

Eleni Lapidaki, Lecturer of Music Education and Music Psychology, Aristotle University of Thessaloniki, Greece

The Interaction between Artistic, Psychological, and Educational Aspects of Temporal Experience in Music: Evidence from Listener's Tempo Judgments

Abstract

This study is concerned with a closer examination of the interaction between the artistic, scientific, and pedagogical aspects of temporal experience in music. It was designed to determine whether listeners were capable of forming consistent 'right' tempo judgments over an extended period of time by adjusting an initially 'wrong' tempo to a personally preferred tempo. The following questions were posed: Is there a consistent judgment of tempo across trials of the same examples using varying initial tempi for each trial? Is tempo judgment affected by the age and music background of the listeners, the pieces? compositional style, or the familiarity with and preference for the music? Results indicated that the initial tempo significantly dominated judgments. A small number of adults were remarkably consistent in their tempo judgments across all four trials. It appeared that these individuals possess an exceptional ability with respect to acute stability of large-scale timing in music that was labelled "absolute tempo." There was evidence that the degree of consistency in right tempo judgments gradually increased from preadolescence through adulthood. Musical style, familiarity, and preference also affected consistency of tempo judgments. However, few statistically significant differences in tempo judgment consistency were found as a result of listeners' music background. By proposing a creative, and most importantly, an intrinsically musical activity reflecting our need to organize and control the passage of time in music, it is hoped that this study can help music educators open a new and intriguing dimension for music teaching and learning.

Introduction

Does a piece of music have one and only one inherent tempo (absolute tempo), and if so, does this concept possess an absolute time framework? Or can a piece of music survive a wide range of tempi? The literature is far from consistent on these questions. For instance, Richard Wagner (as cited in Pöppel, 1990) wrote in his essay "On Conducting" with regard to tempo :

If one wants to summarize what is involved in the right interpretation of a piece, on the conductor's part, then this consists in that he or she always indicates the right tempo, because the choice and determination of tempo makes us realize whether the conductor has understood the piece or not (p. 105, translated from German by E. Lapidaki).

Along these lines, Stravinsky (Stravinsky & Craft, 1980) stated that

A piece of mine can survive almost anything but wrong or uncertain tempo ... What does it matter if the trills, the ornamentation and the instruments themselves are correct in the performance of a Bach concerto if the tempo is absurd? I have often said that my music is to be "read," to be "executed," but not to be "interpreted." I will say it still because I see in it nothing that requires interpretation (p. 135).

Concurring with Wagner and Stravinsky, in a recorded interview with Tim Page, pianist and composer Glenn Gould (1982, recorded interview) said: "I have come to feel over the years that a musical work, however long it may be, ought to have basically one tempo, one pulse rate—whatever it may be—one constant rhythmic reference point."

Conductor and music theorist Epstein (1985) also embraces Gould's approach to tempo with the concept of proportional tempo, also called theory of continuous pulse: So powerful is the element of pulse that if one violates it by distortion of tempo, one runs the risk of an unsuccessful performance. Such a distortion seems to be violating not only a "musical factor," but a biological one as well, one which sets ground limits to our aesthetic perception (p. 37).

On the other hand, harpsichordist Ralph Kirkpatrick (1984) criticized the notion of fixed relationships of pulse and the concomitant belief in an absolute tempo as follows:

We all have different pulse rates; we all have different chemistry. If one wishes to give to a piece of music a characterization that is different from that of another, to endow it with personality of its own, one may need to avoid, rather than cultivate, common relationships of tempo (p. 47).

Pianist Alfred Brendel (1977) opposes himself to the metronome-conscious interpretation of music which, as he points out, has managed to influence musical thinking "through the experiences of Stravinsky and jazz music" (p. 42, translated from German by E. Lapidaki), but he also disagrees with Kirkpatrick's belief in the dominance of the interpreter's chemistry (nature) that influences the execution of tempo. Brendel superimposes a psychological tempo to the notion of metronomic tempo:

The interpreter who follows the flow of music as naturally as possible—and hereby I mean the nature of music and not the nature of the player—will always give the "psychological listener" the feeling that he or she plays 'in the right tempo' (p. 43, translated from German by E. Lapidaki).

