Metric induction through association

How a shifted motive can (or can't) shift a downbeat

Dani Zanuttini-Frank

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Contents

1 Introduction

My thesis is about how meter is induced through the association of musical materials. I trace how the shifting of rhythmic motives, or sets of overmarked beat-classes, can either shift the downbeat through association or be metrically reinterpreted to allow for an unchanged meter. I first discuss the shifting of a long-short motive in the first movement of Brahms's op. 111 string quintet, which shifts the downbeat in the secondary thematic areas in the exposition. The motive's metric reinterpretation in the development allows for an unchanging downbeat in the recapitulation's secondary themes. Next, I discuss Steve Reich's *New York Counterpoint*, in which the rotation of a motive rotates the downbeat until an alternate association prevents a metric shift in the rotated motive's final iteration. In the Reich, associations occur not only between identical sets of accented beat-classes, but also between ones with large intersections. Rotational relations occur when the sets have high-cardinality relations through rotation and low-cardinality relations without rotation. Two examples from flamenco extend the concept of the rhythmic motive from the level of the piece to the level of the style, thus establishing the rhythmic schema. Rhythmic schemas in flamenco establish which particular musical element accents the particular beat-class. In one recording, only some of these musical elements are temporarily shifted, creating a brief metric dissonance, wherein the different elements briefly suggest different downbeats. In another recording, one element's shift causes all other elements to shift, causing a lasting rotation in the perceived downbeat. Finally, I return to the Brahms movement to show how the same rhythmic motive can exist in multiple minimal meters, before using the same Brahms piece to suggest possible paths forward in the study of metric analysis and rhythmic motives.

1.1 On meter

I discuss meter, and the induction of meter, a great deal in this paper. As such, I will include a brief outlining of my concept of meter, which owes a great deal to Cohn (2020).

A meter consists of a path of adjacent pulses, in which each pulse has no more than one slower and one faster adjacent pulse. A pulse is a string of time-points that are felt to occur at equal intervals, i.e. are conceptually isochronous. Adjacent pulses are defined as those that are 1. related by inclusion and 2. in prime frequency-relation to one another. Two adjacent pulses form a minimal meter, or are in minimal meter with one another. A meter with *n* pulses is an *n*-deep meter. A minimal meter is thus a 2-deep meter.

How to deduce the meter of a piece? The typical strategy is that of matching the articulated beats to time-points along various pulses, and filling out intermediate pulses that might not be articulated. I refer to this strategy as the **direct** induction of meter. Lerdahl and Jackendoff (1983, p. 18) describe this method as “match[ing] the given pattern of phenomenal accentuation as closely as possible to a permissible pattern of metrical accentuation.” One might imagine the articulation of time-points in a pulse as a kick off the ground from a swing to get moving at the right time, and each successive time-point in the pulse that is articulated as another kick right as the swing passes the ground, keeping the meter projecting forward.

A rhythmic motive, on the other hand, establishes a meter through association with that motive’s meter in its earlier appearances. The motive’s meter could’ve been established in earlier appearances through the strong articulation of the time-points of a slower pulse. It also could be established culturally, even taught in schools. The analysis of association presents a different style of metric analysis: instead of matching the articulated time-points in the music to the time-points of a meter’s pulses, the music is matched to associative structures, and those structures themselves induce the meter through association. I refer to this strategy as the **indirect** induction of meter.

1.2 Association and meter

Much of the way we comprehend the structure of music is through association between like things. We seek patterns of similarity to draw connections between various musical segments. Hanninen (2012, p. 32) presents “contextual criteria” as the rationales for analysis based on “repetition, equivalence or similarity between ... groupings of notes in a specific musical context.” Contextual criteria are any feature of a musical segment that relates it to another segment within a certain musical context. For Hanninen, the musical context refers to a specific piece. For my purposes, musical context can be a single piece or a repertoire as a whole, over which a listener or performer (or analyst) makes associations.

Hanninen (2012, pp. 40-43) proposes preference rules for determining which contextual criteria are stronger than others. Three are properties of the criteria: stronger relations are born by criteria that are 1. more specific in their musical property (such as exact pitches rather than pitch-classes), 2. comprise an ordered rather than unordered set (such as pitch-classes in a specific order rather than in a chord), and 3. comprise a higher-cardinality set (such as a shared pitch-class set of 5 pitch-classes rather than 3). Two more rules are about the music itself: 1. the frequency of the particular relation, and 2. the co-occurence of the relation with marked "sonic" events, with formal "structural" markers, or with other relational (or "contextual") criteria both determine relational strength. Hanninen (2012)'s contextual criteria are the similarities that result in the association of separate groups, and provides a method for comparing the strength of relations within a piece of music. These rules allow us to compare the strength of relations within a piece of music, and determine cases in which association is particularly likely to occur.

The application of this contextual, or associative, domain to meter was noted by Lerdahl and Jackendoff (1983, p. 75):

> **MPR 1 (Parallelism)** Where two or more groups or parts of groups can be construed as parallel, they preferably receive parallel metrical structure.

MPR 1 states that a relation between groups of music result in parallel metricization. Following Hanninen (2012), my task is to analyze the contextual criteria that allow groups to be construed as parallel. In particular, I will study how particular rhythmic patterns, discussed below, can serve as contextual criteria, creating parallelism or assiciation and inducing like meters.

1.3 The rhythmic referent problem

Theorists have difficulties modeling recurring rhythmic patterns that do not clearly outline a meter of isochronous pulses. Some authors have attacked this problem by extending the notion of a meter to include non-isochronous pulses outlined by these rhythmic patterns, generating a class of non-isochronous meters. However, attempts to model non-isochronous meters are either 1. too permissive to discern what is or is not in some sense truly "metrical" (such as Leong (2014), cited in Selinsky (2019, p. 131-2)) or 2. allowing some non-isochronous pulses while excluding others, without strong support from musical intuitions (such as London (2012), cited in Guerra (2018)). Guerra and Selinsky each suggest alternate models of non-isochronous pulses, defining a meter by the cardinality of inclusion-related "pulses" without requiring each to be isochronous. The non-isochronous meter approach extends the method of direct induction to music with patterns of phenomenal accentuation that don't easily construct isochronous, hierarchical meters.

The source of the difficulty in interpreting a non-isochronous rhythmic pattern as meter is a difficulty in conceiving of what meter does, exactly. It is supposed to be an orienting pattern for music, but it is evident that many musical cultures are oriented in time beyond hierarchical series of pulses. In much African music, these patterns are known as timelines, which coexist with a regular, metrical referent that is also felt by performers and dancers. Gerstin (2017, p. 18) describes two main characteristics of timelines. The first is that they establish the meter (to Gerstin, the "cycle" and its "subdivisions"). The second is that they require the "interpolation" of main beats, meaning that the slower pulses of the timeline-induced meter not accented by the timeline itself are nonetheless perceptually present to knowledgeable practitioners when hearing the timeline. However, the timelines are referents themselves, in addition to the meters they imply: Gerstin writes that the timelines "help musicians keep their place" (p. 19). Evidently, timelines are rhythmic patterns that orient the performers and the listeners, and coexist quite proximally with an isochronous meter, but are not a meter themselves.

In the Western classical tradition, dance forms such as the Sarabande provide additional rhythm-orienting information, coexisting with an isochronous-pulse meter. Allanbrook (1983) describes rhythmic characteristics of dances found in Mozart's music in parallel to their metric structure. In the late 18th century, the brunt of rhythmic-expressive weight was born by contrasting rhythmic dance-characters (p. 24). The meter remains unchanged with the changes in rhythmic character, allowing for cleavage between meter and another rhythmic structure—in this case, dance forms. In addition to its pulse-relations and characteristic affect, each dance form forges expectations of strong or weak beats, rhythmic patterns and their placements in the measure, and phrase-groupings. The idea of a certain pulse-element being characteristically strong without any claim as to its being a member of a slower pulse implies that a pulse's elements that are most eligible for inclusion at the next pulse-level are not necessarily those that are most marked. For example, the Sarabande's strong second quarter note establishes a triple meter and a particular dance form, without suggesting that the strong second quarter note is part of the slower, bar-length pulse. The strong beat associates with a dance form, which in turn induces the meter. This typifies the logic of indirect metric induction, where the phenomenal accents that would directly induce a downbeat instead refer to a pattern that induces a downbeat through association.

Also in the Western classical tradition, Breslauer (1988, p. 9) observes that "the recurrence of a durational pattern in association with widely differing melodic material is a technique that may be observed in the music of both Bach and Brahms." The typical case is that the durational pattern is first presented in the foreground and is later "diminuted," obfuscated by a denser surface rhythm, and is intelligible as a pattern of harmonic changes, direction shifts, or leaps (p. 6). These patterns, in addition to being embellished, are also characteristically "subjected to the operations of reversal and syncopation" (p. 18). Breslauer does not assert these patterns to be common to multiple pieces: he observes them and tracks how they are transformed over the course of a single piece. He shows that associative connections are made with the use of durational patterns, and that the rhythmic motives can maintain their associations while undergoing certain transformations, demonstrating the patterns' robustness.

Gerstin's timelines, Allanbrook's dance forms and Breslauer's durational patterns are rhythmic patterns that, through association, induce a meter without being meters themselves. They can be described as giving form to the isochronous pulses of the meter, an archetype that, if a bit of music resembles, it can be induced into that meter. Two authors (Gerstin and Allanbrook) illustrate clearly how the referents connect to a particular meter. In Breslauer's article, piece-specific rhythmic motives remain unconnected to meter. However, Breslauer shows that durational patterns associate different parts of the music, which by Lerdahl and Jackendoff's MPR 1 makes them likely to induce meter.

1.4 Schemas and meter

In certain cases, such as Gerstin's timelines and Allanbrook's dance forms, parallel musical structures create associations across a whole repertoire. They thus bear resemblance to the concept of a schema, which is important in music theory and is worth relaying.

The notion of the schema is pithily put by Byros (2012, p. 273) with the proverb: "Experientia docet." In more words: "historically and socially effected experience is the basis for applied musical knowledge (p. 274). Our experience of music is shaped by schemas, or "'ideal types', 'norms', 'classes', 'class concepts' and 'class patterns'" (p. 274) that we learn to expect through culture-specific knowledge of a musical idiom. These patterns create a musical-cultural context that allows listeners to grasp rich, culture-specific information from the music. Schema theory has been applied most successfully to the harmonic language of the galant, where Gjerdingen (2007, p. 277) has documented "an entire galant culture of 'schematic music-compositional thought'." In a pertinent, though non-musical, experiment by Sir Frederic Bartlett, relayed in Byros (2012, p. 287), a Native American folk tale was told to two groups: University of Cambridge students with no knowledge of Native American folklore, and culturally knowledgeable Native American students. Students in each group were asked to reconstruct the story. While the Native American students had no issues with this task, the Cambridge students, unaware of the 'schemas' the story was referencing, changed the story quite a bit in the reconstruction, missing its meaning entirely.

In the musical realm, I propose the following analogous thought experiment: compare the experience of a regular listener of bebop to someone whose musical experience is primarily in Chinese opera in encountering Clifford Brown's recording of Donna Lee. The Chinese opera listener will notice the dense melodies of the soloists, quick shifts of interval and direction, lightning-fast tempo and perhaps even harmonic and melodic structures insofar as they might relate to the harmonic and melodic language of Chinese opera. This listener will not be able to tell how the soloist and chordal accompanist are going in or out of the tune's changes,[1] what cross-rhythms the drummer is using in their accompaniment, or how the chordal comping instrument is responding rhythmically to the soloist and to the drummer's ride cymbal. To follow the interaction between the performance and the changes, you must already know or be able to deduce the tune's changes, which form a harmonic schema for the piece. To hear the cross-rhythms and rhythmic interactivity between musicians, you must know the typical rhythms of jazz drumming (such as the shuffle) and comping (such as the Charleston), understand how they interact with the meter, and recognize new rhythms being tossed around between instruments.

