A Three-Dimensional Model for Evaluating Individual Differences in Tempo and Tempo Variation in Musical Performance

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Abstract

People differ from each other, and this includes performers of music. The study of individual differences is well established in many social science disciplines but has been largely neglected in music performance research. To what extent do performers play differently from each other? How can these differences be concisely described and precisely assessed? Questions like these remain unanswered. Focusing on tempo and tempo variation in performance, this article contributes to knowledge by describing a well-defined, clearly illustrated and systematically classified taxonomy for identifying differences in tempo and tempo variation. Based on findings from past theoretical and empirical research on tempo in performance, it presents a model whereby performers' individual differences in tempo and tempo variation can be evaluated. The model identifies six variables representing three dimensions of tempo and tempo variation: basic tempo, global tempo variation, and local tempo variation. It has the potential for providing researchers with a toolbox for analyzing differences among individual performers' use of tempo and tempo variation by assessing the extent to which each of the variables is embodied in specific performances. Evgeny Kissin's and Lars Vogt's recorded performances are used to illustrate how the model will perform its role. Researchers could test the model further by analyzing a larger repertoire and/or carrying out experiments to generate more comprehensive knowledge about individual differences in performance style.

Keywords

individual differences, tempo, music performance, performance assessment, music taxonomy, performance model, performance theory, piano performance, performance style

One of the most significant trends in musicological research in recent years is the shift from a near exclusive focus on composers and compositions to a focus on performers and performances. Of the two broad approaches that can be identified in empirical studies on performance, one

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emphasizes trends and historical differences in performance style (Cook, 2007; Dodson, 2011b; Fabian, 2017; Peres Da Costa, 2012; Philip, 1992; Sung & Fabian, 2011) while the other assumes some relatively constant aspects of expression and concentrates on building models of performance conventions (Dodson, 2011a; Friberg, Bresin, & Sundberg, 2006; Juslin, Friberg, & Bresin 2002; Todd, 1985; Widmer & Goebl, 2004). Few studies have attempted to combine the two approaches: namely, to develop a model for understanding differences among performers and differences among performances. The present study fills this gap by constructing a model whereby individual differences in tempo and tempo variation can be evaluated.[1]

Research shows that performers often differ from each other in their use of such parameters as tempo (Bowen, 1996; Dodson, 2011a; Fabian, 2003; Repp, 1994, 1999a 1999b) and other aspects of timing (Dodson, 2011c; Fabian & Schubert, 2010; Leech-Wilkinson, 2015; Repp, 1992, 1997a, 1997b; Spiro, Gold, & Rink, 2010; Todd, 1985), dynamic variation (Cheng & Chew, 2008; Cook, 2009b; Dodson, 2011c; Todd, 1992), timbre (Bernays & Traube, 2014), ornamentation (Fabian, 2003, 2015; Sung & Fabian, 2011), articulation (Bresin & Battel, 2000; Fabian, 2003, 2009; Fabian & Ornoy, 2009), pitch control (Fabian & Ornoy, 2009; Leech-Wilkinson, 2010), and many instrument-specific aspects such as violin vibrato and bowing, as well as piano pedaling (Bazzana, 1997; Fabian, 2015; Leech-Wilkinson, 2010; Sarlo, 2015). We refer to performers' distinctive ways of manipulating these parameters as "performers' individuality," which research has shown to be recognizable not only by performers themselves (Repp & Knoblich, 2004) but also by most listeners (Gingras, Lagrandeur-Ponce, Giordano, & McAdams, 2011; Koren & Gingras, 2014). In addition, it is suggested that in many cases it is the most renowned performers whose performances differ most from each other and from the statistical norm (Repp, 1990, 1992). In a nutshell, performers' individuality does exist; it can be perceived in the differences among their styles of performance. Moreover, these differences inform the ways in which performers are distinguished and valued.

In research on performers' individuality and differences among performances, the parameter of tempo (or timing) is perhaps the most studied. This may be because tempo is the most readily and reliably measurable parameter that remains faithful in recorded performances to the original real-time performance (Gabrielsson, 1988, p. 29; Johnson, 2002, p. 198). It may also be due to its important contribution to overall musical expression (Gabrielsson, 1988, pp. 29–30) as well as to its significant role in the perception of differences among performances (Gingras et al., 2011, p. 1217).

Existing literature addressing performers' individuality and differences in tempo and tempo variation can be roughly categorized into two types, and each has their own limitations: firstly, studies that mainly concentrate on the qualitative description of the performance style of a particular performer while compromising the comparison between a performer and a larger performance norm—that is, the study of the *individuality* of a performer (Bazzana, 1997; Leech-Wilkinson, 2010, 2011; Sarlo, 2015); and secondly, studies that usually involve the analysis of multiple performances of a specific and short musical piece or musical passage without attempting to generalize the findings to broader and more diverse musical contexts—the study of *differences* among performances (Cook, 1995, 2009b; Repp, 1990, 1995, 1998; Spiro et al., 2010; Spiro, Gold, & Rink, 2016). However, the study of *individual differences* is about the variance between people on the one hand—that is, how people are different—and the central tendency of a person on the other—that is, how a person can best be described in terms of an overall within-person average. Therefore, individual differences in performance style are not simply about the *individuality* of a single performer or the *differences* among performers found in a particular and limited musical context, but rather about whether a performer is more similar to him/herself across musical contexts than he/she is to others, and if the variation within a

performer's performances across musical contexts is less than that between other performers in general (Revelle, 2013).