Similar ideas are expressed by Donington (1963/1973):

Some movements allow a much narrower margin of tempo than others. Perhaps there is always just one interpretation, and therefore just one tempo, which most musicians will find more convincing than any other; or perhaps interpretation is always relative. In either case, the only way of finding the tempo is by responding to the music itself, with a sensitiveness not given to every musician alike nor to any metronome at all (p. 383).

Moreover, music theorists diverge in their opinions of whether structural relationships in music—formal characteristics, local-level and more global harmonic relationships, rhythmic and metric relationships—are in some way dependent on it (Berry, 1986; Lester, 1982; Piston, 1978) or whether they remain independent of tempo (Forte, 1979; Cooper & Meyer, 1966). To quote Piston (1978), for instance: "The speed of music justifies a broader view of the harmony than would be indicated merely by root changes" (p. 208). Furthermore, Clarke (1985) provided evidence for the psychological validity of modifications of performance tempo demonstrating that these

modifications are closely related to the structural characteristics of the music performed. In contrast to Piston's view, Cooper and Meyer (1966) maintain: "Tempo, though it qualifies and modifies [pulse, meter, and rhythm], is not itself a mode of organization. Thus a rhythm or theme will be recognizably the same whether played faster or slower" (p. 3).

Another stark contrast of opinion about absolute tempo may be seen in the positions of Reckziegel (1961) and Reinecke (1974). Reckziegel asserted that

The perceived tempo of music obviously depends not only on the duration of one or more abstract units but also on the rhythmic structure within this duration. Therefore, we would like to introduce the term of "inner tempo" (Innere Tempo) which has been already used by ethnomusicology for some time (p. 215, translated from German by E. Lapidaki).

Reckziegel further expressed inner tempo as the equation $b_r = 1/t \cdot d_t$ where b stands for inner tempo, t stands for the duration of the metric unit, and r stands for the average pulse number within the metric unit. He concluded that "... the attempt to determine an inner tempo results in making measurable the musical time dimension, which is seemingly only comprehensible in a sensory way" (p. 223, translated from German by E. Lapidaki).

Conversely, in an article entitled "On the Development of Research in Music Perception During Recent Decades," Reinecke (1974) stated that "no evidence has been found to prove that one specific musical piece has only one 'right' tempo" (p. 414, translated from German by E. Lapidaki).

Here one may conclude that in a single-movement composition or between the movements of large-scale compositions the relation of tempi to each other may be consistent and in a definite and unambiguous relationship to an "inner" or "base" tempo which, on the other hand, cannot be determined by the musical structure in a precise and absolute way. This perhaps may be the reason why composers set metronome markings to their music.

Although tempo is considered to be a prominent factor in harmonic rhythm, it is surprising that music theorists have paid relatively little attention to it. Indeed most music theories deal primarily with rhythm and meter and take a somewhat dim view of musical tempo. Rhythm and meter can be indeed structured, grouped, arranged hierarchically, notated, and imagined without exact measurement. Nevertheless, as soon as they are listened to, they gain concrete dimension in a fixed period of time, at a certain tempo. In other words, the rhythmic and metric order of a musical composition cannot be realized and, thus, measured without the parameter of tempo.

Yet there are apparently no theories of music that assert that because all note values are obviously relative to each other, a specific time value can only be determined by referring to the speed of the temporal structure of the music in relation to real (externally metered) time. While Glenn Gould (1982) considered the tempo of a composition to be "one constant reference point", Cooper & Meyer (1966), on the other hand, criticized the notion of constant relationships of pulse and absolute tempo of music:

And while changes of tempo will alter the character of the music and perhaps influence our impression of what the basic beat is (since the beat tends to be perceived as being moderate in speed), tempo is not a relationship. It is not an organizing force It is important to recognize that tempo is a psychological fact as well as a physical one (p. 3).

Concurring with Cooper & Meyer, with regard to the dual nature of tempo—Kramer (1988) stated: "If we consider tempo as both the rate of beats and the rate of information, then we can incorporate into this broad concept both the objectively

measured and the subjectively felt” (p. 349). Furthermore, from a phenomenological standpoint, Clifton (1973) maintained that although musical time is an a priori, because it can be perceived immediately, tempo is not an a priori, though it concerns time, “... because we must learn to measure it” (p. 79).