The intercontingent nature of schemas leaves a bit of wiggle room: in his analysis of the le-sol-fi-sol schema in the opening of Beethoven's *Eroica*, Byros (2012, p. 291) notes that different elements of the schema can be missing in any one specific instance, so long as a large enough subset is present to make the schema recognizable. This maps on to Hanninen's discussion of the size of the mapping set, where an association to a subset of a schema forges a weaker but still existent association. Metric induction through parallelism functions very similarly to harmony in rhythmically schematic music: music orients itself in reference to a schema, which in turn induces a metric structure. To use Byros (2012)'s example of Beethoven's Eroica, the C♯ diminished seventh in the opening theme establishes G minor even though only two of its four pitches are in the G natural minor scale, much as how a clave can induce a 4/4 meter while only beating every other

1. Changes are the harmonic structure conceptualized as the essence of the jazz standard, along with the melody. For a fuller treatment of the relationship between a jazz standard's essence and its changes, see Kane (2018)

quarter note, every other half note, and every other downbeat. schemas are aspects of music that associate across repertories. Gerstin's timelines and Allanbrook's dance forms are examples of **rhythmic schemas**. When the association occurs within a piece, the thing being associated is a motive. Breslauer's diminutional rhythms are examples of **rhythmic motives**.

1.5 Tying strings together

Thus far, I have illustrated the concept of association in music, then used MPR 1 to argue that association contributes to metric induction. I then connected it to the concept of the schemas to show how culturally specific musical knowledge can help the associative interpretation of the meter of a given piece of music. Finally, I presented three cases in which non-metric rhythmic referents exist. I will now study three cases, the first movement of Brahms's second string quintet, the first movement of Reich's New York Counterpoint, and the palos of Soléa and Bulerías in flamenco, to show how the shifting of motives (in the case of Brahms and Reich) and schemas (in the case of flamenco) does or does not result in a metric shift.

Before moving on, I will define certain terms. Given a meter with a set of pulses ordered by frequency, I define the highest-frequency pulse as the **unit pulse**. An ***n*-unit pulse** is a pulse that occurs concurrently with every *n*-th unit pulse. A **span** is the length of time, measured by a number of inter-onset intervals of a particular beat. A **cycle** is a span that repeats. A **beat** is a particular time-point included in a pulse, counted by the number element of a certain pulse the beat is in a particular cycle or span. For example, the opening phrases of "Twinkle Twinkle Little Star" articulate beats (0 1 2 3 4 5 6) of the unit pulse in an 8-unit cycle, and its meter consists a unit pulse, 2-, 4-, and 8-unit pulses, which I denote as $\langle 8,4,2,1 \rangle$. Finally, a **rotation by *n* of set S** is a set S' in which each element corresponds to an element of S with n added modulo the size of the cycle from which the elements of S come. For example, in a 12-element cycle, the rotation by 8 of the set (3 5) is the set (1 11).

2 Metric motives in Brahms op. 111.1

In this section, I analyze the first movement of Brahms's Opus 111 String Quintet. The piece is in triple meter, and there is a long-short rhythmic motive. In the exposition, the motive shifts with respect to the notated downbeat. The perceived downbeat initially shifts with the motive, remaining on the long element. In the development section, the motive is rotated with respect to the notated downbeat but the downbeat is not, due to overriding factors. In the recapitulation, the rotated motive coexists once again with the unshifted meter, as the association between the downbeat and the long element of the motive is no longer as strong. This section shows how the transformation of a rhythmic motive generates a metric trajectory that coincides with the structural trajectory of the piece's sonata form.

2.1 [0 1] motive

The first movement of Brahms's op. 111.1 is written in 9/8. There is a triple minimal meter at two levels: the eighth note to the dotted quarter, and the dotted quarter to the bar. Here, I am concerned with the slower minimal meter, between the bar and the dotted quarter. This meter is articulated throughout the movement with a motive of class [0 1].

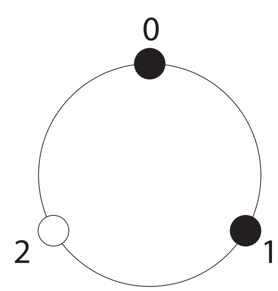


Figure 1: [0 1] motive on a necklace.

The two elements in this motive have different amounts of time following them: one has two beats after it, while the other has only one. I will refer to the element with two beats after it as L, as it is the longer one, and the element with one beat after it as S, as it is the shorter one. Thus, the rotation of the motive with the longer element on the notated downbeat is LS, whereas the rotation with the shorter element on the notated downbeat is SL.[2]

There are three elements that I will track over the course of my analysis, the third of which proceeds from the first two. The first is the rotation of the motive with respect to the notated downbeat. The second is the placement of the perceived downbeat with respect to the notated downbeat. The third is whether the perceived downbeat lands on the L or S element of the motive. The L element is the normal identity due to association with the opening theme, as well as due to the Povel-Essens principle (Cohn 2020).[3] However, this normal identity can be overriden by local factors.

The movement is in sonata form. The various states of this motive occur at different structural points in the form, which will help us in following them. The entirety of the trajecory is summarized in Table 1.

Section	Motive:notated downbeat	Perceived downbeat:notated	Perceived downbeat:motive
Exp. P	LS	unshifted	L
Exp. Tr	SL	shifted	L
Exp. S1	SL	shifted	L
Dev.	SL	unshifted	S
Recap P	LS	unshifted	L
Recap Tr	SL	unshifted	S
Recap S1	SL	unshifted	S

Table 1: Trajectory of the [0 1] motive in the ⟨bar,♩.⟩ minimal meter in Brahms op. 111.1

2.1.1 Exposition

The primary theme, which starts in the cello at the very opening of the piece, presents the motive in the rotation LS, with L on the notated downbeat. The motive is articulated by harmonic changes and longer notes in the cello. The perceived downbeat aligns with the notated downbeat, as G major is articulated on each notated downbeat while off-beat harmonies vary, as well as by the Povel-

2. There is a third possible rotation, in which neither accented beat is the downbeat. This never occurs in the piece.
3. The Povel-Essens principle states that the second of two adjacent articulated notes is more likely to be metrically accented.

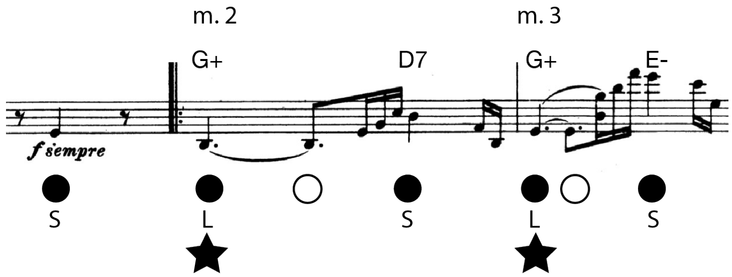


Figure 2: Opening cello melody, with articulated beats denoted with filled in circles, and non-articulated beats denoted with empty circles.

Essens principle. As such, the motive is in its normal metric state, with the perceived downbeat on L.

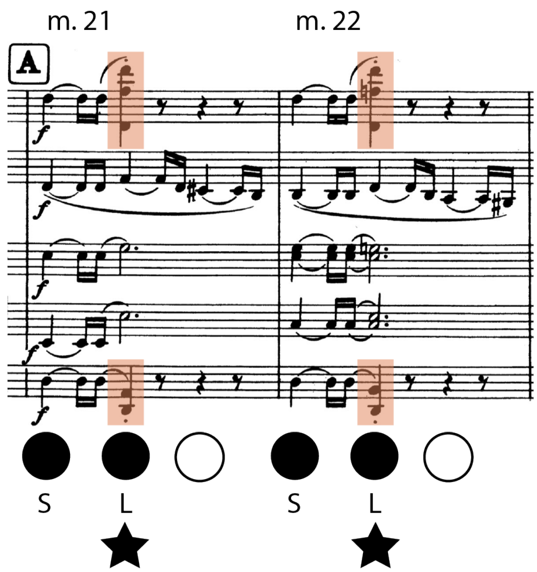


Figure 3: Transition area of exposition (mm. 21-2).

In the transition into the secondary thematic area, the motive is rotated to SL with respect to the notated downbeat. All five instruments articulate dotted quarters 1 and 2 of each bar, and only the second violin plays on the third. The perceived downbeat shifts as well due to association with the primary theme, in which the downbeat lands on L. This is aided by direct metric induction, as element L (the second dotted quarter) has a double stop in the cello and a triple stop in the first violin, as compared with the unison Ds on S (the first dotted quarter). Thus, the rotated motive in the transition shifts the downbeat to the second dotted quarter of the bar, supported by direct apprehension from exceptional phenomenal accents. The motive retains its normal metric state, in which L is the downbeat. This downbeat shift is accompanied by a shift to the D major tonality, a tonal modulation to accompany the metric modulation.

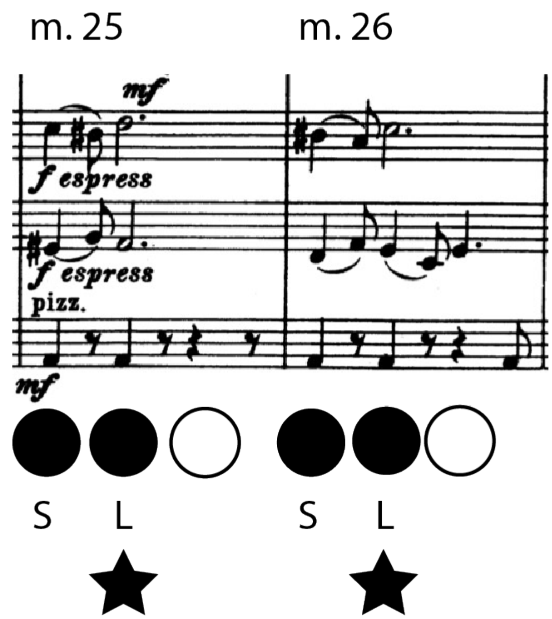


Figure 4: Two violas and cello in the S1 theme (mm. 26-7).

In the first secondary (S1) theme, the motive remains rotated as SL with respect to the notated downbeat. As a result of the association with the primary theme and the transitional material, the perceived downbeat remains shifted. Accordingly, the tonality remains D major.

The motive thus retains its normal metric state throughout the exposition. In the transition and S1 theme, the motive is rotated with respect to the notated downbeat, and the perceived downbeat rotates with it. These downbeat shifts co-occur with tonal modulations.