Although the study of individual differences is well established in many social science disciplines such as psychology and education, in the field of music performance studies such questions remain unexplored largely due to the segregation of the two above-mentioned approaches. This segregation may be because, when it comes to discussing how performers are different from or similar to each other, musicians and musicologists seem to lack a vocabulary as specific and consistent as that used to describe compositional styles of different composers and periods (Dodson, 2008, p. 129; Leech-Wilkinson, 1999, p. 319). Without an adequate taxonomy for describing tempo and tempo variation across a broad musical repertoire, it is difficult to bridge the gap between performers' individuality, on the one hand, and differences between their performances, on the other. With a view to overcoming this limitation, the consistency and variation of a performer's style across musical contexts—the central tendency of a performer—needs to be examined within a taxonomical model that can potentially be applied to a wide range of repertoire instead of a specific musical passage or piece.

This article first describes a concise and specific taxonomy for describing similarities and differences among performers' styles of tempo and tempo variation. On the basis of the existing literature, this parameter is classified into three dimensions: (1) basic tempo choice, (2) global tempo variation, and (3) local tempo variation. Each dimension is further divided into two variables, also derived from findings from past theoretical and empirical research on tempo in performance. The three dimensions, therefore, include six approaches to tempo and tempo variation in performance, regardless of instruments and repertoire, and hence allow the evaluation of differences among performances in a more general musical context. The article then presents a taxonomical model whereby these six variables can be measured, assessed, and combined so that individual differences both among performances as well as among performers can be evaluated. Evgeny Kissin's and Lars Vogt's recorded performances are used to illustrate how the model will perform this role. This three-dimensional model thus potentially provides an effective and precise way of comparing tendencies of performers and facilitates a holistic understanding of individual differences in tempo and tempo variation. This potential should be tested more extensively and comprehensively in future research through further empirical and/or perceptual investigations.

Basic Tempo Choice: Two Variables

Musicians regard basic tempo as one of the most crucial musical elements that has an influence on practically every aspect of music-making (Gabrielsson, 1988, pp. 29–30). In this study, the dimension of basic tempo is sub-divided into two variables: (1) tempo in fast passages and pieces, and (2) tempo in slow passages and pieces. Past research suggests that individual differences in tempo choice can be immense in piano performances (Peres Da Costa, 2012), string instrument performances (Fabian, 2003, 2015; Fabian & Ornoy, 2009), orchestral performances (Bowen, 1996; Philip, 1992), and chamber music performances (Johnson, 2002). In some cases, when a musician performs the same pieces twice the basic tempos of the two versions can be obviously different (Sung & Fabian, 2011; Zhou, in press). Apart from the diversity of basic tempo (Fabian, 2003; Peres Da Costa, 2012), several studies highlight the personal nature of tempo choice (Cook, 2009a; Fabian, 2015; Leech-Wilkinson, 2015). Most importantly, this personal tendency is not necessarily unidirectional (i.e., playing the entire piece or all pieces either fast or slow). According to Fabian (2003, 2005, 2006, 2015), some musicians may tend to perform slow pieces at a very slow tempo and fast pieces
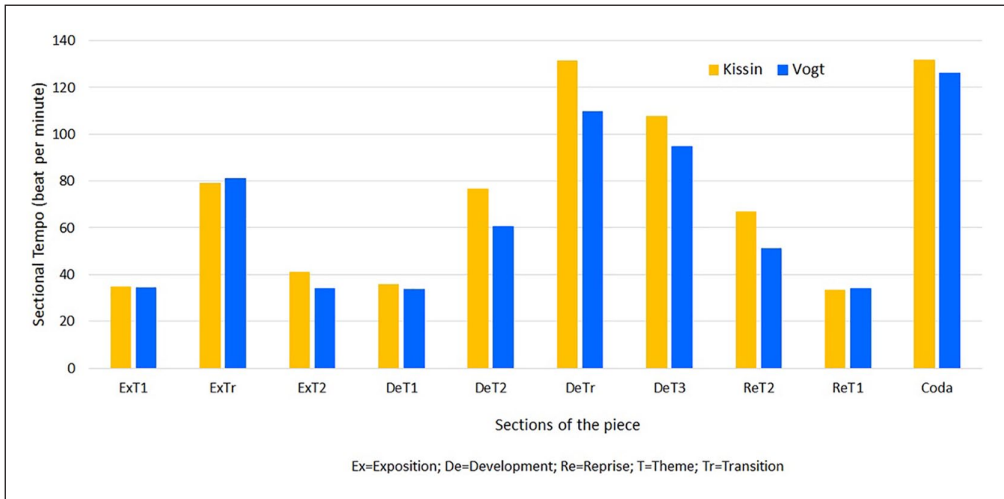
Figure 1. Sectional basic tempo in Kissin's and Vogt's performances of Chopin's Ballade No. 1 in G minor, Op 23.

at a very fast tempo, while others may tend to pick a faster tempo for slower pieces and a moderate tempo for fast ones. Therefore, it is important to consider basic tempo choice as having two separate dimensions, otherwise this distinction is lost to the taxonomy. Dividing tempo choice into two variables can allow a deeper understanding of a performer's style of basic tempo and individual differences in tempo choice between performers, as will be illustrated in the examples below.

