

KOCH'S METRICAL THEORY AND MOZART'S MUSIC: A CORPUS STUDY

JOHN PAUL ITO
Carnegie Mellon University

MIRKA (2009) HAS RECENTLY ARGUED THAT THE 18th-century metrical theories of Heinrich Christoph Koch can be revelatory for a reconstruction of contemporary ways of hearing Viennese high classicism. Koch's claims revolve around interactions between the metrical placement of cadences and the articulation of specific beat levels, and these claims are most specific and testable for common time and 6/8. This paper reports two statistical surveys of works by Mozart that were designed to gauge the fit between the corpus and Koch's theory. In the works examined, the theory was strongly supported for common time, strongly disconfirmed for 6/8, and weakly supported for the other meters encountered. It is argued that these results point toward caution regarding the use of Koch's theories but not toward their outright rejection, and that unexpected statistical contrasts within the corpus indicate the need for a fine-grained approach to meter in music of the later 18th century.

Received: October 24, 2012, accepted June 5, 2013.

Key words: meter, Koch, Mozart, corpus, style

THIS PAPER USES A CORPUS APPROACH TO TEST the applicability of the metrical theories of Heinrich Christoph Koch (1749-1816) to the music of Mozart. Koch is a significant figure in the history of music theory; he has been one of the main sources in the recovery of an 18th-century understanding of sonata form, and he is generally recognized as one of the more important theorists of meter in the second half of the 18th century (Grave 1985; Houle 1987). More recently, Koch's prominence as a metrical theorist has been greatly enhanced by the publication of Mirka's book *Metric Manipulations in Haydn and Mozart* (2009), in which the author argues that detailed aspects of Koch's theories, previously largely overlooked, make his understanding of meter revelatory for the Viennese

classical style.¹ The potential implications are quite wide-ranging, including not just the history of compositional style but also the perception and cognition of meter in the 18th century and a range of new approaches to metrical hearing for listeners today.

Koch's work must be understood in relation to metrical theories from the first half of the 18th century, which generally held that a measure would always contain either two or three main beats, and that only one of those beats, the downbeat, was metrically strong. It was further agreed that in some cases the notated measure contained more than one "real" measure. In particular, common time was understood to consist of two 2/4 measures. (There was less unanimity regarding 6/8, but German theorists of the second half of the 18th century generally held, as did Koch, that it could exist in two versions, a compound version consisting of two 3/8 measures and a simple version, tripled 2/4, which was understood as 2/4 with consistent triplet figuration.) These, then, were the original 18th-century senses of the terms simple and compound with regard to meter: a simple meter was one in which the notated meter and the "real" meter coincided, and a compound meter was one in which the notated measure consisted of two "real" measures. There was, furthermore, a general consensus that cadences should fall on downbeats—though of the real meter, not necessarily of the notated meter. (The degree to which this consensus reflected actual practice is another question.)

In the second half of the 18th century, metrical theories generally preserved this picture of simple and compound meters, with most real meters containing either two or three main beats, but a few theorists (most prominently Kirnberger) began to edge toward the modern understanding of the common-time measure (four main beats, two of which are metrically accented, with the downbeat stronger than beat three), a view that would emerge fully only in the 19th century. These theoretical developments occurred in response to changes in musical style, as in the middle of the century common time increasingly began to look like what

¹ Significant precedents include Grave (1984, 1985) and Maurer Zenck (2001).

before would have been *alla breve*, but with faster note values. Where in the earlier part of the century common time tended to feature half-bar motivic construction, mid-bar cadences, and arbitrary shifts of melodic beginnings from beat one to beat three, midcentury common-time often had full-bar motivic units and downbeat cadences, and it generally lacked half-bar melodic displacements (Grave, 1985).

In contrast with his contemporaries, Koch held to an early-18th-century conception of compound meter; his main accommodation to the empirical reality of full-bar construction in common time was to allow the possibility that the signature for common time was used (mistakenly, in his view) where the meter was in reality *alla breve*. In Koch's mind common time was always a compound meter consisting of two equally weighted 2/4 measures, but in practice his allowance for "mistaken" time signatures made common time exactly parallel to 6/8, in that it could exist in either compound or simple versions, with the two strongest beats in the measure being either the (equally strong) downbeats of the two real measures, or else the two main beats of the single real measure.

This picture summarizes what has been a prevailing view of Koch's metrical theory. In demonstrating that his theory may provide powerful analytical resources, Mirka goes beyond this picture by highlighting two aspects of the theory that had previously tended to draw only passing notice.

The first and more central of these aspects is his insistence that the main beats of the real meter should receive attack points. The German word for measure is *Takt*, and Koch's term for the main beat, of which each real measure contains either two or three, is *Taktteil* (literally 'part of a measure'). Although his terminology would imply the opposite relationship, he understands the *Taktteile* to be more basic; the *Taktteile* form a salient pulse stream akin to the *tactus*, and they are united perceptually in order to form the higher-level units that are the *Takte*. (This will become significant below.) In asserting that the *Taktteile* should always be articulated on the musical surface, Koch provides a much more stringent criterion than his contemporaries. Judging by other treatises, one could look at a movement in 4/4 and, observing cadences on beat 3, conclude that the music is actually in 2/4; if we are reading Koch, this conclusion brings with it the further expectation that all of the quarter-note beats will carry attack points.² Of course this expectation is not always

fulfilled, and this opens a window onto sophisticated metrical play, at least according to Mirka.

The second aspect of Koch's theory drawn on by Mirka is the possibility that the real meter may change among those that are possible for the time signature, including in the middle of a phrase. This is demonstrated by Koch in just one example and discussed only minimally (Grave, 1985, p. 42; Mirka, 2009, pp. 211-212). Although Koch provides the initial clue and some of the conceptual foundations, Mirka develops this idea well beyond anything found in Koch, and this is one of the main contributions of her book. In relation to more recent scholars, her emphasis on the importance of articulating *Taktteile* makes her analyses more fine-grained than those of Grave (1984, 1985) or of Maurer Zenck (2001), more likely to pivot midphrase in response to subtle changes in rhythm and texture.

At their best, Mirka's analyses can be extremely convincing. For example, her reading of the first six-measure phrase from the second movement of Haydn's String Quartet, Op. 50 No. 1, shown in Figure 1, reveals symmetry within asymmetry—although the notated measures group 4+2, the size of the measure is understood to be cut in half in the second unit, so that the number of actual measures is 4+4, four full-size measures plus four half-size measures. I have emphasized this regularity by indicating hyperbeats above the staff; in this notation, which comes from Ito (2013), the numerator represents the hyperbeat number and the denominator represents the size of the understood hypermeasure. Mirka's analysis takes its initial cues from Koch. In the first unit the subphrases conclude on downbeats (as we shall see below, Koch treats these subphrase conclusions as having the same obligations as cadences), and there is consistent articulation of the dotted-quarter beats (the *Taktteile* if the meter is simple 6/8). This fits with an understanding of the actual meter being identical to the notated meter, especially as the eighth-note beats are not all marked, closing off the possibility of hearing half-size 3/8 measures. In the second unit, the half cadence falls in the middle of the measure, indicating that half-sized measures are being used, and now all eighth-note beats are articulated, as Koch's theory predicts. Viewing the music through the lens of Koch's theory works particularly well in this case because the apparent irregularity of the six-measure phrase is regularized, restoring a 4+4 hypermetrical pattern. Furthermore, it is not just surface rhythmic

² Mirka argues that this viewpoint may have been rather more widespread, with Koch the only theorist to make it fully explicit (2009,

p. 32). In personal communication Mirka has called attention to a passage from Marpurg (1763/1974, p. 14) that strongly implies that he also regarded continuous motion as obligatory.

FIGURE 1. Haydn String Quartet Op. 50 No. 1/ii, mm. 1-6. Reproduction of Mirka, Example 6.4 (2009, p. 214), hyperbeats added. By permission of Oxford University Press, USA.

patterning but deeper aspects of the music's pacing that accelerate in the second unit, especially harmonic rhythm and underlying counterpoint. At least in my hearing, this faster pace makes the symmetry revealed by the analysis feel fitting, not forced. The experiential aspects of the analysis are brought out well by conducting the hypermeter, treating the whole passage as two quadruple hypermeasures in which the level of the hyperbeats is the dotted half in the first hypermeasure and the dotted quarter in the second.