The present study

In the present study tempo will be treated as the primary expressive agent for determining the rate at which the subjective flow of time passes which we connect to music of different styles and genres when we listen to it. At the same time it will be attempted to objectively measure and, thus, relate subjective tempo to real time as if it were a physical entity which ticks off musical time like an internal clock controlled by the nervous system. Thereby, it will be sought to disclose consistencies in its function as well as personal factors that may influence it, such as age, musical background (formal music education), taste, and familiarity, among others, that we bring to bear when listening to music.

Specifically, the hypothesis to be tested was that listeners would show a notable consistency over a period of time regarding the way each of them perceived how musical examples would sound in their right tempo. Furthermore, it was of interest whether listeners would exhibit consistency in their determination of right tempo, although the experimenter systematically changed the tempo with which each example was first presented to them at every session. In other words, listeners were given the active task to explore and, finally, determine by themselves the right tempo, which may be very close to common musical practice. One might put it this way: listeners had to reconstruct the musical work examining the influence of tempo on the music in isolation until they came to the decision of right tempo.

Research Methodology

Research Questions

Six specific questions were posed:

- (1) Is there a consistent judgment of correct tempo across four separate sessions of the same musical examples using varying initial tempi for each trial?
- (2) Is the consistency of tempo judgment affected by the age of the listener?
- (3) Is the consistency of tempo judgment affected by the musical background of the listener?
- (4) Is the consistency of tempo judgment affected by the style of music?
- (5) Is the perception of tempo affected by the familiarity with
 - a) the individual pieces and
 - b) their overall style?
- (6) Is the consistency of tempo judgment affected by the listener's preference/liking for a particular musical example?

Apparatus

To answer the research questions, a sequencing program (*Performer* from Mark of the Unicorn) was employed which had the capacity to precisely vary the tempo of the listening examples in real time, without altering any other musical attributes.

Selection of Musical Examples

In all trials subjects listened to the following six compositions: C-major and A-minor *Two-Part Inventions* by J. S. Bach, *Clair de Lune* by Claude Debussy, *Piano Piece* by Michalis Lapidakis, *Yesterday* by the Beatles, and *The Children of Piraeus (Never on Sunday)* by Manos Hadjidakis. These works were chosen because they represented a wide

range of musical styles (e.g., Baroque, Impressionistic, contemporary idiom, rock ballad, and dance music), familiarity, and preference.

Subjects

Subjects ($n=90$) were recruited from different age groups_30 adults (25-52 years, 30 adolescents (junior and senior high school students), and 30 preadolescents (fifth and sixth grade children). Individuals of each age group were selected on the basis of musical background and willingness to participate. Within each age group, half the subjects were musicians, half were nonmusicians.

Procedures

For the four testing sessions, subjects were asked to listen to each composition and tell the experimenter to alter the tempo upwards ('faster') or downwards ('slower') until the tempo was right; that is, the most appropriate tempo for that composition, in the opinion of the listener. Once the six compositions were judged, the subject was asked to return in at least four days time for the next session. This slow pacing of trials was observed in order to prohibit memory carryover from one trial to another.

Each session for each subject systematically varied the order of the compositions and the initial tempo of the listening examples in order to eliminate the possibility on contextual cues. Two initial tempi have been used: M.M.q=20 (slow I.T.) and M.M.q=200 (fast I.T.); all tempo judgments in the Lapidaki & Webster study (1991) had lain within this range. Each initial tempo was repeated twice: either in the first and third or in the second and fourth trials.

In order to examine subjects' familiarity with the listening examples a questionnaire form was handed to them at the beginning of the first testing session. Subjects had to answer questions concerning their familiarity with the particular example and its relevant musical style, after they judged the correct tempo of each example.

Finally, with regard to the question of their individual preference/liking for a particular musical example, subjects were asked to rate it on a scale ranging from 1 (*least-liked or poor*) to 4 (*most-liked or excellent*), after they judged the correct tempo of the example at the fourth testing session. This information was recorded and used in later analyses.

Results

Consistency of Tempo Judgments Across Trials

To test the hypothesis that listeners would render consistent tempo judgments, independently from the initial tempi, a one-way repeated ANOVA for each musical example was performed using tempo judgments at each of the four trials as the independent variable. The .05 level of significance was adopted as the alpha level for these tests.