2.1.2 Re-metricization in the development and recapitulation

The [0 1] motive appears at the very beginning of the development. The slower-moving instruments, the first viola and the first violin, articulate the first and second dotted quarters of each bar, thus articulating the rotated motive, SL, with respect to the notated downbeat. This is the same rotation of the motive as in the transition and first secondary theme in the exposition. In both of those

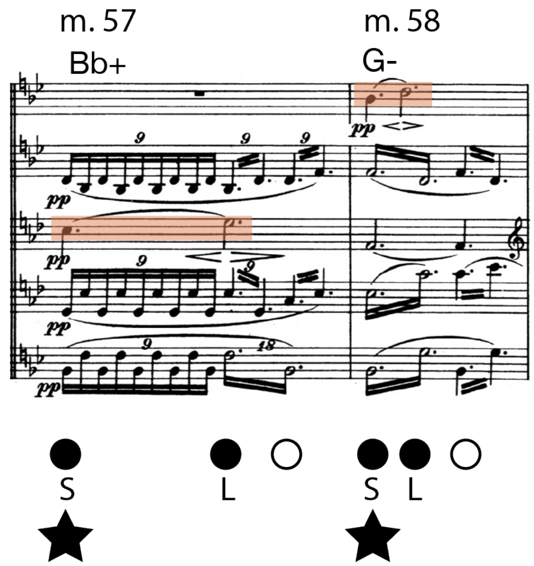


Figure 5: Opening of the development section (mm. 57-8), with harmonies indicated.

cases, the perceived downbeat shifted as well, moving to align with the L element. However, in this case, association with the motive's normal metric state is overcome by the direct induction of the perceived downbeat on the notated downbeat, where harmonic changes occur. The harmonies establish the perceived downbeat more strongly than the motive's association does. As a result, the motive exits its normal metric state, and the S element gets the perceived downbeat. Later iterations of the motive may relate to this metric state, weakening the associational impetus for the L element to be the downbeat.

In the recapitulation, the primary theme, transitional material, and S1 theme are presented with the same rhythmic content as in the exposition. However, the transition and S1 theme no longer causes a downbeat shift from the notated downbeat, as the motive can associate with its metricization in the development. The notated downbeat retains the downbeat. The transition and S1 theme are both resolved to G major in the recapitulation: metric resolution coincides with tonal resolution.

This example from Brahms shows how the rotation of a motive can induce a meter through association with the motive's meter from earlier in the piece, as well as how local factors can overcome that association and weaken it for the remainder of the piece. Here, this script coincides with the movement's sonata form, rendering clear the points of structural importance at which motivic and metric shifts occur.

3 Rhythmic motive in Reich's *NYCP*

Steve Reich's *New York Counterpoint* is composed for eleven clarinets, one of which is live and the other ten of which are prerecorded. The main part of the first movement begins at Rehearsal 7 (R7) and is organized as a series of ostinati. In each ostinato, some of the onsets are more accented than others, creating **subsets** of accented beat-classes from the sets of articulated beat-classes. I am interested in the way that association between these subsets determines metric induction in this piece. I claim that, after an association is established between the subset of the first ostinato and a particular downbeat placement, a later subset either a) suggests the downbeat stays on the same beat as in the first subset if the later subset shares a large intersection with the first, or b) suggests a downbeat shift by 8 beats if the new subset is a rotation by 8 beats of the first. I claim association between subsets as the main cause of metric induction over two alternatives. The first alternative is direct induction, meaning the mapping of metric accents to phenomenal accents. The second is the association between articulated beat-class sets, with the downbeat being placed according to the relations of high intersection or rotation between the sets of onset-articulated beat-classes for each ostinato. Direct induction is necessary to establish the meter of the first subset, as there are no others at that point with which to associate, and both direct induction and association between articulated beat-class sets contribute to arguments for certain metric interpretations in my analysis. However, the relations between subsets are the primary drivers of the metric trajectory.

3.1 About *NYCP*

The time signature of the first movement is written as 6/4=3/2, and the eighth note is the fastest, or unit, pulse throughout the piece: as a result, there are 12 unit pulses per measure. Each ostinato occurs in a measure-long, thus 12-unit cycle, and repeats several times. The ostinati at first have

Section	Characteristics
1	High pitches
2	Low pitches
3	High note density

Table 2: Three sections of the first movement of NYCP, segmented by two surface features of the ostinati, namely pitch height and density.

onsets on (or articulate) 6 of 12 unit beats, but they get denser towards the end of the movement. The second through sixth ostinati are all built up to, meaning that an incomplete part of the full ostinato is played before it arrives in its entirety. The order in which the notes in the ostinati are introduced in the build-ups is not linear or consistent. The live clarinet introduces all of the new ostinati. In analyzing this piece, I'm interested in the music played by the live clarinet, as it is louder than the prerecorded parts, and my metric experience of the piece follows the changes in the live clarinet, as would that of a performer on the live clarinet or an audience member paying attention to the sole live clarinetist on stage. The structure I follow over the course of the movement is that of the 12-beat ostinati, presented in sequence, and often built up to, by the live clarinet.

The form of the piece consists of three sections. Each section consists of a series of ostinati. The second section is marked by a move down by an octave in the tessitura—the fourth through sixth ostinati in the live clarinet are exact transpositions down a major tenth of the first three. The third section is marked by an increase in density of the ostinati: each ostinato in the third section articulates between seven and ten onsets in a cycle, while the ostinati in the first two sections articulate 6 beats per cycle.

I argue that the segmentations into sections represented in Table 2 co-occur with shifts of the downbeat back to its original placement at 0, following a rotation to 8. These shifts, along with each ostinato's subset, are diagrammed in Figure 6. The downbeats are determined by two types of associational relations between subsets. The first is of **large intersection**: if a first ostinato's accented subset is associated with a particular downbeat placement, an ostinato whose subset shares a large intersection with the first subset suggests that the downbeat be established in the same place as in the same place as the original ostinato. The second is of **rotation**: if the subset of a new ostinato are related to those of an earlier ostinato by rotation, then association suggests that the downbeat will rotate the same amount from the downbeat in the original ostinato as the subset rotates. In the second column of Figure 6, the downbeat holds firm through a large-intersection subset. In the third column, the subsets are related to the first subset by a rotation by 8. In the first two sections, this causes a rotation of the downbeat by 8. However, when the rotated subset returns in the third section, at rehearsal 40, the downbeat does not rotate with it. This is due to the particulars of association, which are the focus of this analysis.

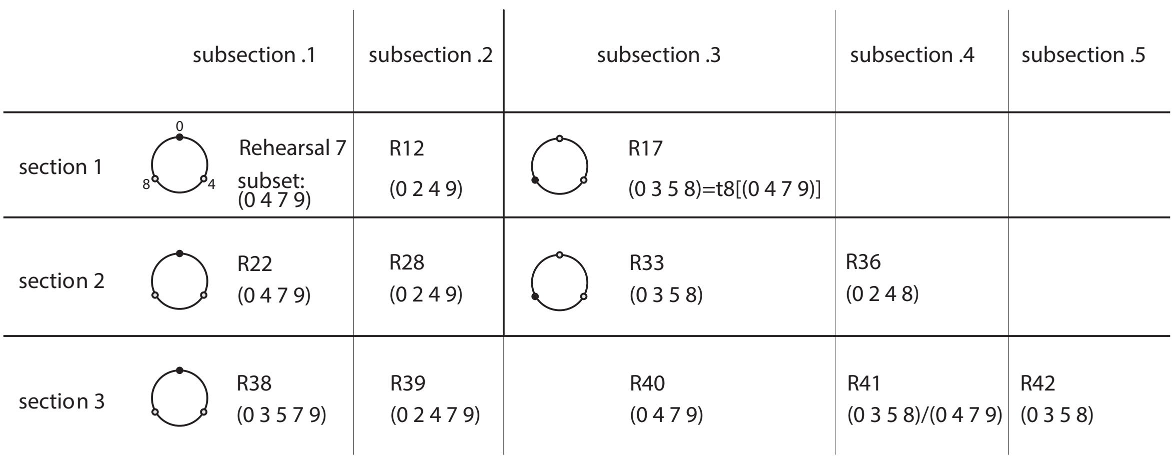


Figure 6: Form diagram of the piece. Each subsection is labeled in two ways: the rehearsal number (R#) at which its ostinato is fully stated, and the beat-class subset of its ostinato. The downbeat location is given as the filled-in circle in the three-element necklace, with the empty circles representing the other (non-downbeat) beats of the 4-unit pulse. Thick vertical lines indicate a downbeat shift.

I analyze the meter through the associational relations of subsets, rather than the associational relations of articulated sets, or than the direct induction from mapping phenomenal accents to metric accents. Roeder (2003) offers an analysis based on direct induction. He notices "beat-class modes" in the first movement of Steve Reich's *New York Counterpoint*, which are akin to my subsets of accented beats in an ostinato. In Roeder's analyis, the accented beats establish meters only directly, by accenting beats of slower pulses, which in turn induce a meter. In my analysis, I show that direct induction does not allow one to conclusively determine the meter in every case; in fact, Roeder's analysis ends after the first six ostinati.

The second alternative, following the association of the sets of articulated beats, similarly peters out after six ostinati, as the ostinati cease to articulate rotations of the same set of beat-classes. On the other hand, the accented subsets continue to be related to one another through rotation or high intersection throughout the piece. Thus, these accented subsets serve as rhythmic motives that induce meter through associations with one another.

3.2 Methodology

First, I establish some rules to determine which beats form the beat-class subset, i.e. which are accented. Next, I get from accented sets to the induced meter. I determine the first ostinato's meter directly, matching phenomenal accents to metric accents, as there are no prior ostinati with which the first can associate. I determine the meters of later ostinati associatively, following my claim that subsets with large intersection share a downbeat location, and a subset that is rotation of a first subset induces an equivalently rotated downbeat.

The following are my rules for selecting the beat-class subsets. In determining accented beats, I have two well-formedness rules and four preference rules, inspired by Lerdahl and Jackendoff (1983). The first well-formedness rule is that a beat must be articulated (meaning it has an onset) to be accented. The second well-formedness rule is that adjacent unit beats can not both be accented. The first preference rule (isolation) is for isolate notes, meaning notes whose adjacent beats are unarticulated. The second (build-up) is for notes that arrive earlier in the build-ups to the ostinati. All ostinati after the first until R36 are introduced bit by bit, with increasingly large subsets of the ostinato articulated until the full one arrives. Beats that are articulated earlier in this build-up feel more accented, as later ones seem like fillings-in of the structure first established.[4] A note appearing earlier in an ostinato which is not built up progressively can have a similar effect. The third preference rule (height) is for notes that are higher than their neighbors. On the clarinet,

4. This process is equivalent to diminution, as described in Breslauer (1988), as in the various recurrences of the first theme of the "Andante" from Beethoven's *5th Symphony*.

higher notes come out louder, and thus are accented. The fourth preference rule (likeness), operational only towards the end of the movement, is for accented beat sets to be more like rather than unlike the ones that have appeared before, as the listener searches for patterns in music. A more local form of this parallelism operates at R39, where I mark a beat as accented to ensure consistent treatment of a two-note pitch motive across a single ostinato.

3.3 First six ostinati: developing a rhythmic motive

3.3.1 Subsection 1.1

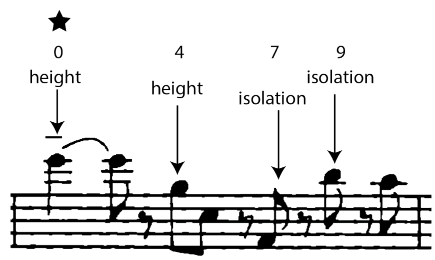
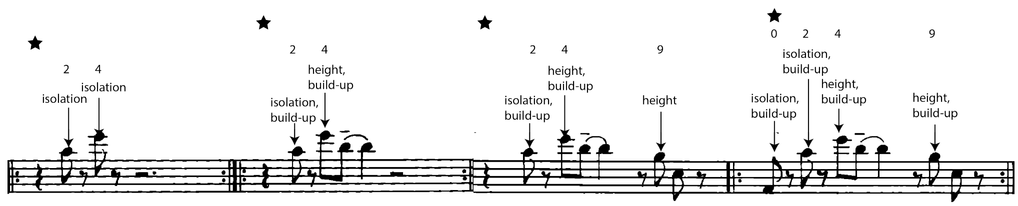


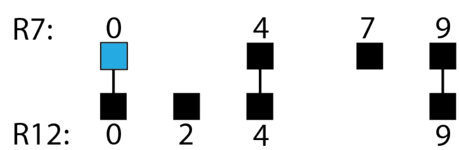
Figure 7: The first ostinato, with the accents labelled with the rule explaining them. The star is placed above the downbeat.