Not all of Mirka's analyses are equally convincing, however. For example, her reading of the opening of Haydn's String Quartet Op. 64 No. 6, shown in Figure 2, is very similar to her reading of Op. 50 No. 1, in that a metric level that is initially absent rises to prominence, with the metrical position of the cadence confirming that this new level is the level of the *Taktteile* for the second portion of the phrase. But while Mirka deals in a satisfying way with the experience of a first-time listener responding to a gradual increase in the prominence of the quarter notes and the increasingly rapid harmonic rhythm, her analysis does not leave any stable hearing for a repeat listener, as there is no definite point of transition between hearing measures in the notated *alla breve* and hearing measures of 2/4. Furthermore, any such choice would result in a hypermetrical hearing that is less regular than the simple hearing suggested by a parallel period that is 4+4 in notated measures. Unlike her treatment of Op. 50 No. 1, this analysis purports to reveal irregularity and complexity where the surface seems quite simple. But is this complexity justified?

While Mirka is critical of Koch on some points, more often she seems simply to assume that the lens Koch gives us is an appropriate one for examining this repertoire. Furthermore, she claims that the patterns described by Koch were so well established that we can be certain both that composers' metrical play was intentional and that it would have been understood by astute listeners (this is made particularly explicit in her discussion of Mozart's K. 516, pp. 88-89).

Mirka's contention that Koch serves as a reliable guide to the metrical practice of Haydn and Mozart is by no means undisputed. Rothstein (2008) does not directly address the question of *Taktteile*, but he argues that Koch's insistence that cadences fall on downbeats represents a perspective on meter that was becoming obsolete theoretically in the final quarter of the 18th century, following a gradual shift in compositional practice that began somewhat earlier. In the newer practice, the notated downbeat was understood to be stronger than any other beat in the bar, and he distinguishes three national metrical types in part on the basis of cadence placement, with cadences often falling after the downbeat in the German barring practice that he identifies.³ This has important implications for the analytical use of Koch's theory, taking as it does downbeat cadences as one of its two foundational premises. If, as Rothstein suggests, midbar cadences were a standard option, one that did not point necessarily to the presence of a compound

³ For an evaluation of Rothstein's typology using a corpus of 19th-century art song, see VanHandel (2009).

The image shows a musical score for Haydn's String Quartet Op. 64 No. 6/i, measures 1-8. The score is in 4/4 time, marked 'Allegro', and features dynamics of piano (p) and fortissimo (fz). It includes four staves (Violin I, Violin II, Viola, and Cello/Double Bass) and a rhythmic diagram below showing the articulation of notes across measures. The diagram consists of three rows of dots connected by dashed lines, with arrows indicating the direction of the notes.

FIGURE 2. Haydn String Quartet Op. 64 No. 6/i, mm. 1-8. Reproduction of Mirka Example 2.35 (2009, p. 83). By permission of Oxford University Press, USA.

meter, then it becomes much more difficult to determine when (or if) to employ Koch's theory.

This paper attempts an empirical assessment of Koch's theory, asking: is there compositional evidence that Koch's rules of cadences on downbeats and articulated *Taktteile* have sufficient predictive value that we are justified in understanding their violation as deliberate metrical play, used intentionally by composers to communicate with expert listeners?⁴ This question will be asked with respect to two partially overlapping bodies of work by Mozart.

Corpus Study #1: Mozart Piano Sonatas and Symphonies

For the first window onto the Viennese high classical style, I focused on a single composer, Mozart, and on two genres, the piano sonata and the symphony. Approximately 500 phrases were examined and for each, three pieces of information were collected: the beat on which the cadence falls; whether attack points consistently articulated what I will call the first subdivision of the measure, referring here to the actual notated measure (the half-note beats in 4/4, the quarter-note beats in 3/4); and whether attack points consistently articulated the second subdivision of the measure (the quarter-note beats in 4/4 and the eighth-note beats in 3/4). Both the first and second subdivisions of the

measure were examined because one of those two levels would correspond to the *Taktteile*, depending on whether the meter was understood to be simple or compound in any given instance.

For each work considered, all movements were included in the survey; minuets and trios were treated as separate movements, as were slow introductions. Within each movement, phrases were collected by taking the first three phrases as well as the first two phrases that started in a new key. If the first phrase that started in a new key occurred earlier than the fourth phrase, the collection of initial phrases was truncated. For the second group of phrases, only the first was required to begin in a foreign key; the subsequent phrase was always considered, without consideration of its initial key. Post-cadential extensions that merely repeated the preceding cadences were not included as independent phrases. This procedure resulted in the sampling of between two and five phrases per movement.

All of the piano sonatas were included, yielding 251 phrases. Among the symphonies, only complete, multi-movement, original symphonies were considered, and enough were used, in descending chronological order, to provide a similar quantity of data (245 phrases). The symphonies used were numbers 25, 28-31, 33-36, and 38-41.⁵ This also resulted in comparable years of composition; the sonatas dated from 1775 to 1789, the symphonies from 1773 to 1788.

⁴ Temperley (2009), a review of Mirka's book, raised similar questions and likewise called for an empirical investigation into Koch's reliability as a guide for this repertoire.

⁵ The slow movement of Symphony No. 31 exists in two versions; the version made primary by the *Neue Mozart Ausgabe* was used.

In looking at whether metrical levels were filled, two main allowances were made: partial-measure upbeat gestures were not included; and once the cadential harmony arrived, the phrase was understood to be complete, so that continuing motion through the cadential harmony was not obligatory.⁶ Because of the way in which data were collected, there are two important caveats in relating the results to Koch's theory.

First, in discussing cadences, Koch uses two different terms, and he includes not only standard cadences as understood in modern music theory (authentic and half) but also what would today be considered non-cadential subphrase endings (including especially the endings of salient initial subphrases called *incises*, designated using the rather general term *caesura*). Because Koch does not provide adequate criteria for identifying these other sorts of cadences, they were not included in the survey.⁷ The present study considered only authentic, half, and deceptive cadences in the modern senses (i.e., involving root-position chords). This led to clear criteria for data collection, but it also resulted in categorical mismatches with Koch: of what Koch would consider cadences, some were collected, some were ignored, and it is possible that some were collected but with different cadence points than Koch would give them.⁸

Second, in looking at whether a given metrical level was articulated, a single missing attack point was sufficient to label that level as not fully articulated. This is of course a rather stringent criterion. Koch's theory is

challenged much more deeply by an example in which obligatory attack points are absent in every measure than by a case in which a single attack point is missing in a long phrase, and yet such cases are not distinguished in the survey.⁹ Ideally, an inquiry into the extent to which Koch's theory fits the repertoire would go beyond the present starkly binary approach and include measures of the prevalence of missing attack points, their placement in the phrase, and even some account of whether they fit Koch's and Mirka's categories of allowable missing attacks; an initial step in this direction was taken in the second corpus study. For now, though, it will be necessary to bear in mind that this survey of works by Mozart holds Koch to the strictest interpretation of his theory.

Six meters were used in the works surveyed: 3/8, 6/8, 2/4, 3/4, common time, and *alla breve*. Of these, two meters—6/8 and common time—are understood by Koch to have two versions (in effect if not in theory in the case of common time), either having actual measures that are identical to notated measures or else actual measures that are half the size of notated measures. Koch was considered to be satisfied if the phrase met either of two criteria: the cadence was on the downbeat and the *Taktteile* for the notated meter all carried attack points (consistent articulation of the first subdivision of the measure); or, in 6/8 or common time, the cadence was in the middle of the measure and the *Taktteile* for half-sized measures all carried attack points (consistent articulation of the second subdivision of the measure).

Especially given the demanding nature of the test, Koch's theory came out fairly well, satisfied by 80% of the phrases in the sample; Table 1 displays the basic results, first broken down by meter signature and then in aggregate. It must be emphasized that there is no clear cutoff that could be used to evaluate the results. Koch's basic theory is posited as a norm, and so we should expect the theory to be satisfied fairly prevalently. But metrical play within the phrase is argued by Mirka to be moderately prevalent as well, and, as metrical play within the phrase sometimes results in phrases that do not conform to the basics of Koch's theory, we would

⁶ There were also a few smaller exceptions. Short transitional passages of a couple of measures (e.g., K. 570/i, mm. 21-22) were not included. If the second subdivision of the measure was consistently converted to triplets (e.g. running triplet eighths in 3/4), the triplets were evaluated for consistent articulation rather than the duple subdivision given by the meter. In the first movement of K. 533, the break following the strong subphrase boundary in m. 8 was not counted as a failure to articulate *Taktteile*, as this so clearly paralleled the breaks commonly found between phrases.