Figure 1 shows how the two variables can be used to evaluate differences in basic tempo between two performances by comparing the performers' approaches to the fast and slow passages in the same piece. The bars in the figure show the tempos of each section, based on average inter-beat duration (beat per minute, or bpm) within the section, of Evgeny Kissin's and Lars Vogt's performances of Chopin's Ballade No. 1 in G minor, Op. 23. It can be seen that the two pianists adopt similar tempos in the slow sections: that is, in all three appearances of the lyrical first theme (ExT1, DeT1, and ReT1).[2] Kissin, however, plays most of the fast sections (DeT2, DeTr, DeT3, ReT2, and Coda) a great deal faster than Vogt does. In this case, the two variables can effectively evaluate the similarities and differences between these two performances. As analysts, we give Kissin a high rating for the variable of "tempo in fast passages and pieces" and Vogt a low rating for this variable. For the variable of "tempo in slow passages and pieces" we give the same rating to the two pianists. This example shows that the two pianists can be differentiated successfully using the two variables representing basic tempo in both fast and slow passages of music.

Tempo Variation at the Global Level: Two Variables

According to Bruno Repp (1992), tempo variation can be global or local. Global tempo variation entails the grouping of the hierarchical structure of the composition at the phrase or section level (i.e., large-scale, or macro variation), while local tempo variation involves within-gesture lengthening or shortening of beats (or notes), usually for expressive purposes, at the bar/beat/note level (i.e., micro variation).

The performance studies literature has identified two main variables at the global level: (1) the use of *rallentando* at structural points, such as sectional boundaries and phrase ends, and (2) the emphasis of contrast in basic tempo between adjacent structural sections. These two strategies can be used to either enhance or undermine structuralization (emphasizing the compositional structure of the piece) in a performance.

Neil Todd (1985) suggested that "the performer uses phrase-final lengthening as a device to reflect some underlying structure abstracted from the musical surface" (p. 34). Todd (1985, 1989, 1992) labeled the strategy "phrase arching"—getting slower and softer when playing out of a phrase and faster and louder when playing into one—and showed its important expressive role in performance. Subsequent studies found that phrase arching may be confined to certain performances and certain historical or musical contexts (Cheng & Chew, 2008; Cook, 2009b; Dodson, 2011b). Research also shows that the features of phrase arching are not limited to structure at the phrase level. The same expressive strategy can be found in performances of the larger-scale structures of music in a variety of styles. Performers tend to shape formal sections, to a greater or lesser extent, by means of getting slower and softer when nearing the end of a section. This convention has been noted in performances of Romantic piano works (Bowen, 1999; Rink, Spiro, & Gold, 2011; Spiro et al., 2010), Classical and Romantic symphonic works (Bowen, 1996; Cook, 1995; Lowe, 2011), Baroque violin works (Fabian, 2015), and Classical chamber works (Johnson, 2002).

While many studies have demonstrated the use of tempo variation at structural points, this is not necessarily the only strategy involving global tempo variation in performance. There are studies that demonstrate contrasting delivery. Cook (2001) notes that Eugene d'Albert hurries at sectional breaks without placing much emphasis on structural points and tends to highlight unexpected accents within sections and phrases. It seems that his strategy is to disguise structure and "through-perform" the piece rather than to use significant *rallentandos* at phrase or section boundaries for structuralization, as Furtwängler is observed to do, for example (Cook, 1995).

The first of the two main variables of tempo variation at the global level—the use of *rallentando* at structural points—can be demonstrated, once again, by comparing Kissin's and Vogt's performances of the Chopin Ballade. Figure 2 illustrates the two pianists' tempos in the first lyrical theme of the piece (bars 8–36). The x-axis shows the bar and beat numbers while the y-axis shows the tempo, measured by inter-beat duration, of each beat (in beat per minute, bpm). The tempo curves show that Kissin and Vogt mostly play this theme at similar tempos. However, Kissin uses more pronounced *rallentandos* at most of the ends of phrases, making his tempo slower than Vogt's at these structural points, as circled in the figure. He also speeds up from bar 22 onwards and slows down significantly from bar 32 onwards, creating a tempo arch between bars 21 and 36. This tempo arch tellingly demonstrates his tendency to structuralize. These observations indicate that Kissin may use structural *rallentando* to a greater extent (i.e., more strongly and more frequently) than Vogt. This example shows that the two pianists can be differentiated successfully using the first of the two variables representing tempo variation at the global level: tendency to use structural *rallentando*.