First, I directly determine the meter of the first ostinato, with which later ostinati associate. The first ostinato starts at R7 and accents beats (0 4 7 9) of the unit pulse in a twelve-unit cycle, where beat 0 is the first beat of the notated measure and the unit is the eighth note. The ostinato's exact repetition every twelve eighth notes establishes a twelve-unit, bar, or 𝅝. pulse. Each beat of this pulse constitutes a downbeat. The downbeat is established at 0 because 0 is an especially accented note. 0 is the ostinato's first note, its highest note, the only note marked tenuto, and the note with the most space after it before the next note. The 4-unit pulse is supported by the accenting of beats 0 and 4, two of its three beats. The 6-unit pulse, on the other hand, is weakened by the rest on beat 6, where its second beat would land. No two contiguous beats in the hypothetical 6-unit pulse are even articulated, while two contiguous 4-unit beats are accented. Thus, there are 12-unit, 4-unit, and unit pulses, with a downbeat at 0: the 2-unit pulse fills in the gap between 4 and the unit, establishing the meter ⟨12,4,2,1⟩ with downbeat placement at 0. The accented subset (0 4 7 9) is now associated with this meter.[5] The particularly important association is with the downbeat placement at 0; the downbeat is the only part of the meter to shift over the course of the piece.

3.3.2 Subsection 1.2



The next ostinato, at R12, accents beats (0 2 4 9). While R7 directly induces a downbeat at 0, R12 does not have any note that is accented to such an extreme degree, and thus does not directly induce a downbeat. Instead, association with the first ostinato's subset encourages parallel metricization. The accented subsets of R12 and R7 share three of four beats—this is an association of large intersection.



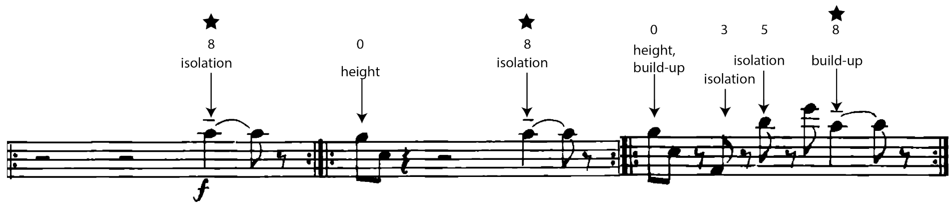
While the downbeat is not directly established in one particular location, the association with the accented subset of the first ostinato places the downbeat at 0.

The set of articulated beat-classes of R12 is an exact rotation by 5 of the set of articulated beat-classes of R7. However, I claim that the meter does not rotate through association with the rotated articulated beat-class set, instead holding steady with the highly-intersecting set of accented beat-classes. If the meter rotated following the rotation of the sets of articulated beats, the downbeat would move to 5, shifting every pulse but the unit. This would be quite a dramatic metric upheaval,

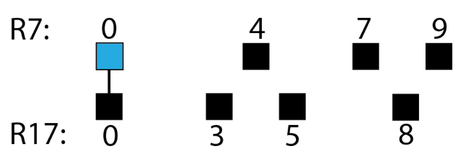
5. Notice that the last 𝅗𝅥 beat before the downbeat is "split," meaning the eighth notes immediately before and after are accented, while it is not. This is a helpful heuristic to follow throughout the piece in determining the downbeat.

especially given that the previous ostinato continues to be played by the prerecorded clarinets, which establish a certain degree of metric inertia. In contrast, the rotational relations between accented subsets, which begin in the next ostinato, only shift the 12-unit pulse, leaving the 4- and 2-unit pulses in place. This smaller shift is more able to overcome the inertia of the layered clarinets than is a simultaneous shift of the 2-, 4-, and 12-unit pulses.

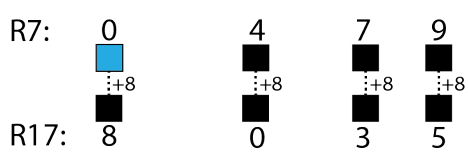
3.3.3 Subsection 1.3



The third ostinato, at R17, accents beats (0 3 5 8). Like the second ostinato, the third ostinato does not strongly establish a location for a downbeat—no one note is highest, longest, and tenuto-marked. Again, association between subsets does. Without accounting for rotation, it would appear that the subset of R17 is quite different from that of R7: the pair have an intersection of only one element.



On the other hand, R17's subset is an exact rotation by 8 beats of R7's subset.



The result is that the meter rotates by 8 beats, placing the downbeat on 8.[6] Two other factors favor the hearing of beat 8 as the downbeat in this ostinato. Firstly, beat 8 shares the tenuto mark and

6. The downbeat's move back by a 𝅗𝅥 is reminiscent of the shifts of the entries of pulsating eighth notes back by a 𝅗𝅥 in the introduction.

following space that distinguish beat 0 in the first ostinato, weakly supporting this new downbeat placement through direct induction. Secondly, the beat-class set in the third ostinato is also an exact rotation by 8 of that in the first ostinato. To the extent that the association between articulated sets induces meter, it here reinforces the metric shift of the association between accented subsets.

3.3.4 Subsections 2.1-2.3

The three first ostinati constitute a section of material, in which the downbeat shifts from 0 to 8. A second section follows as the tessitura of the clarinet drops. Its first three ostinati are pitch transpositions of the three ostinati in the first rotation down a major tenth. The relations between the subsets, and resulting metric trajectory, of these three ostinati are the same as those of the first three in Section 1 (Figure 8, Table 3).

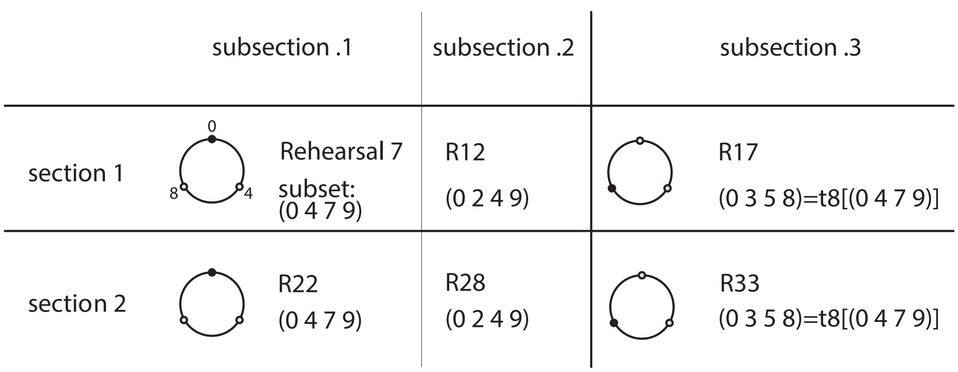
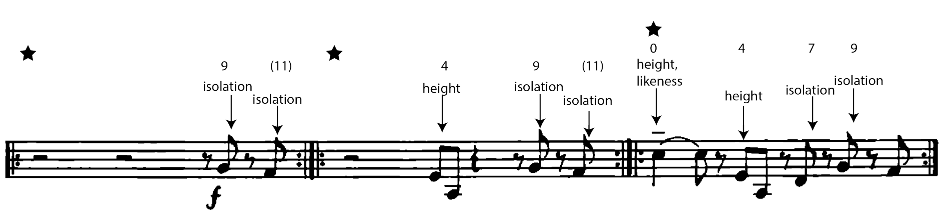


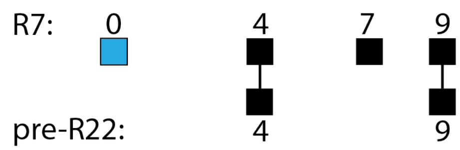
Figure 8: Diagram of the first six subsections, showing beat-class subsets and downbeat shifts.

Subsections		Beat-classes											
1.1	2.1	0				4			7		9		
1.2	2.2	0		2		4					9		
1.3	2.3	0			3		5			8			

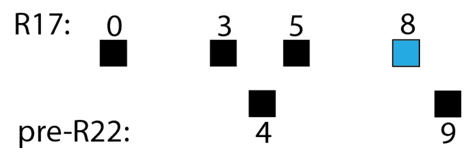
Table 3: First six ostinati, with beat-class subsets and downbeats. Blue-shaded cells are downbeats, while green-shaded cells are other beats of the 4-unit pulse.



In the build-up to R22 (above), the first ostinato of the second section, strong accents on 4 and 9 associate with the rhythmic motive (0 4 7 9).



Conversely, neither 4 nor 9 are in the accent pattern that established 8 as the downbeat at R17, weakening 8's downbeat claim as 0's is strengthened.



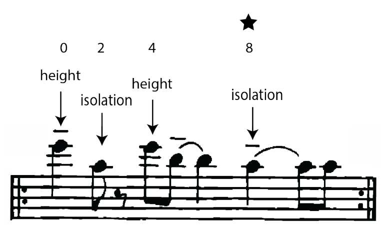
0 is established as a downbeat by the live clarinet leading up to R22 through association with R7 before it is even articulated. Association of subsets can induce a downbeat without it being least bit accented.

The first six ostinati constitute the majority of two sections, shifting the downbeat from 0 to 8, then back to 0, and back to 8 (Figure 8). This is done through the associations of three beat-class subsets, enumerated in Table 3. In associating with one another, these subsets develop a rhythmic motive, [0 4 7 9], that indicates the meter $\langle 12,4,2,1 \rangle$ with the downbeat on 0. The metric shifts are caused by rotations of the motive by 8, which in turn rotate the downbeat by 8. I have shown in these six ostinati that association induces a downbeat in cases where direct induction is not clear. I have also shown how the association between the articulated sets would create a not-smooth trajectory, which would conflict strongly with the piece's metric inertia.

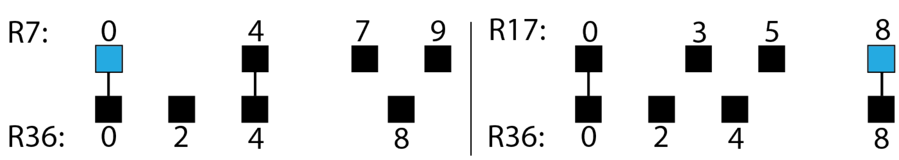
3.4 Later ostinati: applications to more distant material

Up to this point in the piece, in addition to the subsets' relations (by rotation or large intersection), the articulated beat-class sets are also related (by rotation). Later accented subsets continue to associate with the established rhythmic motive of [0 4 7 9] through rotation or large intersection, while the articulated sets become quite different. This is an application of Breslauer (1988)'s insight that sub-surface rhythmic motives tend to appear across different melodic material. It is also a strong argument for the association of subsets: while articulated sets stop associating after the first six ostinati, subset associations create a more comprehensive trajectory, stitching the entire movement together.