⁷ Lacking the clear harmonic criteria of I and V in root position, Koch's insistence that the weaker cadences (specifically, the *Absätze*) fall on a downbeat appears circular in several of the examples cited by Mirka: it seems that Koch simply labels the final downbeat in the subphrase as the *Absatz* (Mirka, 2009, pp. 80-81). This impression of circularity is strongly reinforced by the fact that several of these non-cadential *Absätze* are decorated by cadential harmonic motions in weak metrical positions; in such cases modern theory would locate the real cadence in what Koch calls the decoration. As Mirka acknowledges, and as also noted by Rothstein (2008), this can lead to serious problems in applying Koch's criteria analytically (p. 81, n64).

⁸ A further point of contrast: although Koch forbids melodic decoration of the note of arrival in the strongest cadences, this criterion was not employed in the data collection (melodic decoration of the cadential arrival is extremely common in Mozart's music).

⁹ Koch lists a few typical kinds of exceptions to the demand of *Taktteile* being marked, and Mirka offers many more in the third chapter of her book. From Mirka's discussion it is clear that just a few missing attack points can be significant, especially at the beginning of a movement; this was illustrated in her treatment of Haydn's Op. 64 No. 6, discussed above. But Koch acknowledges cases outside of his categories in which a missing attack point on a *Taktteil* could be acceptable, even pleasing, and he offers no criteria that would allow us to distinguish these cases from those he does not allow (Mirka, 2009, pp. 97-98).

TABLE 1. Basic Results, by Meter Signature and in Aggregate.

Meter signature (<i>N</i>)	Fit to Koch's theory	Proportion of cadences on downbeats	Proportion with which first subdivision of the measure is fully articulated	Proportion with which second subdivision of the measure is fully articulated
3/8 (13)	.69	1	.69	.15
6/8 (44)	.86	.80	1	.48
2/4 (108)	.79	.90	.89	.71
3/4 (164)	.75	.95	.79	.29
Common (117)	.85	.77	.85	.73
Alla breve (50)	.80	1	.80	.60
Aggregate (496)	.80	.89	.84	.53

TABLE 2. Differences Between Meters (Grouped by Type) on Metrics Related to Koch's Theory.

Meter group	Fit to Koch's theory	Proportion of cadences on downbeats	Proportion with which first subdivision of the measure is fully articulated	Proportion with which second subdivision of the measure is fully articulated
Simple only (3/8, 2/4, 3/4, alla breve, <i>N</i> = 335)	.77	.94	.82	.47
Simple or compound (6/8, common, <i>N</i> = 161)	.86	.78	.89	.66
Significance of difference (chi-square)	.027	< .0001	.039	< .0001

expect a noticeable number of non-conforming phrases if both Koch and Mirka were correct. The results thus seem rather good. A very clear majority of phrases conform to Koch's theory, making its function as a basic norm seem credible, and a substantial minority do not, making Mirka's claims about metrical play seem credible as well.

Overall, cadences fell on notated downbeats 89% of the time, as shown in Table 1. In 6/8, 2/4, and common time all other cadences fell in the middle of the measure with just two exceptions, and in 3/4 all of the other cadences except one fell on beat two.¹⁰ The meters that allowed multiple interpretations (6/8 and common time) and the meters that did not grouped together, with significant or highly significant differences on all measured parameters, as shown in Table 2. This table shows that the variables for which Koch's theory would predict the starkest contrasts between the two groups are indeed those with the most strongly pronounced differences.

Because Koch's theory allows two interpretations of 6/8 and common time, it is possible to subject them to a more targeted statistical test. The second subdivision of the measure has no particular significance if the

actual measures correspond to the notated measures, but it is the level of the *Taktteile* if half-sized measures are understood to be the actual measures. If Koch's theory is correct, one would expect that the second subdivision of the measure would be filled more frequently when cadences fall on the midmeasure than when they fall on the downbeat: when there are midmeasure cadences this level is obliged to be filled (barring metrical play of some sort) while with downbeat cadences the filling of this level is purely optional. As shown in Table 3, this prediction was strongly satisfied by common time but not by 6/8. And while for 6/8 the difference between cadence conditions is not significant, the data tend in the wrong direction: it is less likely for the second subdivision of the measure to be filled in phrases that end with midmeasure cadences. There is perhaps a hint of hope for the theory in the small number of 6/8 samples in the survey (*N* = 44); a larger sample size would be needed for a more conclusive result, and this provides the rationale for the second corpus study. In terms of the data at hand, however, the survey had the somewhat surprising result of indicating that two meters that Koch would treat as equivalent were treated differently by Mozart, confirming the prediction for common time while disconfirming the prediction for 6/8.

As it was possible that Koch's understanding of half-sized measures with articulated *Taktteile* might be

¹⁰ The exceptions were the surprising initial cadence in K. 281/i in 2/4, the deceptive cadence in m. 10 of K. 279/i in common time, and the third-beat cadence in m. 34 of K. 280/i in 3/4.

TABLE 3. *The Relative Likelihood of the Second Subdivision of the Measure Being Articulated Based on the Metrical Position of the Cadence.*

Meter signature	Cadence on downbeat; rate of articulation, second subdivision of the measure	Cadence on midmeasure; rate of articulation, second subdivision of the measure	Significance of difference (chi-square)
common	.64 (<i>N</i> = 90)	1 (<i>N</i> = 26)	< .001
6/8	.51 (<i>N</i> = 35)	.33 (<i>N</i> = 9)	.55
alla breve	.60 (<i>N</i> = 50)	n/a (<i>N</i> = 0)	n/a
2/4	.71 (<i>N</i> = 97)	.80 (<i>N</i> = 10)	.82

TABLE 4. *Comparisons of Meters Within Categories (Simple Duple, Four Quarter Notes).*

Meter	Fit to Koch's theory	Proportion of cadences on downbeats	Proportion with which first subdivision of the measure is fully articulated	Proportion with which second subdivision of the measure is fully articulated
2/4	.79	.90	.89	.71
alla breve	.80	1	.80	.60
Significance of difference (chi-square)	.98	.045	.21	.22
common	.85	.77	.85	.73
alla breve	.80	1	.80	.60
Significance of difference (chi-square)	.52	< .001	.52	.15

supported in duple meters in which he did not predict it, 2/4 and alla breve were also examined for this effect. In alla breve it was not possible to make a determination, because there were no cases in which cadences fell on beats other than the downbeat; all of the instances of alla breve that failed to agree with Koch's theory did so on the basis of missing attack points. In 2/4 there was no significant effect, as shown in Table 3.

In Koch's theory 2/4 and alla breve are structurally equivalent, so they were examined for significant differences; as shown in Table 4, only the difference in likelihood of a cadence on the downbeat was significantly different. At .045, however, the *p* value only barely reached significance, and its reliability is somewhat questionable because 100% of the cut-time phrases had cadences on the downbeat. This result should therefore be viewed with caution, and it seems legitimate to conclude that 2/4 and alla breve were only marginally different in this study. Alla breve and common time were also compared, to test a null hypothesis that as they are identical in metrical hierarchy and in containing four quarter notes, both are simply instances of the same meter. As shown in Table 4, again only the likelihood of a downbeat cadence was significantly different, this time highly so. As the downbeat cadence is much more generally attested among 18th-century theorists than the articulation of *Takteile*, this is a noteworthy result.

A number of significant contrasts between sonatas and symphonies appeared in the data; as displayed in Table 5, while the likelihood of fulfilling Koch's theory was in most cases indistinguishable by work type, the likelihood of cadences on downbeats and of filling the first subdivision of the measure varied significantly with work type for many of the meters. We have already seen that although common time and 6/8 fulfill the basic requirements of Koch's theory at the same rate, we end up with rather different judgments regarding that likelihood that this reflects deliberate compositional choice. The contrasts in Table 5 suggest that simply describing meters by their time signatures may not be sufficient; meter apparently interacts with work type, and it may be that the interaction with work type results from a further interaction of work type with other, even more strongly predictive variables. The results for 2/4 are particularly suggestive here, as sonata and symphony movements in 2/4 failed to fulfill Koch's theory at the same rate, but did so primarily because of cadence location for sonatas, and primarily because of missing attack points for symphonies. As I shall suggest in the concluding general discussion, results of this sort point toward the need for a much finer-grained examination of metrical practice.