As indicated earlier, tempo variation at the global level is not necessarily confined to the variation at structural points such as phrase ends and sectional breaks. Altering basic tempos between sections can also be an important approach to global tempo variation. Bowen (1996) uses the terms "sectional flexibility" and "large-scale tempo change" to describe pronounced tempo fluctuations that are used to differentiate structural divisions in symphonic performances. He shows that early recordings tend to illuminate the four sections in the exposition of Mozart's Symphony No. 40 in G minor, K. 550 by adopting slower tempos for
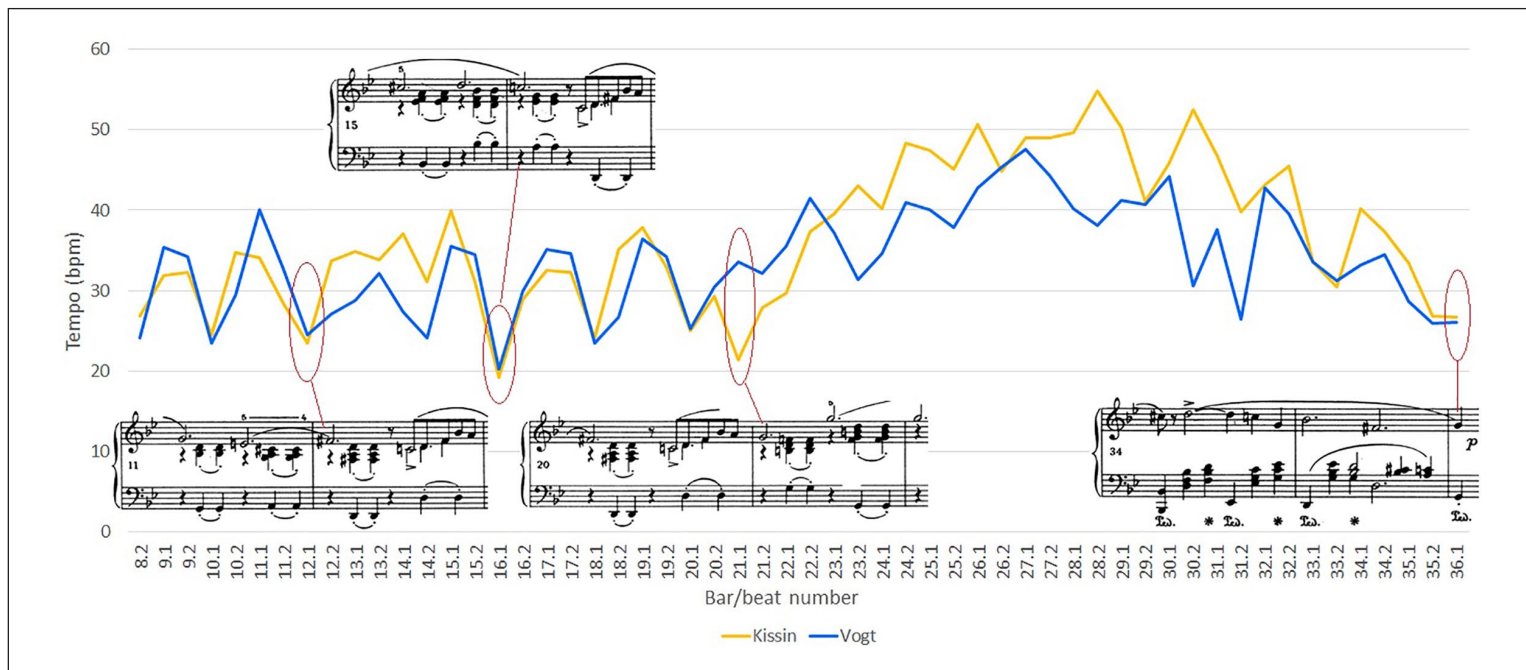
Figure 2. Global tempo variation in Kissin's and Vogt's performances of Chopin's Ballade No. 1 in G minor, Op. 23, bars 8–36.

the first and second themes and faster tempos for the transition and the closing section, although tempo change is not indicated in the score. Structuralization by means of sectional tempo flexibility is found not only in performances of Classical symphonies but also in piano performances of Romantic works (Rink et al., 2011) and violin performances of Baroque music (Fabian, 2015). While this strategy can be observed in many performances of Classical and Romantic repertoire, it is not employed universally. Some performers seem to manipulate inter-sectional tempo in seemingly opposite ways. For instance, Bowen's research shows that some conductors working in relatively recent years (Herbert von Karajan being one) seem to prefer a more even tempo across sections to create structural continuity across the four sections of the exposition of the first movement of Mozart's Symphony K. 550 (Bowen, 1996, p. 134).