3.4.1 Subsection 2.4



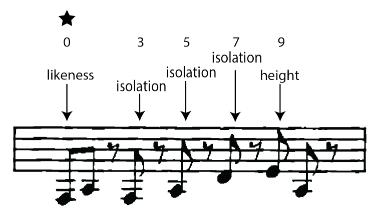
The next ostinato, at R36, is the first whose set of articulated beats is not an exact rotation of the first.[7] The four unit-pulse gap between onsets, which followed the downbeat in the first and third ostinati, is not present in this ostinato. R36's subset (0 2 4 8) is also new. (0 2 4 8) shares equally many elements with the sets of the first (R7) and third (R17) ostinati.



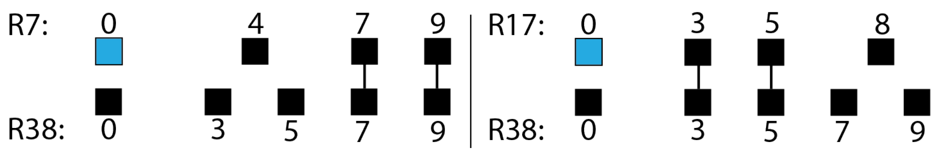
All three half-note beats are articulated strongly, thus directly articulating the 𝅗𝅥 pulse fully for the first time, equalizing the different candidates for downbeat placement under direct induction. This ambiguity allows the old downbeat placement at 8 to continue undisturbed. Associational and direct induction are inactive, so inertia triumphs.

7. It articulates beats (0 2 4 5 8 e), which has prime form [0 1 3 5 6 9], while the earlier ostinati articulated sets of beats with the prime form [0 1 3 5 7 8].

3.4.2 Subsection 3.1

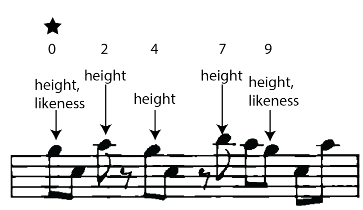


The next ostinato, at R38, accents beats (0 3 5 7 9).[8] The subset (0 3 5 7 9) shares three elements with the beat-class subsets of the first and third ostinati (R7 and R17, respectively), neutralizing their associative metric implications.



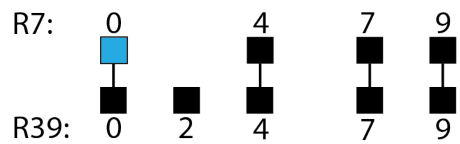
However, only one 𝅗𝅥 beat is articulated, and as such it is established as the bar pulse through direct metric induction in the absence of a clear associational force. The accenting of beats 3 and 5 in a context in which 0 is the downbeat creates a new association for the rest of the movement, no longer associating these accents exclusively with the beat 8 downbeat. Formally, the third section has begun, as the downbeat has returned to beat 0. This is also the first ostinato which has more than 6 onsets, beginning a new section in the manner indicated in Table 2 as well.

3.4.3 Subsection 3.2



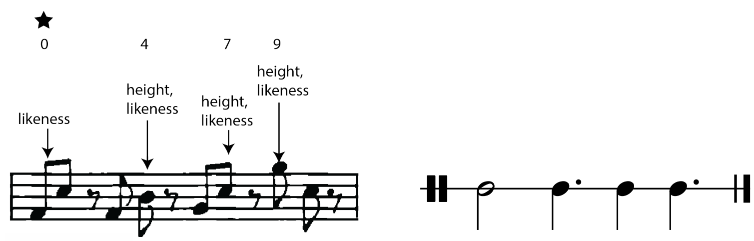
8. 0 is the lower of a pair of adjacent notes, but the inertia of having had an accent on 0 in each prior ostinato grants it an accent (likeness).

The following ostinato, at R39, accents beats (0 2 4 7 9).[9] R39's beat-class subset includes the first ostinato's subset.



As such, it maintains the meter of the first ostinato, which was re-established in R38, as discussed above. This ostinato, the second ostinato of the third rotation, performs a similar function to the second ostinati of the first two rotations. Its subset shares a large intersection with the first ostinato's, and thus the meter is maintained.

3.4.4 Subsection 3.3



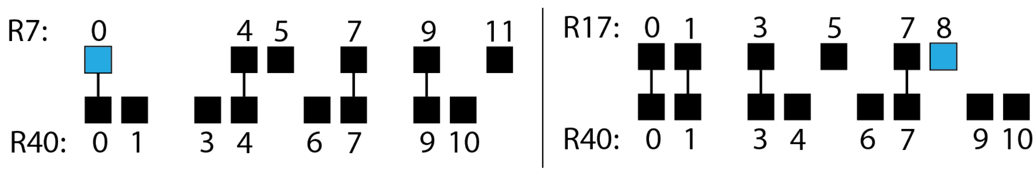
The ostinato at R40 returns to the subset (0 4 7 9).[10] This is the unrotated motive, the same as that of the first ostinato, establishing 0 as the downbeat. This is the third appearance of this subset. Thus, this ostinato which is new onto the surface is well-integrated into the existing associational network of the piece, and is strongly associated with its downbeat placement.

This ostinato is a good case with whch to demonstrate the value of accented subsets rather than articulated sets in determining metric associations: the articulated sets don't succeed in determining

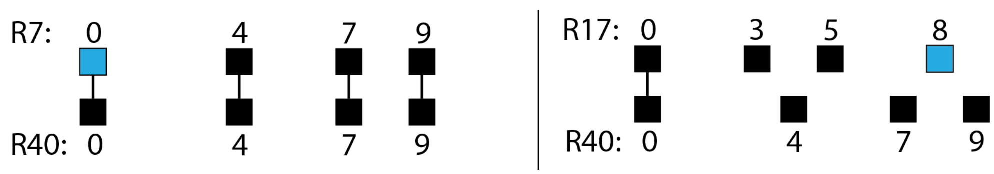
9. 8 and 11 are also higher than at least one adjacent note, and they conflict with accents on 0, 7, and 9 by well-formedness rule 2. 0 takes precedence over 11 because of the inertia of accenting 0 in every subset (likeness). 7 and 9 take precedence over 8 because 7 is highest, and the leap down after 9 is much bigger than the leap down following 8 (height). 9 also takes precedence because the same G-C (notated pitch) figure that occurs two other times in the cycle (0-1, 4-5) occurs on beats 9 and 10, each time with G accented (likeness).

10. Height argues for an accent on 1, but the inertial accent (likeness) on 0 precludes this by the the second well-formedness rule, which states that adjacent beats can not be accented.

associations with these later, more different ostinati. I claim that R40 associates with R7's meter, rather than R17's. R40's articulated set, (0 1 3 4 6 7 9 t), shares four elements with R7's set (0 4 5 7 9 e), and four elements with R17's set (0 1 3 5 7 8).

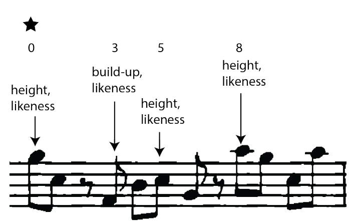


It's hard to determine which of these associations is stronger, as they're of equal cardinality. On the other hand, R40's subset (0 4 7 9) is identical to R7's (0 4 7 9), but only shares one element with R17's (0 3 5 8).



This example shows how associations between accented subsets connect ostinati whose articulated sets aren't particularly related.

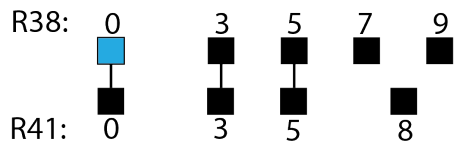
3.4.5 Subsections 3.4-3.5



R41 alternates R40's pattern with one that accents (0 3 5 8),[11] which is equivalent to the third ostinato's set of accented beats. This subset has thus far been associated with a downbeat on 8, so

11. Even though 3 is lower than 4, I mark 3 as accented as it arrives earlier than its adjacent notes in the ostinato (build-up), and because the frequency of the (0 3 5 8) accent pattern up to this point prepares the ear for this particular pattern (likeness).

its appearance in R40 might suggest a downbeat shift to 8. However, this shift is hindered by two factors. The first is the alternation of (0 3 5 8) and (0 4 7 9) every bar. It would be hard to shift between the meters that fast; the bar pulse would be stretched to 5 half notes and compressed to 1 over a 2-bar cycle. The second is the new association established by R38, in which the subset (0 3 5 7 9) placed the downbeat at 0. (0 3 5 8) shares a large intersection with (0 3 5 7 9), so this more recent association suggests that downbeat of R41 is at 0.



The inertial pressure of the rapid alternation with (0 4 7 9), in combination with the association with R38, keep the downbeat at 0 during the (0 3 5 8) subset. This creates a new association between the (0 3 5 8) subset and the downbeat placement at 0.

At R42, the ostinato with the subset (0 3 5 8) repeats on its own. After the alternations at R41, the new association between the accented subset and the downbeat on 0 keeps the downbeat in its place at 0. This accomplishes a metric resolution. The R17 ostinato's beat-class subset, the original instigator of metric movement, resolves here to the downbeat placement at 0. This is analogous to the tonal thematic closure at the end of a sonata, in which a secondary theme returns in the primary key area. Rather than a secondary theme returning in the tonic, here the rotation of the rhythmic motive is reinterpreted in the un-rotated motive's meter. The subset that first caused a metric shift in the piece now returns in the original downbeat placement.

3.5 Concluding thoughts

In my analysis, I demonstrate how a metric trajectory can be traced through the recurrence and rotation of a rhythmic motive in the form of a set of accented beats, as well as how the association of a subset of a motive creates a weaker, but still extant, association. Table 4 shows all of the beat-class subsets in the movement.

Subsections			Beat-classes											
1.1	2.1	3.3	0				4			7		9		
1.2	2.2		0		2		4					9		
1.3	2.3		0			3		5			8			
	2.4		0		2		4				8			
	3.1		0			3		5		7		9		
	3.2		0		2		4			7		9		
		3.4	0			3		5			8			

Table 4: Beat-class subsets ordered by appearance, with metric information overlayed. Blue indicates a downbeat, and green indicates a non-downbeat 𝅗𝅥 beat, as in Table 3.

3.4 is colored differently from 1.3 and 2.3 as it is re-metricized. One is able to see 3.4's relation with 3.1 by looking at the table's columns: three of its elements have already appeared in sets with the downbeat at 0. Also, the table's empty column at 6 (and lack of accents on 2 when 8 is the downbeat) explains the dominance of the 4-unit pulse. Referring back, the form diagram in Figure 6 shows the three sections of the piece. The third section does not include a downbeat shift, as the (0 3 5 8) subset bears a new association, which leaves the downbeat at 0.

In my analysis, I claim that the metric shifts primarily follow the associations between subsets of accented beat-classes, rather than sets of articulated beat-classes. I have presented two arguments for this already: first, that more of the movement's subsets of accented beat-classes are clearly connected; and second, that the subsets' relations generate smoother metric shifts. I will add a third: it is easier for me as a listener to follow the trajectory of the subsets, as they are of lower cardinality. Much as one imagines the harmonic trajectory of a piece as motion through lower-cardinality chords rather than higher-cardinality scales, I here prefer to follow these lower-cardinality subsets of accented beats rather than the higher-cardinality sets of articulated beats. Thus, accented subsets allow for a smoother, more comprehensive, and easier analysis of the piece than articulated sets do.