The results from the statistical survey are not univocal regarding Koch's theory. In general the rate of agreement

TABLE 5. Differences Between Sonatas and Symphonies, Partially Broken Down by Meter.

Comparison group	Work type	Fit to Koch's theory	Proportion of cadences on downbeats	Proportion with which first subdivision of the measure is fully articulated	Proportion with which second subdivision of the measure is fully articulated
All	Sonata (<i>N</i> = 251)	.82	.82	.89	.63
	Symphony (<i>N</i> = 245)	.77	.96	.79	.43
	Significance of difference (chi-square)	.21	< .0001	.003	< .0001
common	Sonata (<i>N</i> = 69)	.91	.65	.91	.84
	Symphony (<i>N</i> = 48)	.77	.94	.77	.56
	Significance of difference (chi-square)	.06	< .001	.06	.002
alla breve	Sonata (<i>N</i> = 18)	1	1	1	.83
	Symphony (<i>N</i> = 32)	.69	1	.69	.47
	Significance of difference (chi-square)	.022*	n/a	.022*	.026
2/4	Sonata (<i>N</i> = 51)	.80	.82	.98	.86
	Symphony (<i>N</i> = 57)	.77	.96	.81	.58
	Significance of difference (chi-square)	.87	.035	.01	.002

*Note: Chi-squared approximation may be incorrect.

between data and theory seems reasonably good, but this cannot in principle close the matter. Mozart might well have been playing with meter about 20% of the time, or the agreement between theory and data could be artifactual, resulting from the combination of strong (but uncorrelated) tendencies toward downbeat cadences and toward marking metrically strong attack points. In the two cases in which further analysis was able to shed light on this question, the results were quite different, suggesting that Koch's theories may apply to Mozart's music for some meters but not for others.

The result for 6/8 is quite interesting, but with such a small data set it is impossible to be confident that the result is correct. This motivated the second corpus study, which focused on 6/8 and 3/8.

Corpus Study #2: Mozart Instrumental Works in 6/8 and 3/8

The second corpus study had three main aims. The first was to see if a larger sample would reveal a significant difference in the rate at which the eighth-note level is

filled in 6/8, in the two conditions of downbeat and midbar cadences. The second was to compare the population of 6/8 phrases with midbar cadences with the population of 3/8 phrases with downbeat cadences in terms of the rate at which the eighth-note level is filled; according to Koch's theory, these populations should be indistinguishable. The third aim was to verify the informal observation that 3/8 and 6/8 were used quite differently by Mozart (irrespective of cadence placement in 6/8), with 6/8 tending to emphasize the dotted quarter as a likely tactus value and 3/8 tending to suggest the eighth note; though this observation has the character of a gestalt perceptual judgment, it seems to stem mainly from 6/8 having slower harmonic rhythm and few subdivisions of the beat smaller than sixteenth notes, and 3/8 having faster harmonic rhythm and many subdivisions of the beat smaller than sixteenth notes.¹¹

¹¹ Breidenstein (2011) also makes an exhaustive comparison of 3/8 and 6/8 in Mozart, and he is similarly concerned with prevailing note values and implied tactus. For a number of reasons, however, including the use of Kirnberger's conception of compound 6/8 rather than Koch's and the

The study looked at instances of 6/8 and 3/8 in the larger-scale instrumental works of the last decade or so of Mozart's life. The works selected were all composed following Mozart's move to Vienna in March of 1781, based on the dating in the works list in the *New Grove Dictionary*. The criterion of larger-scale works was understood to include works with titles such as symphony, sonata, and quartet; works such as self-standing dance movements or sets of variations were not included. A complete list of the 81 works included in the survey is given in Appendix A. This yielded 65 movements or partial movements in 6/8 or 3/8, 49 in 6/8 and 16 in 3/8 (partial movements are explained below).

Phrases were collected using the same procedure as in the first study; this yielded between three and five phrases per movement or partial movement. The data collection procedure was augmented with more flexible measures of whether Koch's theory was fulfilled. The original procedure of requiring all attack points to be filled was maintained as the 'strict' standard. I also gave my own judgment of whether it seemed Koch's theory was fulfilled in spirit, so to speak (the 'hand coded' standard). This allowed me to take into account several classes of exception. These included pauses that seemed rhetorically charged (as opposed to incidental), including general pauses but also other less obvious instances, and they also included cases in which a few stray attack points missing in inconspicuous locations seemed perceptually immaterial. This procedure also allowed me to come closer to evaluating Koch on his own terms, as I would excuse missing attack points that resembled those found at the ends of incises. Though I would have preferred to deal with these in a more objectively procedural manner, two factors made this difficult: the absence of clear harmonic criteria, as noted above; and the tendency of similar pauses to appear in locations that were not ends of incises, for example in the midst of transitional passages. Lacking objective criteria, the hand-coded standard provided a way to make exceptions for these cases. In two cases the hand-coded standard allowed exceptions to rules about cadence placement, cases in which cadences on weak eighth beats seemed clearly to result from something akin to non-harmonic tones in all voices on the strong beat (though they happened to correspond to a harmony).¹²

use of more informal judgments regarding prevailing note values, it is difficult to make direct comparisons between his results and those reported here.

¹²In one case the chord on the strong beat was a vii°_7/vi idiomatically interpolated in a deceptive cadence, and in the other it was a vii°_7/V chord used as a substitute for the cadential 6/4. The cadences in question are found in K. 493/ii, m. 22, and in K. 331/i, Var. III, m. 12.

Based on self observation, I concluded that hand-coded exceptions to Koch tended to weight the beginnings of phrases rather heavily; if consistent eighth-note motion was established early on, I easily overlooked a few (or occasionally many) missing attack points later on, while just one or two prominent missing attack points in the first measure of a phrase could lead me to conclude that the phrase failed to give the impression of consistent eighth-note motion.

As a counterweight to these admittedly subjective judgments, counts were also made of how many attack points were missing and of the total number of obligatory attack points in the phrase, with the phrase understood to begin with the first complete dotted-quarter beat of the phrase and to end with the arrival of the cadential harmony (so that this number was always one greater than a multiple of three). This made it possible to compute what proportion of the eighth beats were missing attack points, and a (mostly) arbitrary cutoff of $\leq 10\%$ was chosen for a third way of measuring whether the eighth beats were close enough to being filled (the 'proportional' standard). This cutoff was chosen for three reasons: because it is a round number; because it seemed to approximate my more normal judgments of whether or not to consider the eighth-note level filled; and because it is noticeably smaller than 1/6, or approximately 17%, which would be the rate of missing attack points if one eighth were missing from every measure (a case in which it would seem quite evident that all of the eighth beats were not filled).

In looking at the degree of rhythmic activity for signs of implied tactus, each complete dotted-quarter beat in the movement or partial movement was examined, one per measure in 3/8 and two per measure in 6/8. Each was coded as either busy or not busy, defining busy as having subdivisions of the beat smaller than the sixteenth, and the total number of such units within the movement or partial movement was recorded. Because my primary interest was in implied tactus, a number of adjustments to this basic scheme were made. A sforzando or a fortissimo on a weak eighth beat was coded as busy, as were similarly obvious textural accents such as a rest on the strong eighth beat followed by an isolated eighth note on the following weak beat. Textures with sixteenth rests on the eighth beats and attack points

There were also a few cases in which midbar cadences were understood to fall properly on the downbeat. These were cases in which a V chord from the previous measure was repeated on the downbeat, very much like a typically Mozartean retardation but with the bass voice also delaying resolution to tonic, cases also addressed by Koch and Mirka (2009, p. 81, n64).

TABLE 6. Contrasts Between 6/8 and 3/8 Populations in the Degree to Which Koch's Theory is Satisfied, Using Three Different Metrics.