The second of the two main variables of tempo variation at the global level—tendency to use sectional flexibility—can be used to evaluate differences between two performances in terms of contrasts in basic tempo between adjacent sections of a piece. This is illustrated in Figure 1, which indicates that Kissin shows greater contrasts in his choices of basic tempo for each section compared with Vogt. We therefore give Kissin a higher rating for the "sectional flexibility" variable than Vogt. In short, Kissin's individuality as a performer can be attributed, at least in part, to his more extreme use of global tempo variation.

It can be concluded that musicians take different approaches to global tempo variation, which can be achieved in various ways. Some might use prominent *rallentandos* at structural points, while others might use contrasting tempos to differentiate sections. Performers could exhibit both approaches to an equal extent, or one or the other to a much lesser or greater extent. These variances in the tendencies to use (1) structural *rallentando* and (2) sectional flexibility constitute further criteria for differentiating one performance from another and thus form the two variables of tempo variation at the global level, the third and fourth variables of the three-dimensional model.

Tempo Variation at the Local Level: Two Variables

In contrast to global tempo variation, which articulates compositional structure, local tempo variation involves the lengthening or shortening of note(s) and beat(s) (i.e., accentuating certain moments of a piece) for expressive purposes. It is referred to variously as "rhetorical tempo change" (Cook, 2010), "small-scale tempo change" (Bowen, 1996), "localized rubato" (Fabian, 2015), or agogics (Thiemel, 2017) and is routinely employed in performance. Local tempo variation, like global tempo variation, can be achieved in different ways.

A classification of local tempo variations in performance is provided by Drake and Palmer (1993). They investigated the role of three types of accents—rhythmic, melodic, and metric. They suggested that rhythmic grouping accents are characterized by the emphasis of the initial or final event (note) in rhythmic groups, usually by the performer playing it louder, delaying it, and/or preceding it with a pause. Melodic accents are given at the jumps and turns of a melody, depending on musical context, and are played louder, delayed and/or lengthened. Metric accents are made by playing the strong beat louder and/or longer, according to musical context (Drake & Palmer, 1993, pp. 373–374). Research suggests that these types of local tempo variation are practiced in diverse ways. Some performers place more emphasis on shaping metric or rhythmic groups, while others stress melodic or harmonic events (Bisesi, Macritchie, & Parncutt, 2012). Based on these findings, we propose two variables representing local tempo variation: the melodic-harmonic approach, and the metric-rhythmic approach.

The melodic-harmonic approach involves the accentuation of pitch- and/or harmony-related events (Huron & Royal, 1996). These types of accents have been evidenced in a number of empirical studies of performance. According to Leech-Wilkinson (2011, 2015), Alfred Cortot's rubato is melodically driven, mainly through emphasizing melodic peaks—lengthening the top melodic notes—and varying tempo according to melodic contour. The strategy of shaping melodic contours by varying tempo is also demonstrated by Fabian (2015) in various performances of Bach's solo violin music. Beat-level tempo measurements show that Monica Huggett emphasizes melodic-harmonic goals by following "melodic patterns across bar-lines creating shifted metric accents" (Fabian, 2015, p. 214). Similarly, Philip notes that Fritz Kreisler highlights large intervals to create an intensely expressive climax in the opening *Adagio* of Bach's Violin Sonata No. 1 in G minor, BWV 1001 and that this strategy may also be found in his performances of Brahms and Grieg (Philip, 1992, p. 158). The emphasis of large melodic leaps in this manner is also observed in cello playing (Philip, 1992, p. 167), orchestral music (Philip, 1992, pp. 187, 195, 196), and solo piano music (Philip, 1992, pp. 55–59).

These studies demonstrate that in both solo instrumental and orchestral music there are performers who tend to emphasize unexpected melodic-harmonic elements by shortening or lengthening the time value of a note or a group of notes or by matching tempo variation to melodic contour. We label this type of local tempo variation the melodic-harmonic approach. It is characterized by the shaping of melodic elements through the means of local tempo variation, including placing agogic accent or short *ritenuto* on melodic cruxes such as melodic high/low points, large leaps, important non-harmony notes and pivotal points. This tendency may vary from one performer to another and represents an important variable when evaluating individual differences in tempo variation.

The other main type of local tempo variation identified by researchers in performance studies is the use of agogic accents at the beginning of a bar (metric organization) or a group of notes (rhythmic organization). Metric organization refers to the regularly alternating succession of accented and unaccented beats (i.e., strong and weak beats) at one or more levels of musical structure (Caplin, 1983, p. 1). The periodic alternation of strong and weak beats forms a multi-level hierarchy of accents (Drake & Palmer, 1993). In music that is perceived as metrically structured, the emphasis of events on the main beat is regarded as metric accentuation (Repp, 2010, p. 1390). The relationship between tempo variation and metric accent is identified in a variety of writings by musicians and musicologists (Bowen, 1999; Philip, 1992). It tends to involve the elongation of metrically important moments, such as the first beat of a bar. Fabian defines metric rubato as "timing variation in the melody at the bar level with frequent *ritenutos* but few longer *accelerandos* and *rallentandos*" and suggests that this practice is more often found in early recordings than in more recent ones (Fabian, 2015, p. 194).