There are four key takeaways in this analysis worth highlighting. The first two come from the Brahms analysis as well, and are reinforced here; the second two are new in the Reich. The first is that rhythmic motives can serve to associate music that on its surface appears quite different, as occurs in the ostinati following the first six. This is equivalent to Breslauer (1988)'s insight that sub-surface rhythmic motives tend to appear across different melodic material. The second is that that associations change over the course of a piece. The (0 3 5 8) subset that was originally so strongly identified with the downbeat at 8 returns with the downbeat at 0, due to a new association brought about in another subsection. The third is that subsets of rhythmic motives (in the case of this analysis, subsets of subsets) can still associate. The subset at subsection 2.2 shares three of its four elements with the that of the opening ostinato, and this large intersection is able to associatively establish the downbeat at 0. The fourth is that, through association, a downbeat can be established without its even being articulated. In the build-up to R22, the accenting of beats 4 and 9 establishes the downbeat at 0, as neither of these beats are in the subset which establishes 8 as the downbeat and both are in the one that establishes 0. In these four ways, this analysis develops my concept of metric induction by association of rhythmic motives.

4 Rhythmic schemas in Soleá and Bulería

In this section, I analyze characteristic recordings of two styles of Flamenco music. Both styles represented in my analysis, Soleá and Bulería, have regular cycles of 12 counted beats. Both have paradigmatic elements which serve to define the style. These elements typically accent specific beats in the cycle, and in doing so suggest a downbeat placement in reference to those beats. These accentual elements induce meter through their associations across a repertory. I term these elements **rhythmic schemas**, as they are the style-general analogues of the piece-specific rhythmic motives. In both recordings, paradigmatic elements at times shift to new locations six beats away from their typical locations within the cycle. Such a shift creates pressure for the downbeat to shift by six beats, halfway around the cycle. In one case, this pressure causes a temporary dissonance: other paradigmatic elements retain their typical places, indicating that the downbeat has not moved, and the shifted element returns to its typical location within a few cycles. In the other case, all the other elements also rotate to suggest a downbeat 6 beats later, indicating that the pressure of the shifted element displaces the downbeat. This analysis of these two flamenco recordings extends indirect, associational metric induction to the style-general but element-specific rhythmic schema. I show how the displacement of a rhythmic schema can in one case create a temporary dissonance by suggesting a different downbeat than is projected by the other elements of the performance, and in another case overcome inertia and shift the downbeat.

4.1 The organization of time in flamenco

Flamenco music is organized into many different *palos*, or styles.[12] In many styles of Flamenco music, there is a regularly repeating rhythmic cycle that is counted out with an isochronous faster pulse. In the two styles represented in my analysis, Soleá and Bulería, there are twelve counted beats per rhythmic cycle. These beats are counted with the integers 1 to 12, starting from 12 or 1.

Each style has particular elements which serve to establish it: Jimenez de Cisneros Puig (2017) refers to these as the style's "paradigmatic" elements. Each of these elements accents certain beats in the cycle, serving as points of reference for performers and listeners to know where in the cycle they are. I refer to these elements as *accentual elements*. In addition to serving as points of reference themselves, accentual elements also suggest a downbeat in relation to their position. Soleá and Bulería share some accentual elements, and have others particular to each. The establishment of a single meter by several accentual elements, each marking different beats, recalls Gerstin (2017, p. 8, footnote 10)'s remark that "strongly contrasting [rhythmic patterns within a style] are performed and heard in relation to a common metric scheme."

One shared accentual element is the fingernail taps, or *golpe*, that the guitarists maintain throughout a performance. The fingernail taps can come from either set in Figure 9 or a combination of the two. While (1 2 3 7 8 9 10) is most typical in Soleá and (12 3 6 8 10) is most typical in Bulería, beats from each set are accented in both styles. In a single 12-beat cycle in Soleá or Bulerías,

12. The following description of flamenco styles is taken from Jimenez de Cisneros Puig (2017), Manuel (2006), Kai Narezo's YouTube videos, and other online resources, such as canteytoque.es.

the most critical beats, 3 and 10, will always be accented by the fingernail taps, while the other members of either set are interchangeable in either case. Typically, the accents on each group of six beats separated by vertical lines in Figure 9 stay together in a given cycle, but the situation can be more flexible (Narezo 2021a).

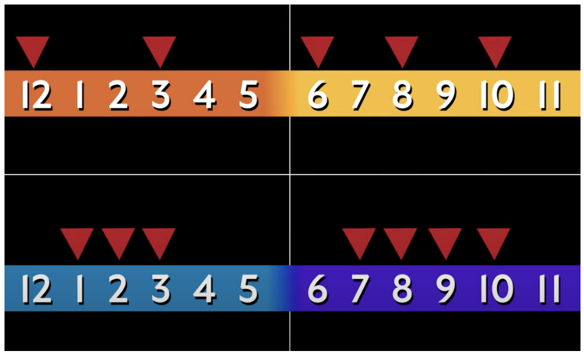


Figure 9: Screenshot from Kai Narezo's video "Four Elements of Bulería Compàs" at 3:10, showing the different elements of accent patterns for Bulería. In this video, Narezo shows how a performer can switch between these two accent patterns, as well as combine the first half of one with the second half of another.

Another accentual element shared between the two styles is the harmonic changes, outlined by the guitar. In Soleá and Bulería, there are typically new chords on beats 3 and 10. Beat 3 often marks the point of tension, the bII chord, while beat 10 marks the point of arrival, the I chord.

Standard harmony	12	1	2	3	4	5	6	7	8	9	10	11
Harmonic changes				bII							I	

Table 5: Typical harmonic changes in Soleá and Bulería. The beats accented by the chord changes are colored blue, while the downbeat projected is colored red.

In both recorded examples, even as the chords diverge from this simple pattern, new chords consistently arrive on beats 3 and 10. Thus, the harmonic changes continue to accent the set (3 10), even when the particular harmonies venture away from bII and I.

The following table shows the two accentual elements shared between Soleá and Bulería, along with the beats they accent. I will present accentual elements particular to each style in my analyses.

Accentual element	Beats accented
Fingernail taps	(12 3 6 8 10) or (1 2 3 7 8 9 10)
Standard harmonic changes	(3 10)

Table 6: The accentual elements shared between Soleá and Bulería, and their sets of accents.

As stated above, these accentual elements suggest a downbeat position by accenting certain beats in the cycle. I take 12 as the downbeat. However, nothing rides on this choice: the suggested rotation of the downbeat is equivalent to the rotation of the accentual element regardless of which downbeat is chosen. The interesting part is the way the downbeat does or does not shift, not its particular location.

The deep meter corroborates my choice of 12 as the downbeat. Figure 9 gives us a large set of accents from which to directly induce a meter. Jimenez de Cisneros Puig (2017, p. 12) tells us that the fingernail taps give us "the best window into the flamenco performer's viewpoint,"[13] and are thus a sensible place to look for a meter. The only intermediate isochronous pulse whose beats are accented is the 6-unit pulse, with beats at 12 and 6 in the top accent pattern in Figure 9. At the faster pulse level, a 3-unit pulse is accented between 12 and 6, and a 2-unit pulse is accented between beats 6 and 12. Jimenez de Cisneros Puig (2017) claims that this "horizontal hemiola," a 6/4 bar connected to a 3/2 bar with a quarter note unit pulse, is itself the the pulse level between the unit and 6-unit pulses. The resulting meter of $\langle 12,6,3/2,1 \rangle$ is mostly well-formed, with only one ambiguous pulse-level, and the seesawing horizontal hemiola effect harmonizes with my personal experience in playing and listening to this music.

13. Actually, Jimenez de Cisneros Puig (2017) says that the strumming patterns give the best window into the performer's viewpoint, and that the strumming patterns are based on the fingernail taps. I think my formulation is equivalent.

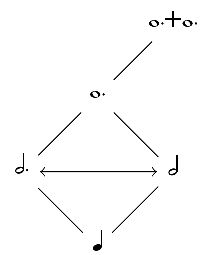


Figure 10: Ski-hill diagram of the metric space of Soleá and Bulería, with the quarter note as counted pulse.

Beats 12 and 6 become candidates for the downbeat, as the two elements of the next-slowest, 6-unit pulse. I claim that 12 is the downbeat of the cycle, as it is closer to the launch point of vocal phrases than is 6. I will thus assume 12 to be the downbeat, or orienting point, in my analyses. As a result, all of the accentual elements in their typical locations in the cycle suggest a downbeat at 12.

Each accentual element marks a particular location in the cycle, orienting the listener towards a downbeat that is in a particular relation to it. The downbeat suggestions created by these accentual elements are comparable to metric preference rules: if they all concord and suggest the downbeat in the same place, then that beat is the downbeat. If they suggest different downbeats, with one accentual element in its original location and another rotated by 6 elements, there is metric dissonance, and the downbeat location is ambiguous. In both recordings I analyze, certain accentual elements are rotated by 6, suggesting a downbeat shift by 6. In the Soleá, other elements hold their original place, and the shifted elements soon shift back. In the Bulería, the downbeat shifts as suggested by certain rotated elements, causing the other accentual elements to rotate as well.

The difference between these accentual elements and most metric preference rules, however, is that accentual elements do not suggest the downbeat placement through extraordinary direct overmarking. Instead, accentual elements suggest the downbeat placement through indirect association with the typical location in the cycle of the element's accents. For example, the harmonic changes, which accent beats 3 and 10, suggest a downbeat on 12, which the harmonic changes do not accent. If the harmonic changes were to accent beats 4 and 9, they would suggest a downbeat on 6, as (4

9) is a rotation by 6 of (3 10), and not because 6 is newly accented.

I have made the following claims which are critical to my analysis. The first is that there are several accentual elements in each style of flamenco, each of which marks certain beats in the cycle. The second is that the accentual elements in their typical rotations suggest a downbeat at 12. The third is that these accentual elements can concord, strongly projecting the downbeat in their agreed-upon beat, or compete, creating metric ambiguity. We will see how these accentual elements work together and against one another to create metric trajectories in flamenco music. It is important to note that the organization of time in flamenco is very strict: it is a cardinal sin of the music to be "out of compás," or out of the time-feel of the other musicians. As colorfully put by the blog Fascinating Flamenco, "If you don't realise that you are out of compás, you might as well give up your flamenco career." However, as the blog author points out, the problem is more specifically being out of time without *realizing* it. Contra-metric dissonance is expected, so long as it is controlled and intentional. Shifts of rhythmic schemas are either quickly reversed or quickly subsumed, allowing a single meter to remain dominant for most of the performance.

4.2 Metric dissonance without a shift: "A quién le contaré yo"

I will now proceed through an analysis of a Soleá, "A quién le contaré yo," showing how rotations of the accentual elements around the cycle shift, or don't shift, the downbeat.

4.2.1 Soleá-specific accentual elements

I have already described several characteristics of Soleá, the style Jimenez de Cisneros Puig (2017, p. 12) refers to as "the most paradigmatic genre of flamenco," in the introduction: in particular, I gave the metric structure and two accentual elements that are shared with Bulería. Before discussing the piece, I will present three accentual elements particular to Soleá. The first is a guitar lick that I refer to as the *turnaround* figure. Its low bass note lands on beat 10, thus projecting a downbeat two beats later, at beat 12.