Population compared	Comparison Group					
	6/8 (N = 216)	3/8 (N = 57)	6/8 w/ midbar cadence (N = 42)	3/8 (N = 57)	6/8 w/ midbar cadence (N = 42)	6/8 w/ downbeat cadence (N = 174)
Koch's theory satisfied <i>strict standard</i>	.90	.77	.57	.77	.57	.98
Significance of difference (chi-square)		.02		.057		< .0001*
Koch's theory satisfied <i>hand coded</i>	.93	.96	.62	.96	.62	1
Significance of difference (chi-square)		.45		< .0001		< .0001*
Koch's theory satisfied <i>proportional standard</i>	.95	.96	.79	.96	.79	.99
Significance of difference (chi-square)		.88*		.013*		< .0001*

*Note: Chi-squared approximation may be incorrect.

on the weak sixteenth beats were also coded as busy. And a number of essentially ornamental subdivisions smaller than the sixteenth were coded as not busy.¹³

Theme and variation movements present interesting issues, as the variations often have quite different rhythmic characteristics; indeed this is often one of the most important points of contrast between variations. To avoid conflating these deliberately different rhythmic profiles, each variation was treated as if it were a separate movement; this is the main source of partial movements in the survey. While this meant that variation movements ended up being overrepresented in the phrase population, this would probably work to Koch's advantage, as variations are often rhythmically busier (and therefore less likely to lack attack points) than themes. And as we shall see, weighting techniques were introduced that took account of the length of each movement (or partial movement).¹⁴

¹³ These ornaments were as follows: grace notes; decorated resolutions of trills; written-out turns and mordants; single anticipations leading into dotted-quarter beats (but not when these clearly formed motivic dotted rhythms, e.g. dotted-sixteenth followed by thirty-second); runs of any constant note value all in the same direction, either beginning on or landing on a dotted-quarter beat; and neighbor figures decorating stepwise motion into an eighth-note beat, for downward motion either moving up and then down twice by step or else moving down to an anticipation and then overshooting by a step and returning, and for upward motion the parallel decorations in the opposite directions.

¹⁴ The partial movements other than individual variations were relatively few. Mostly they were codas of final movements written in new time signatures. In an extremely small number of cases, the partial movement was the majority of a movement, excluding those portions in which music in another time signature intruded.

As can be seen in Table 6, the results of this survey were quite similar to those of the earlier one, the main exception being a marked improvement of the fit between 3/8 and Koch's theory under the two less-strict measures. There were a total of 57 phrases in 3/8 and 216 phrases in 6/8. Of the phrases in 3/8, all but one had the cadence on the downbeat. The one outlier, mentioned above, fit Koch's theory under the hand-coded standard. Of the phrases in 6/8, 81% had cadences on the downbeat, and all but one of the rest had midbar cadences. The one remaining phrase was the other of the weak-eighth-beat cadences discussed above, also judged to fit Koch's theory under the hand-coded standard. A list of phrases that failed the strict standard is given in Appendix B.

Of the phrases in 6/8, 98% of those with downbeat cadences fit Koch's theory, compared with 57% of those with midbar cadences, and this difference was highly significant. While the less-strict standards led to improvements in the performance of the midbar cadence group, as would be predicted, the contrast with the downbeat cadence population remained robust. The phrases in 6/8 with midbar cadences also contrasted with the 3/8 phrases, though not as definitively; under the strict test the difference between the 57% of 6/8 phrases that fit Koch and the 77% of 3/8 phrases just failed significance ($p = .057$), though under the less-strict standards the contrast became significant.

As shown in Table 7, while the various measures of filled eighth-note levels had somewhat different results, in no case was there a statistically significant difference between 6/8 phrases with downbeat vs. midbar cadences

TABLE 7. Rate of the Eighth-Note Level Being Filled in 6/8 Depending on Cadence Location, Using Three Different Metrics.

Cadence position	8th-note level filled <i>strict standard</i>	8th-note level filled <i>hand coded</i>	8th-note level filled <i>proportional standard</i>
6/8 w/ midbar cadence ($N = 42$)	.60	.62	.76
6/8 w/ downbeat cadence ($N = 174$)	.47	.65	.66
Significance of difference (chi-square)	.18	.85	.28

in the likelihood that the eighth-note level would be consistently filled. This result significantly strengthens the disconfirmation of Koch's theory with respect to Mozart's use of 6/8 that was seen in the first study.

The examination of the proportion of busy dotted-eighth units strongly confirmed the prediction that 3/8 and 6/8 would differ on this metric. I expected a bimodal distribution, basically a "busy" and a "not busy" population within each meter, and indeed the data showed two groups with wide gulfs between the populations in which no data were found. Among 3/8 movements, no movements had proportions of busy dotted-eighth units between 7% and 39%, and among 6/8 movements, no movements had proportions of busy dotted-eighth units between 17% and 49%. It was therefore a safe conclusion that the "busy" population extended down to 39% busy, and the "not busy" population extended up to 17% busy.

As shown in Table 8, 3/8 and 6/8 were strongly distinguished by degree of busyness, with 56% of 3/8 movements belonging to the busy population versus only 12% of 6/8 units belonging to the busy population, with a highly significant p value. Further comparisons were made to see whether populations with downbeat cadences and midbar cadences differed in busyness. To do this, the cadence position of the first phrase of each movement was taken as representative for the movement as a whole. This was clearly an imperfect measure, as movements are not consistent throughout in terms of cadence position. It would have been better to look at the busyness of each phrase for which cadence position had been recorded, but the calculation of busyness was done at the level of the movement, not at the level of the phrase. But though flawed, the procedure was not unreasonable, as 6/8 movements tend to begin with main melodic material that is highly representative of the movement as a whole, in contrast (for example) to the common-time symphony movements that begin with fanfare gestures that are essentially introductory, discussed below. These comparisons revealed no meaningful distinction between 6/8 movements whose first phrases had downbeat versus midbar cadences; furthermore, the 6/8 movements whose first phrases had

midbar cadences contrasted with 3/8 movements comparably to the 6/8 population as a whole. Granted the problems with taking the first phrase as representative of the movement as a whole, this is further evidence that the 6/8 population is homogenous and not differentiated with respect to cadence position.

This contrast between meters is enhanced when the length of the movement or partial movement is taken into account; the longer the movement, the more likely that 3/8 movements are busy and 6/8 movements are not busy. A logistic regression showed a significant interaction of meter with number of measures in predicting busyness ($p = .002$). A plot of the regression is shown in Figure 3, and a plot of the data, binned into three arbitrary groups based on number of dotted-quarter units in the movement, is shown in Figure 4.

The idea that the degree of busyness was related to the tactus received further support from an interaction between busyness and tempo. Movements were coded as either fast or slow; these decisions were mainly obvious, the one point requiring comment being that Allegrettos were coded as slow for interior movements and as fast for final movements, and that the Andante grazioso of K. 331 was coded as fast as a first movement. As shown in Table 9, fast movements were less likely to be coded as busy; this was the case in the aggregate and for each meter individually, but significant only in the aggregate.

Discussion of Examples

Because the quantitative results do not by themselves settle the issues, this section looks at patterns observed in the works surveyed in order to better contextualize the quantitative results. The discussion will focus on four main issues.¹⁵

PROGRESSION FROM INSTABILITY TO STABILITY

There appears to be a tendency toward greater instability with respect to Koch's theory earlier in a movement

¹⁵ Because the complete Neue Mozart Ausgabe is now available online (<http://dme.mozarteum.at/DME/nma/>), readers are referred there for examples from Mozart's works, cited in the form used by the NMA.

TABLE 8. Contrasts Between 6/8 and 3/8 Populations in the Degree of Busyness.

Population compared	Comparison Group					
	6/8 (N = 49)	3/8 (N = 16)	6/8, 1 st phrase has midbar cadence (N = 15)	3/8 (N = 16)	6/8, 1 st phrase has midbar cadence (N = 15)	6/8, 1 st phrase has downbeat cadence (N = 34)
Rate at which coded as busy	.12	.56	.13	.56	.13	.12
Significance of difference (chi-square)	.001*		.034		1*	

*Note: Chi-squared approximation may be incorrect.

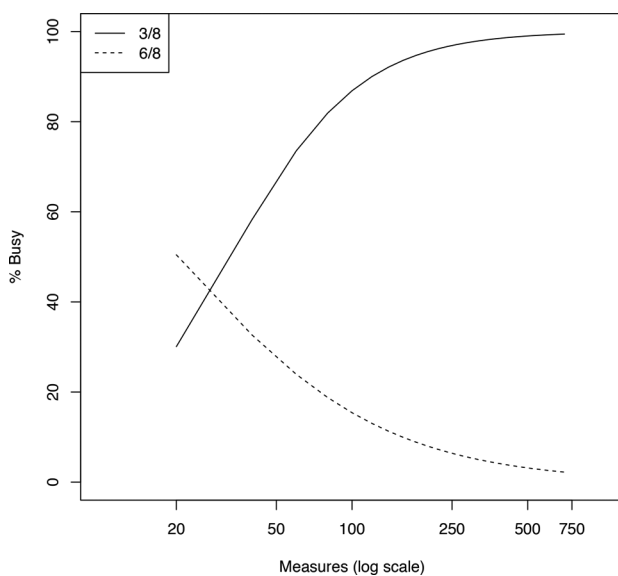


FIGURE 3. Logistic regression showing interaction of meter with number of measures in predicting busyness.