While Fabian's examples, obtained empirically, evidence metric rubato in performances of late Baroque music, Philip (1992) demonstrates its use in performances of Beethoven's Violin Sonata Op. 96 (p. 62), Chopin's Mazurka Op. 63 No. 3 (p. 51) and Nocturnes Op. 9 No. 2 and Op. 27 No. 2 (p. 55). Sloboda (1983) also shows that experienced pianists tend to mark events in strong metric locations with tempo variations. These features may be considered strategies for conveying metric or rhythmic organization in performance.

From the above review we can conclude that employing local tempo variation (such as rubato and agogics) to highlight melodic-harmonic elements and metric or rhythmic organization has been a strategy for performers who play late Baroque, Classical, and Romantic repertoire. Performances in which melodic-harmonic elements are emphasized by means of local tempo variation illustrate the "tendency to use melodic-harmonic approach." Performances in
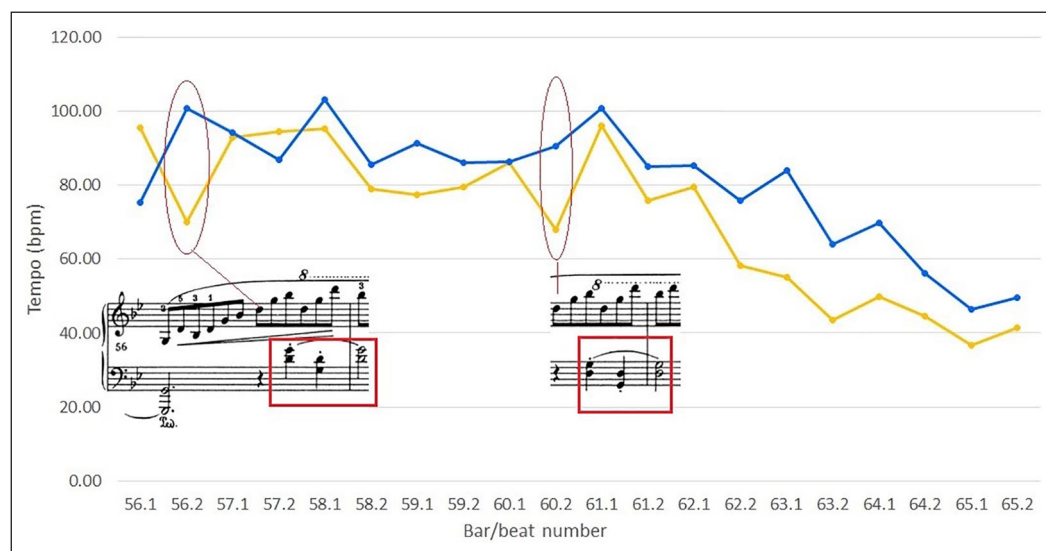
Figure 3. Tempo in Kissin's and Vogt's performances of Chopin's Ballade No. 1 in G minor, Op. 23, bars 56–65.

which metric or rhythmic grouping is highlighted by lengthening or delaying a metrically important note, or the initial or final notes, of a rhythmic group demonstrate the "tendency to use metric-rhythmic approach."

The tendencies to embody these two approaches may vary from one performer to another and represents the final pair of variables when evaluating individual differences among performers. They can be illustrated once again by comparing Kissin's and Vogt's recordings of Chopin's Ballade No. 1 in G minor, Op 23.

In the transitional passage of the exposition of this piece, the right hand plays figurative patterns while the left hand plays alternate short rhythmic motives supported by a harmonic bass line. In Figure 3, which shows parts of the relevant passage, it can be seen that Kissin highlights the rhythmic gesture by placing pronounced agogic accents at the beginning of a rhythmic group in the left hand (indicated by circles at bar 56 beat 2 and bar 60 beat 2) whereas Vogt's tempo in this passage is relatively smooth and even. This difference can be described by reference to the two variables of tempo variation at the local level. Given the extent to which Kissin emphasizes these motives, his approach would be rated higher than Vogt's on the "tendency to use metric-rhythmic approach" scale. Vogt, by contrast, would be rated higher on the "tendency to use melodic-harmonic approach" scale since he highlights the elements in the right hand while smoothing over the rhythmic motive in the left hand.

Constructing the Three-Dimensional Model

Thus far, we have identified six variables that can be used to evaluate individual differences in tempo and tempo variation among performers. Figure 4 shows the six variables in a hierarchical order.