Results for these analyses show that listeners did not exhibit significant consistency in their judgments of the most appropriate tempo of the musical examples across the four trials (Bach I, $F=84.43$, $p < .0001$; Bach II, $F=86.27$, $p < .0001$; Debussy, $F=80.37$, $p < .0001$; Lapidakis, $F=139.07$, $p < .0001$; Beatles, $F=59.02$, $p < .0001$; Greek dance, $F=78.856$, $p < .0001$).

Further examination of the results revealed that both means of tempo judgments for the trials with the fast initial tempi were higher than the means for the trials with the slow initial tempi with respect to all musical examples: the slower initial tempo generally evoked slower preferences, and so on.

Age

To test the effect of age on the consistency, either a repeated measures MANOVA or the adjusted univariate test had to be utilized for each musical example. Both analyses led to the same conclusion, namely that consistency of tempo judgments across the four trials for all examples were significantly influenced by the age group of the listener ($p < .02$). Furthermore, in order to ascertain which age group exhibited the highest degree of consistency, the individual deviation scores (IDS) averaged over the four trials of each piece were used as an additional measurement of tempo judgment consistency for each musical example (see Table 1). Results clearly indicated that adults were the most consistent and preadolescents the most inconsistent with regard to all musical examples ($p < .001$).

Table 1

Cell Means for Individual Deviation Scores (IDS) Averaged over the Four Trials Arranged by Musical Example and Subjects' Age Groups from ANOVA Procedure

MUSICAL EXAMPLES	AGE GROUPS						F
	PRE-ADOLESCENTS ^a		ADOLESCENTS ^a		ADULTS ^a		
	M	SD	M	SD	M	SD	
BACH I	51.168	35.200	39.592	35.200	18.592	25.733	8.90*
BACH II	49.654	26.973	37.046	21.557	22.769	23.376	9.37*
DEBUSSY	48.962	23.336	42.058	22.661	15.511	20.434	19.02*
LAPIDAKIS	64.351	28.047	55.758	30.590	37.551	30.765	6.31*
BEATLES	43.466	21.085	15.260	12.264	11.094	17.947	30.44*
GREEK DANCE	41.404	26.969	36.685	20.589	14.613	18.628	12.29*

Note. N=90. ^an =30.

P < .001

Musical Background

With reference to the third question regarding musical background, a repeated measures MANOVA revealed no group effects, except for the Debussy example. ($F=19.02$, $p < .001$).

Musical Style

To answer the fourth question regarding differences between compositional styles, a repeated measures ANOVA using style as the experimental factor (five levels corresponding to the five different musical styles of the pieces) and the mean number of IDS averaged over the four trials of each style as the response variable was performed. Results revealed that the rock ballad style exhibited the highest degree of consistency followed by the styles of Greek dance music, Impressionism, and Baroque, respectively. The tempo judgments for the contemporary piece were the least consistent among all styles.

Familiarity and Preference

A repeated measures MANOVA was performed using tempo judgments for each example averaged over the four trials and the 5 familiarity levels as variables. Results

indicated that familiarity with musical examples significantly influenced tempo judgments ($p < .001$).

Furthermore, a repeated measures MANOVA was employed using tempo judgments averaged over the four trials and preference levels as variables. Results revealed that tempo judgments were significantly affected by subjects preference for the musical examples ($p < .05$).

The musical ability of 'absolute tempo'

A closer look at the range separating the fastest from the slowest tempo judgments of individual subjects for each piece often revealed strikingly small discrepancies. It appears that a relatively small number of listeners (e.g., adult musicians and non-musicians) possess an exceptional ability with respect to acute stability of large-scale timing in music. This ability to give over time consistent tempo judgments to a piece of music in conditions seemingly devoid of an external tempo reference (a score or the body interaction involved in performance) may be referred to as absolute tempo, analogous to absolute pitch.

It must be also noted that "absolute tempo" has been observed with musical examples that were thoroughly known by the subjects. Nevertheless, this finding should be treated with caution, since these subjects did not exhibit the ability of absolute tempo with respect to all pieces for which they had the same level of familiarity. Contrary to absolute pitch, one might suppose with respect to absolute tempo that the same person seems to follow different cognitive strategies of timing for each individual piece, which leaves one wondering whether the stability in viewpoint is to some extent discrete rather than continuous.