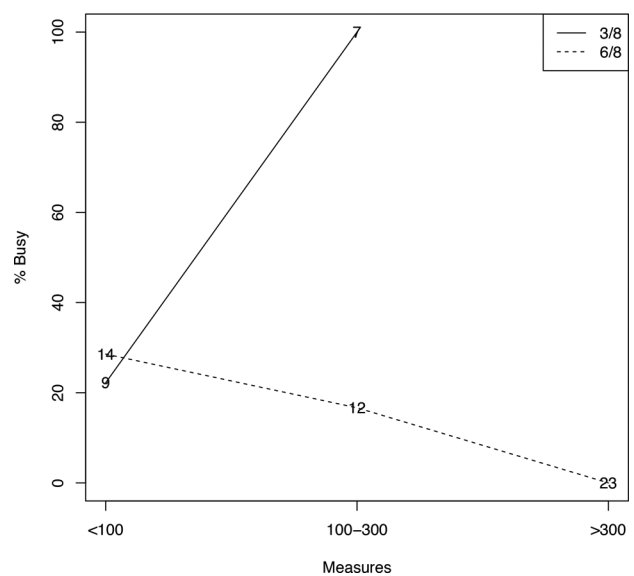


FIGURE 4. Plot of data by measure-length group (number = size of group) for interaction of meter with number of measures in predicting busyness.

and greater stability later. It was observed in the course of data collection that missing attack points are often particularly salient near the beginnings of movements, and that they tended to be filled in as the movement progressed. This accords with Mirka's treatment of the establishment of meter in the second chapter of her book. Particularly obvious examples of this are provided by the fanfare-like beginnings of many of the symphonies, in which initially sparse attack points gradually fill in more of the metric hierarchy; the beginning of Symphony No. 34, K. 338 (IV/11/6, 59), is characteristic.¹⁶ A sense that attack points missing at the

¹⁶ In comments on an earlier version of this paper, Mirka argued that Koch assumes a textural distinction between melody and accompaniment (meaning especially the bass), and that in cases in which this does not obtain, such as the fanfare texture found in this passage, the requirement that the bass supply attack points missing from the melody is impossible to fulfill.

outset were often filled in in short order was confirmed in the first corpus by comparing initial phrases with the two that followed; all attack points in the first subdivision of the measure were filled 78% of the time in initial phrases and 90% of the time in phrases two and three ($p = .009$). In some cases the course of the material suggests an awareness of missing attack points; for example, the theme from the first Menuetto of the Piano Sonata K. 282 conspicuously omits an attack point on the second beat that is then supplied in a parallel gesture in the theme's post-cadential extension (IX/25/1, 43). Similarly, while no statistics were compiled for final cadences during this survey, it was observed that final cadences of major sections have a particularly strong tendency to fall on downbeats, as for example in the slow movement from the Piano Sonata K 283, in which all cadences within the exposition fall on the middle of

TABLE 9. Correlation Between Tempo and Busyness, in the Aggregate and for Individual Meters.

Population compared	6/8 and 3/8		6/8		3/8	
	Fast (N = 38)	Slow (N = 27)	Fast (N = 36)	Slow (N = 13)	Fast (N = 2)	Slow (N = 14)
Rate at which coded as busy	.08	.44	.08	.23	0	.64
Significance of difference (chi-square)	.0016		.37*		.34*	

*Note: Chi-squared approximation may be incorrect

the measure until the final one, which falls on the down-beat (IX/25/1, 52-53).

TEMPO, TACTUS, AND THE ARTICULATION OF *TAKTTEILE*

As suggested in the second corpus study, it seems likely that tempo interacts with the articulation of attack points. A salient example is the final movement from the Piano Sonata K. 280, a 3/8 presto, in which two of the main thematic ideas feature missing attack points (IX/25/1, 22-23). Though there seems an element of play in the first of them, the second of the themes does nothing to call attention to the lack of an attack point on the second beat. Part of the issue in K. 280 could result from a deeper problem with Koch's theory. As discussed above, Koch starts with the *Taktteile* and unites these into larger units, the *Takte*, or measures. This implies a strong association between the *Taktteile* and the *tactus*. Mirka includes a careful discussion of the distinction between *tactus* and *Taktteil*; while the two will often coincide, especially for a historically informed listener, there are many circumstances in which they might diverge, for reasons including perceptual factors, the effect of tempo, and the often complex interrelations between compositional design and listener response (Mirka, 2009, pp. 241-248). She does not, however, explicitly address the case in which the *tactus* is slower than the *Taktteile*, something which seems quite likely in the final movement of K. 280, as the 3/8 presto seems much more likely to have the dotted quarter as the *tactus* as opposed to the eighth. But if the *Taktteile* are faster than the *tactus*, the motivation to mark them with attack points seems to recede rather markedly. This seems to be a case in which the failure of traditional metrical theory to account for the musician's everyday experience of feeling music in one becomes a noticeable shortcoming (Ito, 2013).

SUPPORT FOR KOCH FROM LOCAL CONTEXT

The survey included many examples that lent qualitative support to Koch's theory, either by pointedly supplying attack points missing in the melody or else by creating contexts in which the absence of an attack point

did not seem to create a conflict with Koch's theory. To start with the first case, there is a very characteristic texture in which the melody omits attack points that are supplied by another voice, often the bass (this case is one of the points of evidence used by Koch; Mirka, 2009, p. 96). This seems to support the idea of a requirement to articulate each *Taktteil*. A particularly clear example is found in the third movement of the Piano Sonata K. 282, when the second appearance of a theme shifts the beat that is supplied by the bass (mm. 16-19, 24-27; IX/25/1, 45). (It seems fair to ask, though, as this seems clearly an instance of a stylistic emphasis on a dialogic relationship among voices, whether the additional explanatory layer of marking *Taktteile* is needed.)

Moving on to the case of excused absences for attack points, the most obvious case was that in which there were clear pauses after incises in the first half of a phrase, as discussed above. The first movement of the so-called "Kegelstatt" trio, K. 498, is a nice example, as it features two different kinds of pause (VIII/22/Abt. 2, p. 104). The movement is in 6/8, and four times in the first phrase there are rests on the second dotted-quarter beat; the first and third seem like rhetorical pauses, making clear that the music is taking its time getting going, while the second and fourth mark incises. Syncopations are also among the cases of patterned, typical omissions of attack points discussed by Mirka (2009, pp. 122-131), and the survey included examples, such as the second theme of K. 333/i, in which a salient syncopation seems clearly a part of the compositional design (IX/25/2, 49). With a bit of stretching, Koch's theory can even accommodate an example like the opening theme from the Piano Sonata K. 570 (IX/25/2, 132). Nothing about this music suggests that there is anything striking about these missing attack points; they don't seem likely to be missed by listeners, and though the theme returns in various guises throughout the movement, in no cases are all of these missing attack points supplied. But though Koch considered double measures (in this case a "real" meter of 6/4 as tripled *alla breve*) a mistake, he did acknowledge the possibility, and both Maurer Zenck (2001) and Mirka (2009) have explored it, with Maurer Zenck

including this movement among her examples (2001, p. 42).¹⁷

FURTHER CONSIDERATION OF 6/8

There are several examples of 6/8 with midbar cadences in which the missing attack points (always the second eighth within a dotted-quarter unit) seem completely normal and unremarkable. These instances strongly reinforce the questions raised by the statistical survey regarding 6/8 with midbar cadences. The examples are the first phrases (or in some cases the first two phrases) from the second movements of the Duo for Violin and Viola K. 424 (VIII/21, 41), the Piano Trio K. 496 (VIII/22/Abt. 2, 88), and the String Quartet K. 421 (VIII/20/Abt. 1/2, 42), and from the first movement of the Piano Sonata K. 331 (IX/25/2, 14). These phrases seem thoroughly typical, lacking in suggestions of metric play (though the first variation of K. 331 does proceed both to call attention to the missing attack point in the melody and to fill it in in the accompaniment). That they conflict with Koch's theory suggests that there is at least a significant population of phrases to which his theory simply fails to apply.