The six variables represent three different dimensions of tempo and tempo variation in performance: basic tempo choice, global tempo variation, and local tempo variation. They form the
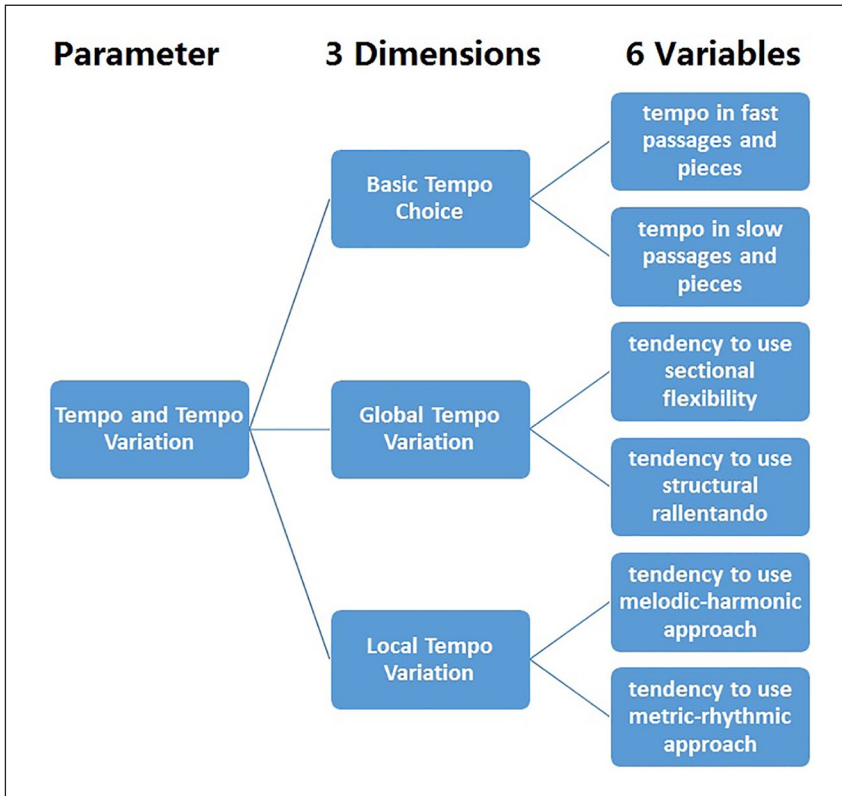
Figure 4. Six variables for evaluating individual differences in tempo and tempo variation in performance.

taxonomical model that has the potential for being used to evaluate differences among performers, and among performances, in terms of their use of tempo and tempo variation in repertoire beyond the works studied to date. The six variables of this three-dimensional model are not considered exclusive categories. Rather, each performer is expected to show the tendency to use each variable to a greater or lesser extent, as illustrated by the brief analyses of parts of Kissin's and Vogt's performances provided above. The extent to which each variable is demonstrated in a performance can be assessed by various methods including subjective ratings and quantitative measurements.

Subjective ratings can be gathered in the course of psychological experiments in which musically trained participants are asked to listen to excerpts of recordings including the defining features of each variable, as identified by analysis of the score, and rate them according to a given scale. For example, phrase ends and sectional breaks could be extracted from performances of the same piece and participants could be asked to rate the extent of *rallentando* in each excerpt.

Quantitative measurements can be obtained from analyses of multiple performances of the same piece, which can then be aggregated and compared. Tempo and timing data of each version can be obtained using software tools (e.g., Sonic Visualiser; Cannam, Landone, & Sandler, 2010) to indicate note-onsets. From tempo and timing information about each performance, an overall norm can be established, for example, by averaging the information for all performances of the
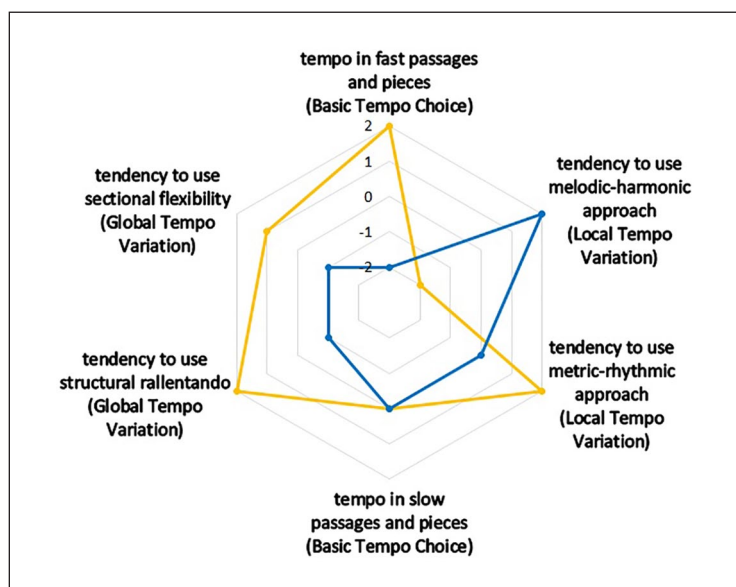
Figure 5. Stylistic profiles of Kissin and Vogt (based on preliminary results).

same piece. When establishing the norms, the data need to be selected carefully to ensure comparability and experimental control. Individual differences may depend on the selected sample and context in which the recordings were made. An analyst's decision regarding the size and nature of the sample, and recording context, determines how the norm is defined. Once the norm is established, the extent to which each variable identified in a given performance deviates from the norm is assessed and quantified according to a pre-determined scale. It is the amalgamation of the extent to which a performer demonstrates their use of each of the six variables that differentiates them from other performers. This in turn produces knowledge that can be said to form the performer's stylistic profile and explains their individuality.