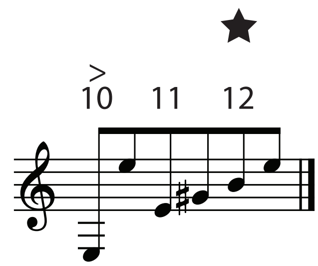


Figure 11: Turnaround figure. The quarter note takes the counted beat, as enumerated above the staff. The accent indicates the accent created by this figure, while the star indicates the downbeat placement this figure projects.

Another accentual element particular to Soleá is a secondary pattern of harmonic changes that frequently occurs in the style, in particular during the instrumental breaks between sung verses. This is often referred to as the *escobilla* pattern, and it accents beats (1 4 7 10) with harmonic changes (Narezo 2021b). 10 is still the locus of a harmonic arrival, arriving at I, while beat 3 no longer receives a new chord.

Escobilla	12	1	2	3	4	5	6	7	8	9	10	11
1st version		bII			bVI			bII			I	
2nd version		iv			bVI			bII			I	

Table 7: Accents caused by harmonic changes in the *escobilla* pattern in Soleá.

Manuel (2006)'s transcription of the Soleá "A quién le contaré yo" places dashed bar lines on beats 1, 4, 7, and 10, giving primacy to the *escobilla* rhythm over the other accentual elements in directly determining the meter. However, I see this as a secondary set of accents for three reasons. Firstly, it occurs only occasionally, on some of the guitar interludes and never while there is singing. Secondly, even while it occurs, the fingernail taps remain on the typical beats, indicating that the previous metric structure remains under the *escobilla*. Third, three of its accents, beats 1, 4 and 7, are rarely accented by other accentual elements in Soleá. Accordingly, I keep the downbeat at 12 and metricize according to Figure 10.

The final accentual element is the vocal launch point. In the recording I analyze, most phrases start on beat 1, suggesting a downbeat a beat earlier. The following table lists the accentual elements in

Soleá, along with what beats they accent.

Accentual element	Beats accented
Fingernail taps	(0 3 6 8 10) or (1 2 3 7 8 9 10)
Standard harmonic changes	(3 10)
Turnaround figure	(10)
Escobilla harmonic changes	(1 4 7 10)
Vocal launch point	(1)

Table 8: The accentual elements in Soleá.

This clip shows two versions of the typical feel: it is worth listening several times to get acquainted with the feel outside of the context of an example from the repertoire. This clip allows us to get acquainted with the relationship between the downbeat at 12 and two accentual elements, namely the standard harmonic changes shown in Table 5 and the turnaround in Figure 11. This clip shows two versions of the *escobilla* feel from Table 7. This shows the role of this accentual element, as well as how the turnaround figure fits in with this alternate harmonic pattern. In both of these clips, the fingernail taps are not on the correct beats, and there are no vocal phrases launching, so neither of these two accentual elements (fingernail taps or launch point) can be learned from these clips. However, building up some familiarity with the other three elements will make it easier to hear them in the context of the recording.

4.2.2 "A quién le contaré yo" analysis

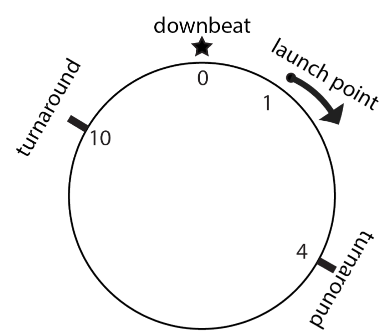
I analyse the performance of "A quién le contaré yo" (1962) by singer Juan Talega and guitarist Eduardo el de la Malena that appears on the album *Archivo del Cante Flamenco*. This song is in the Soleá style (Manuel 2006, p. 16).[14]

The form of "A quién le contaré yo" is delineated in the above table. There are 4 sections, each including several sung phrases that are primarily 2 cycles long.[15] The phrases are grouped into sections and letters (A vs. B) by rhyme scheme (Manuel 2006) and melodic content. There are

14. A version with a visualized 12-beat compás can be found here.
15. As indicated in the form diagram, two of Talega's phrases last three cycles, but the rest last two.

Section	Phrases and guitar breaks							
1 (0:52)	A (2 cycles)		A (2)	break (.5)	B (2)	break (.5)	B (2)	break (2)
2 (1:53)	A (3)	break (2)						
3 (2:18)	A (2)	break (1)	A (2)	break (.5)	B (2)	break (2.5)		
4 (3:14)	A (2)	break (1)	A (2)	break (.5)	B (3)	break (.5)		
Coda (3:38)	A (2)							

guitar breaks between the phrases in each section, as well as between the sections. There are two primary types of guitar breaks. One is the *escobilla*, with harmonic changes accenting beats as described in Table 7. The other I call the *double turnaround figure*.[16] The double turnaround lasts a whole cycle, and has two turnarounds in it, accenting beats 4 and 10, respectively. The turnaround accenting beat 4 is a rotation by 6 beats of the typical turnaround, and thus projects a downbeat on 6. However, the double turnaround figure as a whole does not strongly suggest a downbeat shift, as the rotated turnaround's downbeat suggestion of beat 6 is immediately countered by the unrotated turnaround's downbeat suggestion of beat 12. Additionally, after the double turnarounds, the vocal phrase starts at its typical launch point, 1, which also suggests a downbeat at 12. The downbeat thus remains at 12 through the double turnaround figure.

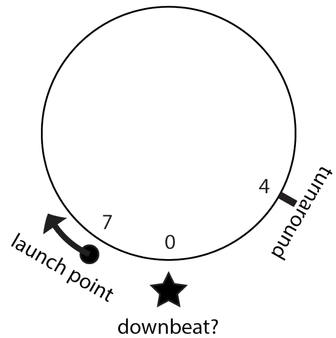


After this double turnaround is introduced, there are guitar breaks between sung lines that last only six beats, and consist of only a single turnaround. The first single turnaround guitar break[17] accents beat 4 with the turnaround figure. The singer then launches his next line on beat 7. A turnaround accent on 4 and a launch point on 7 both suggest a downbeat on 6: now, two accentual elements

16. The double turnaround can be first heard at 1:03, in this clip. The turnaround figure is not articulated especially clearly on beat 10 in this clip, but the strong arrival of the I chord on beat 10 associates with the turnaround figure, and the expectation of that figure on that beat primes me to hear what the guitarist plays as a version of the figure.

17. This can be heard at 1:18, in this clip.

have rotated to suggest a downbeat shift to 6.

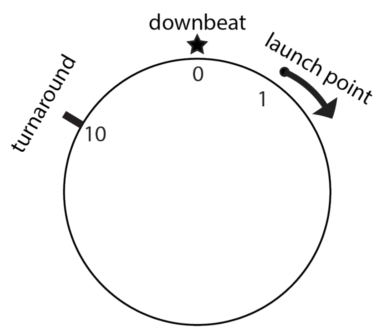


At this point, two elements (the turnaround and the launch point) suggest a downbeat 6 beats removed from the original one. There are two possible metric interpretations: either we maintain the earlier downbeat due to inertia and the new placement of the accentual elements is a temporary dissonance against them, or the shifted elements' metric potential is realized and the downbeat shifts by 6. Table 9 indicates how the downbeat would shift in the second scenario.

Cycles	12	1	2	3	4	5	6	7	8	9	10	11
1st		L										
2nd											T	
3rd					T			L				

Table 9: Possible downbeat displacements in the first section of "A quién le contaré yo." This table covers from the second A phrase to the second B phrase in the 1st section. Red cells indicate a downbeat placement, and blue indicate an accented beat. L indicates that the accent comes from a launch point, projecting the downbeat 1 beat before it. T indicates that the accent comes from a turnaround, projecting the downbeat 2 beats after it.

However, two factors suggest that these shifts create temporary metric dissonance rather than a more permanent metric modulation. The first is that another accentual element, the fingernail taps, remains in its standard position. In the first 1-turnaround guitar break, while the turnaround places the accent on beat 4, there are fingernail taps on beats (1 2 3 6 8 10), a union of the bottom left and top right parts of the accent set in Figure 9. This set of accents is very expected for a downbeat location at 12, while a rotation by 6 to (12 2 4 7 8 9) doesn't accent 3 or 10, the two most crucial beats for the fingernail taps to accent. The second is that both accentual elements that suggest a shift are restored to their original location within two cycles of their displacement. Following the single-turnaround guitar break in the first section[18], the singer (Talega) sings a phrase that lasts two cycles, after which the guitarist plays another single-turnaround break that accents beat 10. After this, the singer sings another phrase starting on 1, returning to the turnaround-launch point pair that establishes the downbeat at 12.



This same rhythmic trajectory occurs two more times over the course of the piece, in the third and fourth sections. In each case, the displacement is maintained for one vocal phrase, after which the turnaround returns to its original location and the music continues with 12 as downbeat. The displaced vocal phrases are always accompanied by fingernail taps suggesting the non-displaced downbeat at 12, indicating that the downbeat is not fully shifted. In the third verse, rather than following the single-turnaround guitar break accenting beat 10 with another vocal phrase to establish a launch point, an *escobilla* guitar break starts in the next cycle, accenting beats (1 4 7 10) with harmonic changes. While the set of accents in *escobilla* is invariant under rotation by 6, the particular harmonies on each beat are different from one another. The iv chord that arrives on the subsequent beat 1 serves the same function as an accentual element as the vocal launch point does: it indicates 12 as the downbeat with an accent on 1 that would not typically occur on beat 7, corroborating the downbeat projections of the turnaround and the fingernail taps.

This performance of Soleá allows metric dissonance that does not cause permanent modulation. Non-modulation seems to be a hard rule in Soleá; while I have not completed anything like a

18. This occurs at 1:31, in this clip

corpus study, online discussion forums agree that the true offsetting of the cycle by six beats, as is discussed in Bulería below, occurs rarely if ever in Soleá.[19]

4.3 Accentual elements shift the downbeat: "Gitana te quiero"

In Bulería, rhythmic schemas in unexpected places can cause permanent metric shifts, rather than temporary dissonance, as discussed above in the case of Soleá. Narezo (2018) explains how this works: typically, the second six beats of the 12-beat compás cycle repeat without the first beat, displacing the 12-beat pulse by six beats. Kliman (2020) lists hundreds of examples of "half-compás," in which the second six beats of the cycle are repeated in Bulería por Soléa (a slightly slower version of Bulería), as Narezo describes. In this piece, accentual elements are rotated by 6 beats, and thus shift the downbeat by 6. However, it is not as simple as the second six beats of a cycle repeating: the different accentual elements shift at different points over the course of a cycle and a half before ending up with the same downbeat. I will show how this occurs in Camarón de la Isla's performance of "Gitana te Quiero,"[20] accompanied by guitarists Paco de Lucia and Tomatito.

4.3.1 Accentual elements particular to Bulería

I will first present a pair of accentual elements particular to Bulería that will aid me in my analysis. The first is a vocal launch point on 12, rather than on beat 1 as in Soleá (Narezo 2018). This suggests a downbeat on 12, the beat the element itself is accenting.

The second accentual element is a hand clapping pattern, in particular a pattern of accented claps. Jimenez de Cisneros Puig (2017) notices characteristic sets of accented hand claps in his analyses of various styles of flamenco, though the pattern in the recording I am analyzing is different from the one he presents as most canonical for Bulería. In "Gitana te quiero," there are claps on every unit beat, and there are stronger hand claps on (12 3 6 8 10). As with the other elements, this set

19. See this post for a discussion of displacement in Soleá.
20. This recording is available on the album *Integral*, and was originally recorded on the album *Como el Agua*.

indicates a downbeat on 12. The accented claps take the place of the fingernail tapping pattern in Soleá, performing a similar percussive role and accenting a similar set—the set of accented hand claps is one possible version of the set of fingernail taps described in Figure 9.[21] Additionally, I find it difficult to make out any fingernail taps in the recording I analyze.

