring to colonial influence. I identified the mother country for each nation in the sample. Then, I calculated the musical code for each mother country's anthem. (Again, this variable will be slightly different for the composition period and the adoption period. Some mother countries change their anthems between the two events.)

To construct *musical stylistic period,* I recorded the year in which each anthem was composed and the year in which each anthem was adopted. (Many nations display a considerable time gap between the two events.) These data were derived from Cartledge *et al.* (1978) and Mead (1980).

Anthem genre was coded as earlier described: hymn vs march.

I used regression analysis to examine the effects of social and musical variables on the structure of anthems' overall musical codes (the dependent variable). Table 6 shows the results.[11]

Composition Period

During the period in which national anthems are written, four of the variables in the regression model influence the structure of musical codes. First, composers in South American countries write anthems with more embellished codes than any of the other eight regions. The coefficients also reveal that composers living in core nations of the world–system

[11] Because I am using nine geographic regions, I ran a preliminary regression equation to determine which of the geographic areas should be entered into the final model. Only South America showed significant association to melodic codes. In preliminary analysis, I examined musical stylistic period in an alternate way as well. Rather than using a continuous variable, I coded musical stylistic period according to five eras: Renaissance, Baroque, Classical, Romantic, and Modern. Each period was entered into the regression equation as a dummy variable. None of the variables proved to be significantly related to variations in melodic codes. It is important to note that national anthems represent a very constant musical form. This may explain the lack of influence displayed by musical stylistic period. With another type of music (e.g., symphonies, popular songs), this variable might be a significant factor in explaining music's structural change—that remains an empirical question.

TABLE 6
The Effects of Social and Musical Factors on Musical Codes

Independent variables	Dependent variables: (Period of composition) Overall musical code	(Period of adoption) Overall musical code
Geographic region:	B = 2.23*	B = 2.47**
South America	Beta = .30*	Beta = .34**
Structural position:	B = −.89*	B = −.34
World–System position	Beta = −.25*	Beta = −.05
Socialization:	B = .17*	B = .41**
Code of Mother Country	Beta = .17*	Beta = .41*
Anthem genre:	B = 2.40*	B = 1.77*
Hymn vs march	Beta = .32*	Beta = .24*
Musical stylistic period:	B = .009	B = .02
1572–1974	Beta = .13	Beta = .15
R^2	.48	.40
F	8.72**	6.58*

* $P <$ or $= .05$.
** $P <$ or $= .01$.

write anthems with basic musical codes; as we move toward the periphery of the system, musical codes become more embellished. Third, composers are likely to write anthems with musical codes that resemble those of their mother countries. In addition to these effects, the table shows that the type of anthem that composers write influences the structure of musical codes. In accordance with earlier findings, hymns are associated with basic codes while marches tend to have more embellished codes. These variables are significant at the .05 level or better. The equation accounts for 48% of the variation in musical codes.

Adoption Period

Findings for the adoption period are nearly identical to the composition findings. Specifically, South American leaders are more likely to adopt embellished music than leaders in other regions. In addition, elites are likely to adopt musical codes that resemble those of their mother country. Finally, the adoption of hymns is associated with basic musical codes while the adoption of marches is related to embellished musical codes. These variables are significant at the .05 level or better. The model accounts for 40% of the variation found in musical codes.

Discussion

Both composers and political elites appear to be susceptible to very similar structural influences. First, while national anthems are assertions of individuality, they are also "membership cards" in a world community (Cerulo, 1988a). Therefore, we might expect that anthems composed and adopted in certain regions—those with closely tied cultural traditions (i.e., South America)—will be similar in structure to those of their geographic neighbors. An anthem with a dramatically different structure might be seen as odd or exclusionary. The findings confirm this. Second, the findings show that composers in structurally equivalent positions write similarly structured messages. Structural equivalence suggests shared training for composers, and shared knowledge of compositional norms. Therefore, it is not surprising that composers writing in similar structural positions subscribe to the same compositional strategies, while those in different structural locations utilize different compositional strategies. In addition, we must recall that the format of national anthems, and the musical conventions of which they consist, were developed in the core of the world-system. Therefore, composers writing in core nations produce basic, conventional messages—the building blocks of the anthem format. On the other hand, composers in the periphery are likely to be either unfamiliar with such conventions or desirous of breaking with them in order to establish new, more individualistic styles. In these nations, we see the production of embellished codes. (These trends are suggested in the adoption model as well. However, the findings are not statistically significant when controlling for other influences.) Third, the findings suggest that composers and political elites tend to impose the symbolism of the mother country on their own national symbols. We see similar phenomenon in other symbolic realms, i.e., constitutions, legal systems, etc. These similarities are not unexpected when we consider the political issues faced by new governments: efforts to project cultural continuity, deference to cultural insidiousness, and in some cases, compensation or loyalty to the former ruling power (see, e.g., Boli-Bennet, 1979: 234). Finally, at both time periods, actors are influenced by the constraints of particular musical forms. We have seen that hymns are traditionally associated with basic musical codes while marches are traditionally more embellished in design. Composers and political elites, no doubt, come to learn these associations. This is likely the result of training—with regard to writing for composers and listening for elites. Therefore, it is not surprising that those writing or adopting hymns express them via basic codes while those writing and adopting marches use embellished codes.