The model uses the results generated by either of the subjective or quantitative methods outlined above and permits the performer's profile, specifying their use of tempo and tempo variation, to be visualized. We propose to represent performers' stylistic profiles in the form of a hexagonal diagram. Since every performer is likely to use each of the six variables to a certain extent, the shape of the hexagon distinguishes one performer's style, in relation to tempo and tempo variation, from another. Taking Kissin and Vogt as examples, our preliminary results show that Kissin tends to play faster than Vogt in fast passages whereas in slow passages the tempos of the two pianists are comparable. Kissin also shows a stronger tendency to use structural *rallentando* and sectional flexibility than Vogt. In terms of local tempo variation, our preliminary results show that Kissin tends to highlight metric-rhythmic groups while underemphasizing melodic-harmonic elements, whereas Vogt shows the opposite tendency. With this information to hand, and using a 5-point rating scale, preliminary stylistic profiles of Kissin and Vogt can be created (Figure 5).

It should be noted that the above profiles are based on results generated from the analysis of limited repertoire, in this case certain passages of Chopin's Ballade No. 1 in G minor, Op. 23. Figure 5 aims to illustrate how the six variables can be assessed and combined to present and illustrate a performer's individual tendencies to use the six variables. The model needs to be

tested further by means of studying a larger repertoire that provides a broader context for each pianist's tendencies. Their performances in several slow and fast pieces across different stylistic periods, as well as a variety of pieces with a range of melodic, harmonic, rhythmic and structural features, need to be studied. Investigating larger datasets, using the subjective or quantitative approaches described above, would enable the applicability of the model to be tested, producing more valid results in the form of comprehensive and reliable stylistic profiles. This would also permit the refinement of our understanding of a performer's individuality across time periods and musical contexts.

Such investigations could produce a variety of outcomes. For example, it may be that some musicians are consistent across different repertoires while others demonstrate different approaches according to style period or even in performances of the same piece. Or there may be consistency across or within performers in certain types of music but not others. Regardless, we have demonstrated that the model can identify differences among performers. Such systematic and taxonomical investigations would also refine our knowledge of general trends; for example, we should be able to obtain more reliable data to test the hypothesis that performances of European art music have become more uniform and homogenous over time, as would seem to be claimed by the authors of some general overviews of recorded music (Philip, 2004). We should also have a more scientific, evidence-based way of describing the individual artistry of specific performers.

Conclusion

This article reports the construction of a taxonomical model for concisely describing different approaches to tempo and tempo variation in performance. A comprehensive review of existing research on tempo was conducted to identify the constituents of tempo and tempo variation, shown in Figure 4. The resulting model categorizes tempo and tempo variation into three dimensions: basic tempo choice, global tempo variation and local tempo variation. Each dimension is further divided into two variables, defined and described in detail and illustrated by preliminary empirical data. The consistency of research results from past research, which involves the investigation of Baroque, Classical and Romantic solo and orchestral repertoire, demonstrates that the variables can be generalized to a broader compositional context than the case studies used to propose the model. It therefore has the potential to provide researchers with a toolbox for analyzing differences among performers and among performances in terms of tempo and tempo variation.

The efficacy of the model needs to be tested further by means of analysis of a larger repertoire and/or by experiments in order to generate more comprehensive knowledge about individual differences in performance style. Since the literature and examples that formed the basis for constructing the model focused mainly on pieces by Bach and Chopin, as well as some other Classical and Romantic repertoire, it may be more effective, when testing the model, to start with performers interpreting pieces from these periods of the European art music tradition. Nevertheless, it would be interesting to explore the range of musical styles to which it can be applied. We contend that features of the three dimensions proposed in this study are potentially observable in performances of music from other periods and styles. For example, performances of Gregorian Chant may also involve a wide diversity of basic tempo and the extent of *rallentando* at phrase ends. Future research could explore the extent to which the model might work in such contexts. It could also investigate how the model might be applied or extended in such a way as to apply to other musical practices, such as improvised music or music of other traditions.

Discography

F. Chopin *Ballade No. 1 in G Minor, Op. 23*
Kissin, Evgeny (Rec. 2016), RCA Records 888880760142
Vogt, Lars (Rec. 2014), CAvi-music CAvi8553267

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Notes

1. In this study, tempo was considered the time at the beat level and tempo variation the change of beat length. Change of time value (duration) of individual note(s) that does not result in change of beat length, such as *notes inégales* or hands dislocation in piano performance, was not taken into account. For this reason, the expression "tempo variation" rather than "timing" is used in this article.
2. In this figure, Ex, De, Re, and Tr represent exposition, development, recapitulation, and transition respectively. T represents theme so T1 represents theme 1, T2 theme 2, and so forth.

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