Interestingly enough, these subjects reported that they were surprised when they heard that their right tempo choices were virtually identical across trials. Thus, it would seem that physical, psychological, and environmental factors, such as, fatigue, mood or time of day, did not have an effect on their tempo judgments. One reason might be that music engages and programs psychobiological clocks or neural (Epstein, 1985; Clynes, 1986; Pöppel, 1990) which function subconsciously but give conscious read-outs and thereby guide the listeners' choice of right tempo in an exact and stable manner.

Tempo perception and recommendations for music teaching and learning

This study was based on the premise that tempo is a general cognitive constraint influencing the way we organise long-scale musical events in real time and, thus, make sense of them. Tempo constitutes an important element of music by enabling various sound events to be woven together at a fixed pace in time. In turn, this temporal pacing is what gives music its unique motional, emotional, and sensuous character, as has been acknowledged in most discussions concerned with music aesthetics, theory, and compositional or performance practice (Lapidaki, 1990).

If this is the case, then the development of a more refined or discerning concept of tempo in students should be considered crucial for a thorough understanding of the expressive qualities of music. Instead of focusing solely on reading of notated structural parameters of music (e.g., melody, rhythm, meter, and the like), music instruction should promote the development of listening skills, especially with reference to the imprecisely represented in conventional notation, motional, and emotional aspects of music, as is the case with tempo (Lapidaki, 1992).

It is somewhat surprising to find, however, that tempo is commonly being treated in music instruction of all levels as if it were solely applied to the metronome or to verbal designations. This leads us to believe that students are not supposed to have an

awareness that tempo judgements lie deeply within the human mind which intuitively attempts to supply its own tempo to music in order to ensure the meaningful co-ordination and motion of sound relationships through time. In other words, it is the relation of melody, phrasing, harmony, rhythm, timbre, dynamics, style, and other musical features, to tempo that imbues them with a new and exciting perceptual dimension. Music educators can help students to gain a deeper sense of recognition and mastery of all kinds of relations in a piece of music by showing them the power that tempo exerts on their synthesis.

To help students of all ages find a use for the concept of tempo in music, music educators may consider the task utilised in this research which proposes a fascinating, creative, and—most importantly—an intrinsically musical activity reflecting our need to organise and control the passage of time in music. More specifically, listeners were given the task of manipulating the tempo of a piece of music in real time while examining its influence on the way the music sounds. The ultimate objective was to come up with a tempo in which all elements of the piece would fit together naturally, in a right pace.

On the one hand, listeners were provided with the opportunity to choose the most appropriate tempo in their opinion among a vast number of tempi available to them by means of the computer, something that cannot happen when you perform music due to motor-sensory limitations of the performer. On the other hand, listeners were faced with the technical problem of saying "this tempo is not correct" or "that tempo is correct" which is an important aspect of the creative process in music (Lapidaki, 1992).

However, in a real educational setting, students' musical decisions about correct tempo have to also rest on the teacher's guidance. The skilful music teacher will use musical materials which are appropriate for each particular age level but will attempt to demonstrate how musical parameters are integrated and flow with a rightful pace in all music. The thoughtful use of examples— particularly, from contemporary music and from music of various genres and cultures—may also help students to understand the different roles tempo fulfils within the musical structure, from aesthetic fulfilment, to inspiration of dance and song, to arousal of a certain emotional ambience. In addition, the teacher's recommendation that tempo is the parameter with the greatest degree of variability and possibilities in music will give students the freedom to experiment with music with greater ease and curiosity while focusing on the pacing of musical events.

Finally, by using tempo as a reference point in order to teach other musical elements in their proper motion, we can open a new and intriguing dimension for listening. As Stockhausen (Cott, 1973) said referring to the importance of manipulating tempo in compositional practice:

"... a person who experiences this music becomes as much slower and as much faster in his reactions and experiential time as the music. This expands man and also his awareness of what music can be" (p. 193).

In this context, the finding that most listeners did not prove to be precisely consistent in their correct tempo judgements over a period of time becomes a secondary issue. Indeed we all vary in the abilities with which our aesthetic perceptions operate.

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