And yet even here there is the possibility that several of these phrases may belong to a significant class of exception. Commenting on a related, partially overlapping set of examples in an earlier version of this paper, Danuta Mirka suggested that reference to the *siciliano* topic, evidenced by dotted-eighth/sixteenth/eighth rhythm in the melody and quarter/eighth rhythm in the accompaniment, excused passages in compound 6/8 from the requirement of articulated *Taktteile* on the grounds that the *siciliano* rhythm took priority. I am not entirely convinced by this explanation, as I could equally well imagine stipulating that the presence of *siciliano* rhythm with its missing eighths always required the use of 6/8 as tripled 2/4. And the melodic *siciliano* rhythm is not exactly prominent in all of these examples. And yet it does appear at the start of the first phrase in K. 424 (though hardly at all afterward) and even in K. 421, the strongest of the exceptions, it can be found at some cadences, including the first. Only K. 496 lacks the *siciliano* rhythm in the accompaniment, as it does in the melody (assuming a case for an underlying rhythm is discounted); but it has a somewhat rhapsodic character, so that it is perhaps less typical than the others in its general stylistic characteristics, more a case in which Koch's rules might be expected to be broken. Other even more convincing examples of *siciliano* rhythm with midbar cadences can be found,

¹⁷ This point also was raised by Mirka in relation to an earlier version.

such as Haydn's String Quartet Op. 20 No. 5/iii, shown in Figure 5. Could it really be that such fleeting references to *siciliano* rhythm as are found in K. 424 and K. 421 suffice to activate that schema—and that it indeed excuses unarticulated *Taktteile* in compound 6/8?¹⁸ It seems a remarkable claim, one that invites more detailed investigation.

Conclusions

This study concludes with two summary discussions, the first relating specifically to Koch's theories and the second addressing the metrical analysis of later-18th-century music more generally.

It would be possible to come away from this study with a rather skeptical position with regard to Koch's metrical theories. The statistical investigations have provided strong confirmation for Koch's theories with respect to only one meter, common time. With this result combined with the metric displacements in Mozart's music in common time demonstrated by Grave (1984, 1985), it seems reasonable to believe that Mozart sometimes wrote in compound common time.

But Koch's theory is strongly disconfirmed for 6/8. At least within the corpus studied, it can be argued that 6/8 exists only as tripled 2/4, not also as compound 6/8. While cadences often fall on the downbeat, in a significant minority of cases (about 20%) they fall on the middle of the measure, and this fact carries no larger implications for the meter. Six-eight fits Koch's theory fairly prevalently for the following reasons: 80% of the cadences fall on the downbeat, and the downbeat and midmeasure are very frequently articulated in this repertoire; and when cadences fall on the midmeasure, a general tendency toward marking eighth-note beats in 6/8—uncorrelated with cadence position or supposed shifts in the level of the *Taktteile*—results in a significant number of these phrases also fitting the claims of Koch's theory. Six-eight has in the great majority of cases an implied tactus equal to the dotted quarter (again, without regard to cadence placement); looking at implied tactus gives no support for Koch's argument that the eighth notes are often the *Taktteile* in 6/8.

The results for the other meters studied are less conclusive, but because none of them achieved a fit between

¹⁸ It is noteworthy in this connection that the one partial movement labeled 'Siciliana' in the survey, the final variation from the Violin Sonata K. 377/ii, uses the melodic *siciliano* rhythm in all measures except two, not counting measures in which cadences occur, in many of those measures employing it in both dotted-quarter beats. All of the cadences fall on downbeats.

Adagio

The musical score is for the third movement of Haydn's String Quartet Op. 20 No. 5, measures 1-8. It is in 6/8 time and marked Adagio. The score is written for four staves (Violin I, Violin II, Viola, and Cello/Double Bass). The first system (measures 1-4) features a melody in the first violin part marked *mp* and *staccato*, with the other parts providing a rhythmic accompaniment also marked *staccato*. The second system (measures 5-8) continues the melody, with the first violin part marked *tenuto* and the other parts also marked *tenuto*. The key signature has one flat (B-flat).

FIGURE 5. Haydn String Quartet Op. 20 No. 5/iii, mm. 1-8.

data and theory as good as the fit for 6/8, and because the fit for 6/8 may be regarded as an artifact of a general tendency to articulate several of the more prominent metrical levels within the measure, the results do not provide particularly convincing support for the other meters. Certainly one could argue that the burden of proof is on those who would defend Koch's theories.

A skeptic could still retain a positive view of Mirka's contribution, but this would probably mean regarding Koch's theory as an analytical bay leaf, to be discarded once it had seasoned the stew. In this view, Mirka's analyses do not chart shifting meter in Koch's sense but

rather in London's (2004), providing the most extended analytical application to date of his call for greater attention to moment-by-moment fluctuations in the active depth of the metrical hierarchy.

There are some simple points that could be raised in response by those who would defend Koch. The corpus used is one slice in time and genre of the works of one composer, and his theories may well apply broadly in other music from the second half of the 18th century. Most other meters are within ten percentage points of common time's fit to Koch's theory, and in any case common time and 6/8 are so close that these other

meters are just as likely to group with common time in fulfilling the theory as they are to group with 6/8. And even if a substantial number of pieces in 6/8 have mid-bar cadences without implying half-sized measures, there could also be a significant minority population that fulfills Koch's theory for 6/8, but that is not large enough to sway the statistics for the meter as a whole.

But arraying the arguments in this way tends to create a false choice between largely dismissing Koch's theories and upholding them as generally valid, perhaps with a significant new class of exceptions. I would argue that the results best support a third position: that the patterns Koch describes are prevalent enough to make analysis in terms of his theory a credible option in many cases, but that they are not prevalent enough to justify taking them as givens whose implications are always valid, even when other approaches would generate much simpler results.

Koch has offered a set of tools for the analysis of meter in music from the second half of the 18th century, and Mirka has demonstrated, to an extent far surpassing Koch himself, that Koch's tools can provide an extremely rich perspective on the music of Mozart and Haydn. In order to do this, Mirka fully inhabited Koch's perspective, taking his theories as a foundational set of assumptions. This meant taking Koch's theories in the same spirit in which he offered them, as possessing a generality that makes them essentially mechanistic: if missing attack points do not fit one of the standard categories offered by Koch (and augmented by Mirka), then they may be taken as a sign that the meter has changed. This approach may well have been necessary in order to show the full potential scope of the theory. But the results of the present study suggest that listeners who wish to make use of this mode of listening should do so selectively, making informed judgments about whether or not the theory is credibly applicable in any given instance.

There are a number of cues that can signal that composers are using compound meter in the 18th-century sense, and they vary both in strength of implication and in degree of objectivity. The least equivocal evidence is the return of a complete thematic statement with a shifted metrical position. As a cue to the use of compound measures, this is extremely common in music from the first half of the 18th century, for example in works by Vivaldi or Telemann, but there are only two documented instances that I know of in Mozart's music.¹⁹ This fact alone should indicate that, as Grave (1984, 1985)

¹⁹ These are the second themes of the first movements of K. 183 and K. 421 (Grave, 1984, 1985).

has also argued, if we perceive Mozart using compound meter, it is in a form that is both a remnant of and a transformed reference to an earlier, more robust practice.²⁰ Cadence placement is another relatively objective cue, though there is room for argument regarding the degree to which the rule of cadences on the (real) downbeat should be expected to hold. Like themes, sub-thematic motivic units may also shift metrical position; this can be objectively documented but its significance for meter is open to debate. Finally, the perception of the downbeat may also shift aside from thematic repetitions, though in such cases there will be questions about how far these perceptions generalize, whether to other listeners in the present or to historical listeners in the past. We are in Mirka's debt for reviving Koch's insistence that the consistent articulation of *Takteile* belongs on this list, but we do not need to follow Koch in giving it preeminence (together with cadence position). These factors and no doubt many others (e.g., relating to tempo or to implied tactus) will each need to be weighed, and in some cases weighed against each other, in making judgments about the plausibility of various metrical interpretations.²¹

Interestingly, this study has also indicated that the degree of evidence that should be provided by those who would apply Koch's theories will differ based on context, depending most clearly on the meter signature used, but also varying with genre, instrumentation, and tempo. This result leads into the second main conclusion, which is that the metrical terrain of later-18th-century music seems likely to be quite varied, perhaps more varied than would have been predicted. This study has revealed significant variation in the topography of Mozart's metrical practice: with respect to cadence placement and the articulation of metrical levels, but also finding that 3/8 tends strongly to be more rhythmically active than 6/8, that piano sonatas feature more consistent motion at smaller metrical levels than symphonies, and that the exceptions to Koch's rules in 2/4 come almost exclusively from misplaced cadences in the piano sonatas

²⁰ Grave has also concluded that in comparison with the number found in common time, metrically shifted thematic and motivic statements are extremely rare in 6/8 in late-18th-century music, even in cases in which Koch's theory is nicely satisfied (1985). Together with the results of the present study, this raises the (conjectural) possibility that the prevalences of the more overt and the more subtle signs of compound meter may covary across different contexts.