Space limitations constrain further investigation or speculation on these findings. However, the analysis helps illustrate the utility of the measures presented in this article. The findings begin to address those factors that influence communication strategies; they help illustrate the nature of that influence—the ways in which social forces affect the "formation" of important cultural messages. The findings suggest the fruitful questions these tools allow us to pursue. To be sure, our concerns need not stop with social structure's effect on symbolic structure. Using these tools, we can determine more about the ways in which actors use symbols. For instance, we might ask if certain events always elicit similarly structured communication strategies. Consider the phenomenon of death. If we were to study requiem masses, for example, would we find that different circumstances of death (i.e., death of a child, spouse, parent; accidental death; war-related death, etc.) are conveyed by different musical codes? Do composers faced with different conditions of death systematically encode their responses in different ways? Are communication strategies different for those who lose a loved one versus those writing about death in the abstract? Prior to the introduction of these measures, a study of requiems would have to be limited to subjective classification or superficial elements of music such as tempo, songtype (e.g., ballads vs marches), or lyrics. Using the present measures, however, we could compare the musical codes of requiems (or the music of any other social event) in a much more thorough, direct, and standardized way and derive answers to the research questions just cited.

Using the tools presented in this article, we can also determine the relationship between symbolic structure and strategies of action. Laboratory experiments could reveal much in this area. For example, do certain musical codes produce greater physiological arousal? Are certain musical codes more easily recalled? Are some codes more effective than others in motivating action? Are basic and embellished codes differentially interpreted . . . do they convey different messages or systems of meaning? The answers to these questions hold implications for both scholarly and applied research. With regard to political symbols, for example, we could determine which codes are most stimulating to populations at large or specific blocks of voters. Such knowledge would also be valuable in marketing research. Advertisers could determine which configurations of jingles will produce the most desirable results. Finally, classifying musical codes could offer important information in the therapeutic domain. With the increased usage of music and art as treatment for the mentally ill, the differing effects of various musical codes could prove highly useful in designing treatment programs. In all of these areas, our attention to symbol structures will be greatly enhanced by the availability of tools for their accurate measurement.

The indicators presented here have broader applications as well. The basic–embellished continuum discussed in this paper can be extended to other cultural symbols such as visual symbols. The present musical measures suggest the vital dimensions and appropriate indicators for quantifying visual symbols. I am currently developing measures for capturing variation in color, contrast, and shape. While the measures are being applied to the analysis of flags, they can be used to study any visual symbolic form. Further development along these lines can only strengthen the empirical foundation of the study of culture.

CONCLUSION

Students of culture have longed acknowledged the importance of symbols in society. Yet, our study of symbols generates as many questions as it answers. Are all symbolic structures equally effective at motivating social members to action or unification? How do social factors influence a group's production and selection of various symbolic structures? These questions are not new. (They have been suggested in the past, beginning with Durkheim, 1915: 266). Yet, they still await answers. Our failure to provide definitive answers has been, in part, due to a measurement problem—a lack of method. We have simply lacked the tools necessary for capturing meaningful variation in cultural products—tools that respect both the special characteristics of cultural products and the requirements demanded by a scientific approach to culture. The measures developed in this article provide a modest first step in filling that void. Using the basic–embellished continuum represented by these measures, we can begin to harness our knowledge into "bundles" and begin exploring the nagging research questions that have been "flapping and hanging about our shoulders." To be sure, this research road is long, and the approach provided by this proposed method represents only the beginning of a journey. Yet, availing ourselves of these tools brings us one step closer to exploring and verifying the links between the social and cultural domains.

APPENDIX: Countries in the Sample Listed According to the Style of Their National Anthem

Hymns	Marches
Australia	Afghanistan
Austria	Albania
Barbados	Algeria
Brunei	Andorra
Bulgaria	Argentina
Canada	Bahamas
China (Taiwan)	Belgium
Denmark	Bolivia
Fiji	Brazil
East Germany	Chad
Great Britain	Chile
Guyana	Columbia
Hungary	Costa Rica
Isle of Man	Cuba
Jordan	Dominican Republic
Kedah	Ecuador
Korea (South)	France
Latvia	Guatemala

APPENDIX—*Continued*

Hymns	Marches
Liberia	Guinea Bissau
Lithuania	Haiti
Luxemborg	Honduras
Malaysia	Ireland
Malta	Italy
New Zealand	Ivory Coast
Nicaragua	Malagasy
Nigeria	Mali
Norway	Mexico
Panama	Monacco
Papua New Guinea	Oman
Penang	Paraguay
Perlis	Peru
Rhodesia	Sri Lanka
Romania	Switzerland
San Marino	Trinidad/Tobago
Surinam	Tunisea
Tonga	Turkey
Uganda	United States
Wales	Uruguay
	Venezuela

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