²¹ The potential complexity of this task may be seen from the two examples from Mirka discussed above. I was convinced by Op. 50 No. 1, but the statistical study calls it into question as it is in 6/8. And I was skeptical of Op. 64 No. 6, but Mozart's exclusive use of downbeat cadences in *alla breve* make its midbar cadences appear much more striking.

and almost entirely from missing attack points in the symphonies.²²

These results dovetail with a number of other findings and hypotheses, including Grave's (1985) observation that fugues preserved a thoroughly baroque treatment of compound meter well into the 19th century, Mirka's thoughts regarding the siciliano reported above, and the national metrical types proposed by Rothstein (2008), to suggest that nationality, genre, instrumentation, and a host of other parameters may well have demarcated identifiably different metrical practices in the later 18th century. In general, it is evident from the judgments of experienced listeners that every musical style is in fact a collection of microstyles, and if the results of this study are a reliable indication, the metrical microstyles internal to the galant and the high classical may well harbor some striking statistical contrasts. Determining

the extent to which this is the case will require further work in metrical mapping, greatly expanding the scope that was possible here both in terms of the parameters examined and in terms of the range of works included. It is hoped that the present modest effort may help to stimulate that larger project.

Author Note

Thanks are due to Danuta Mirka, Leigh van Handel, and an anonymous reviewer for extremely helpful comments on earlier versions of this article. Howard Seltman's generous participation was essential to the statistical analysis.

Correspondence concerning this article should be addressed to John Paul Ito, School of Music, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA 15213. E-mail: itojp@cmu.edu

References

- BREIDENSTEIN, H. (2011). *Mozart's Tempo-System: Ein Handbuch für die professionelle Praxis* [Mozart's tempo system: A handbook for professional practice]. Tutzing: Hans Schneider.
- GRAVE, F. K. (1984). Common-time displacement in Mozart. *Journal of Musicology*, 3, 423-442.
- GRAVE, F. K. (1985). Metrical displacement and the compound measure in eighteenth-century theory and practice. *Theoria*, 1, 25-60.
- HOULE, G. (1987). *Meter in music, 1600-1800: Performance, perception, and notation*. Bloomington, IN: Indiana University Press.
- ITO, J. P. (2013). Hypermetrical schemas, metrical orientation, and cognitive-linguistic paradigms. *Journal of Music Theory*, 57, 47-85.
- LONDON, J. (2004). *Hearing in time: Psychological aspects of musical meter*. New York: Oxford.
- MARPURG, F. W. (1974). *Kritische Briefe über die Tonkunst* [Critical Letters about Music] (Vol. 2). Hildesheim: Olms. (Originally published 1763, Berlin: Birnstiel)
- MAURER ZENCK, C. (2001). *Vom Takt: Untersuchungen zur Theorie und kompositorischen Praxis im ausgehenden 18. und beginnenden 19. Jahrhundert*. [On meter: Investigations into theory and compositional practice in the late 18th and early 19th centuries] Vienna: Böhlau.
- MIRKA, D. (2009). *Metric manipulations in Haydn and Mozart: Chamber music for strings, 1787-1791*. New York: Oxford University Press.
- ROTHSTEIN, W. (2008). National metrical types in music of the eighteenth and early nineteenth centuries. In D. Mirka & K. Agawu (Eds.), *Communication in eighteenth-century music* (pp. 112-159). Cambridge: Cambridge University Press.
- TEMPERLEY, D. (2009). Review of the book *Metric Manipulations in Haydn and Mozart: Chamber music for strings, 1787-1791*, by D. Mirka. *Journal of Music Theory*, 53, 305-328.
- VANHANDEL, L. (2009). National metrical types in nineteenth century art song. *Empirical Musicology Review*, 4, 134-145.

²² There is even the possibility of a shift in Mozart's practice over the short span of time surveyed in the second study, as a larger sample, also including major vocal works, showed a significant trend toward more frequent use of alla breve in relation to common time over the course of these years. This survey included all of the works listed in Appendix A plus the C minor Mass, the Requiem, *Die Entführung aus dem Serail*, *Le nozze di Figaro*, *Don Giovanni*, *Così fan tutte*, *Die Zauberflöte*, and *La clemenza di Tito*. (In the operas, each instance of a new time signature within the numbers was recorded. Secco recitatives which were not designated as numbers in the *Neue Mozart-Ausgabe* were not recorded.) Each work was dated, choosing the year of completion, or the latest of the possible dates when multiple possibilities were given in the works list in the *New Grove Dictionary*, and for each year of composition the proportion of alla breve used was computed by dividing the total number of instances of alla breve by the sum of the total instances of alla breve and common time. A linear regression showed that this proportion trended upward over those years with a *p* value of .02. The meaning of this trend is unknown. The possibilities include a growing preference for the musical characteristics of alla breve (with those characteristics understood to be stable in time), or possibly a shift in Mozart's use of the time signatures, so that similar passages grew in their likelihood of being notated in alla breve.

Appendix A: Works Included in Survey 2

<u>Work type</u>	<u>Köchel numbers (K¹), order as in <i>New Grove</i> works list</u>
Symphony	385, 425, 504, 543, 550, 551
Serenade	375, 388, 361
Piano Concerto	414, 413, 415, 449, 450, 451, 453, 456, 459, 466, 467, 482, 488, 491, 503, 537, 595
Wind Concerto	417*, 447, 495, 412, 622
Ch. Mus., Str. + Wd.	298, 407, 581
String Quintet	515, 516, 593, 614
String Quartet	387, 421, 458, 428, 464, 465, 499, 575, 589, 590
String Duo or Trio	423, 424, 563
Qr. or Qn. w. Pno.	452, 478, 493
Piano Trio	496, 498, 502, 542, 548, 564
Violin Sonata	379, 376, 377, 380, 454, 481, 526, 547
Piano Sonata	330, 331, 332, 333, 457, 533, 494, 545, 570, 576
Sonatas, 2 Pianists	497, 521, 448

The second movement of K. 417 presented very unusual problems in determining cadence locations; the omission of this movement from the autograph manuscript was therefore judged to be adequate grounds for omitting it from the survey.

Appendix B: Phrases Not Fitting Koch's Theory from Survey 2

3/8

<u>Work</u>	<u>Cadence m.</u>	<u>Hand-coded as fitting? (1=Y)</u>
Serenade K. 388, ii	8	1
Serenade K. 388, ii	16	1
Pno. Conc. K. 450, ii	4	1
Pno. Conc. K. 450, ii	12	1
Pno. Conc. K. 482, ii	12	1
Pno. Conc. K. 482, ii	32	1
Hn. Qn. K. 407, ii	18	0
Hn. Qn. K. 407, ii	31	0
Pno. Qr. K. 478, ii	42	1
Pno. Qr. K. 478, ii	50	1
Pno. Qr. K. 493, ii	10	1
Pno. Qr. K. 493, ii	22	1
Pno. Qr. K. 493, ii	35	1

6/8

<u>Work</u>	<u>Cadence m.</u>	<u>Hand-coded as fitting? (1=Y)</u>
Pno. Conc. K. 450, iii	39	1
Hn. Conc. K. 417, iii	73	1
Str. Qn. K. 593, iv	26	1
Str. Qn. K. 614, i	15	0
Str. Qn. K. 614, i	19	0
Str. Qr. K. 421, ii	8	0
Str. Qr. K. 421, ii	12	0
Str. Qr. K. 458, i	2	0
Str. Qr. K. 458, i	4	0
Str. Qr. K. 458, i	6	0
Str. Qr. K. 589, iv	8	0
Str. Qr. K. 589, iv	12	0
Str. Qr. K. 590, ii	8	1
Duo K. 424, ii	4	0
Pno. Trio K. 496, ii	8	0
Pno. Trio K. 496, ii	14	0
Pno. Trio K. 498, i	12	1
Pno. Trio K. 548, iii	8	0
Pno. Sn. K. 331, i.Th	4	0
Pno. Sn. K. 331, i.Th	8	0
Pno. Sn. K. 331, i.V3	12	1
Pno. Sn. K. 332, iii	14	1