The following table summarizes the accentual elements in Bulería.[22]

Accentual element	Beats accented
Accented hand claps	(12 3 6 8 10)
Standard harmonic changes	(3 10)
Vocal launch point	(12)

Table 10: The accentual elements in Bulería.

4.3.2 Analysis of "Gitana te quiero"

I now analyze Camarón de la Isla's rendition of "Gitana te quiero" (1981).[23] The form is summarized in the below table.

Subsections	.1	.2	.3	.4	.5
Section 1	**A** ("Gitana te quiero")	**A'** ("Eres la mujer")	**B** ("En el alba")	**A** ("Gitana te quiero")	
Section 2	**A'** ("Tengo que decirte")	**A** ("Gitana te quiero")	**B** ("Que sin ti")	**A** ("Gitana te quiero")	**A** ("Gitana te quiero")

The two sections are separated by a 10-cycle guitar interlude. The sections consist of 4-5 concatenated subsections of length between 3 and 7.5 cycles. Subsections are separated most prominently by harmonic closing: each subsection ends on a I chord, which never arrives before beat 10 of the subsection's last cycle. Subsections are also occasionally separated by three-cycle guitar interludes.

21. In particular, it is the set said to be more common in Bulería.

22. I omit the strumming pattern, which certainly creates orienting accents throughout the cycle, for the two reasons. First, the strumming pattern accents the same set of beats, (3 10), as the harmonic changes, and at the points most critical to my analysis, accented strums co-occur with harmonic changes, making the strums' accents redundant analytically. Second, it is not easy for me to establish an objective basis on which to claim which strums are the more accented ones. The harmonic changes are comparatively easy to tease out, as I can hear the sounding pitches change.

23. The recording is available here.

Each **A** phrase is four 12-unit cycles long, has the same vocal melody and text, and has the following harmonic progression:

Cycle	12	1	2	3	4	5	6	7	8	9	10	11
1st	I			bVI							bII	
2nd				bVII							bIII	
3rd				bVI							bII	
4th											I	

A' phrases differ in text, though they are all three cycles long, have relatively similar melodies (to each other and to **A**), and have the following harmonic progression:

Cycle	12	1	2	3	4	5	6	7	8	9	10	11
1st	I			bII							bIII	
2nd				bVI							bII	
3rd											I	

The harmonic scheme of **A'** is a variation of **A**. The first cycle in **A'** gets to the bIII harmony, which arrives at the end of the second cycle in **A**, and the second and third cycles of **A'** correspond to the third and fourth cycles of **A**.

In **A'**, just as in **A**, harmonic changes only occur on beats 3 and 10, serving to accent those beats. The harmonic accentual element is thus quite strong, even though the harmonies themselves are not especially repetitive. The **A** and **A'** phrases also share the accented hand claps and vocal launch point described in Table 10, establishing the downbeat at 12 in these three ways.

The two **B** phrases share a general harmonic outline with **A** and **A'**, and share a melody with each other, but are of different lengths. Each **B** phrase lasts a non-integer number of cycles: the first lasts 7.5 cycles, and the second lasts 5.5. In both cases, this is caused by a downbeat shift by 6. This downbeat shift is caused by accentual elements rotating by 6, much as in "A quién le contaré yo." The difference in this performance, however, is that all of the accentual elements follow, shifting the downbeat to that suggested by the first shifted elements.

I will discuss the two **B** subsections in order.

4.3.3 First B

The first **B**, starting at 1:13 in the recording, lasts 7.5 cycles. The launch point of the first line is at beat 12, suggesting a downbeat placement at 12, supported by harmonic changes and accented claps. However, the launch point of the second line is around beat 6, which suggests a downbeat at 6. The harmonic changes in the first three cycles are the following:

Cycle	12	1	2	3	4	5	6	7	8	9	10	11
1st cycle	I			bVI							bII	
2nd cycle											bVII	
3rd cycle					bIII					bVI		

The third cycle has new harmonies on beats 4 and 9. This creates difficulties with the regular expectation of accents from the harmonies. Beats 4 and 9 are not included in the set (3 10) typical of harmonic changes. However, (4 9) is a rotation by 6 of (3 10), and as such projects a downbeat on 6, in accordance with the launch point. If the third cycle starts at 6 rather than 12, the accent that first seemed to be on 4 ends up on 10, and the 9 ends up on 4.

Cycle	12	1	2	3	4	5	6	7	8	9	10	11
1st	I			bVI							bII	
2nd											bVII	
3rd											bIII	
4th				bVI								

In this **B** section, the launch point drives the metric shift. The launch point suggests a downbeat on 6 in the second cycle, but the new harmony on beat 10 of the second cycle suggests that the guitarists are still hearing the downbeat 2 beats later; it is not until the arrival of bIII six beats later that it is clear that the guitarist has followed the metric shift of the singer.

Up to this point, the case is analogous to that of Soleá. One accentual element suggests a downbeat rotated by 6, and another follows. However, there are two differences that cause this case to be a metric shift rather than merely a dissonance. The first is that the third accentual element, the hand claps, catch onto this new downbeat. While in the Soleá, the fingernail taps maintained their regular patterns through the displaced phrase, in this section the clapping accents shift meter right with the guitarists. They do this by accenting the second half of the pattern (12 3 6 8 10) twice in a row, creating an equivalent half-cycle to that depicted in the above table.

The second is that these changes are made permanent. The launch points of later lines occur at intervals of 12 beats after the launch point of the second line, six beats away from the original downbeat. The hand-clapping patterns continue in the rotation that suggests this shifted downbeat. And the remaining harmonic changes in the section all arrive on 3 or 10 with respect to this shifted downbeat, with the final harmonic resolution to I arriving two beats prior to this shifted downbeat, as it is paradigmatically supposed to.

Cycle	12	1	2	3	4	5	6	7	8	9	10	11
1st (“En el alba”)	I			bVI							bII	
2nd (“Por la noche”)											bVII	
3rd											bIII	
4th (“Porque pienso”)				bVI								
5th (“Las estrellas”)				bII								
6th (“Y yo siento”)												
7th (“Y de la luna”)												
8th (“Y de la luna”)											I	

Table 11: Harmonic changes in the first **B**.

This preponderance of factors indicates that there is a true downbeat shift. The change is not felt as a local dissonance: it changed the orienting point of the musicians. In the subsections between this **B** and the next one, including the 10-cycle guitar interlude, all accentual elements place the downbeat in its shifted location.

4.3.4 Second B

The second **B**, which starts at 2:45, also has a non-integer number of cycles, caused by a rotation by 6 of the 12-unit pulse.

Like in the first B, the shift comes in the second sung line, with the singer waiting an extra 6 beats before entering. However, in this case, the guitarists match, rather than trail, the singer’s rotation. If the harmonic changes were heard with an unshifting 12-beat, they would be the following:

Cycle	12	1	2	3	4	5	6	7	8	9	10	11
1st	I			bVI							bII	
2nd										bVII		
3rd					bIII					bVI		

Again, accents on beats 4 and 9 of cycles alert us that we are "out of compás." This time, however, the disruption occurs earlier on, with the bVII chord on what first appears to be beat 9 of the second cycle voiding the upcoming 12 beat of its status. The launch point on 6, which suggests a downbeat on 6, is immediately supported in its downbeat claim by the harmonic change three beats later.

Cycle	12	1	2	3	4	5	6	7	8	9	10	11
1st	I			bVI							bII	
2nd												
3rd				bVII							bIII	

The accented claps follow the same pattern as in the first **B**, repeating the first half of the pattern twice. As in the first **B**, the harmonic changes, accented claps, and launch point are in relation to this shifted downbeat for the rest of the subsection, as well as for the rest of the recording.

Cycle	12	1	2	3	4	5	6	7	8	9	10	11
1st cycle ("Que sin ti")	I			bVI							bII	
2nd												
3rd ("Que no para")				bVII							bIII	
4th ("Viviré siempre")				bVI							bVI	
5th ("Te amaré")				bVI							bII	
6th ("Y moriré")				bII							I	

Table 12: Harmonic changes in the second **B**.

Like the first **B** section, the second **B** section causes a metric shift that lasts as a modulation, rather than acting as a temporary dissonance. The difference is that the harmonic element rotates so as to concord with the first shifted downbeat suggested by the launch point, rather than catching up to it to suggest the next one 12 beats later.

4.3.5 Conclusion

The two **B** sections of "Gitana te quiero" demonstrate how downbeat shifts occur in Bulería. In the first **B**, the guitarists react to the vocalist's late launch point, adjusting their harmonic changes six beats after the launch point to align with the singer's shifted downbeat. In the second **B**, the guitarists shift their harmonic change immediately after the vocalist's late launch point, supporting the downbeat claim of the beat suggested by the late launch point. This pair of examples shows how the various accentual elements characteristic of Bulería can be manipulated to shift the downbeat.[24] These accentual elements are strongly associated with a downbeat on 12 through a large repertory of music, which the involved performers have presumably danced to, played with, sung and studied for much of their lives. As such, slight shifts in accents can change the meter with a moment's notice, keeping the large group of guitarists, dancers, and percussionists aligned with one another through flights of fancy in this highly rhythmically structured music.

4.4 Analytical takeaways

My analysis of flamenco shows metric induction, in particular the shifting of the downbeat, through the association of rhythmic schemas. These schemas are equivalent to the rhythmic motives in my analyses of Brahms and Reich, except that they are established over a style as a whole rather than a piece in particular. Such schemas don't require as much build-up within a single piece. Because these accentual elements are culturally established, the elements' positions in the 12-beat cycle create metric pressure due to outside context, rather than associations within the individual performance. This is a key difference from rhythmic motives, which need to be clearly established in the given piece and build associative strength through repeated appearances.

In addition to being genre-wide rather than piece-specific, the schemas in flamenco are specific to certain accentual elements, denoting how certain beats are accented rather than just which beats are

24. As discussed in the introduction, these downbeat shifts are described as the repetition of the second half of the cycle (Kliman 2020). As is clear from my analysis, I find this somewhat reductive: in some elements, it is the first half that repeats, or in the case of the launch point, is delayed by 6 beats.

accented. The two styles of flamenco music I discuss have not just one but several characteristic sets of accents, each defined by a particular element. Metric induction is suggested by the shifting of several individual sets of accents, rather than by the shifting of any one set.

Another takeaway is that metric shifts don't necessarily have to be resolved in any particular way. When the downbeat shifts in Bulería, there is no expectation that it will shift back; the fact that it does in "Gitana te quiero" is more an artifact of where the recording was stopped than it is about large scale form in the piece. This suggests an analogue of a characteristic of harmonic modulations in popular music: often, harmonic modulations in popular music merely bring "a new home," serving as a dash of added excitement in the transition but not resulting in any lasting tension from the expectation of return.[25]

5 Return to Brahms: Same motive, different pulse level

I will now return to the first movement of Brahms op. 111 to show another feature of rhythmic motives: co-occurrence at multiple metric levels. In Section 2, I followed the [0 1] motive at the minimal meter ⟨bar,♩.⟩. Here, I show that the motive also occurs at a faster minimal meter of ⟨♩.,♪⟩. The motive follows a very similar trajectory at this faster meter, except with the S2 theme containing the rotated motive rather than the S1 theme. The following table outlines this trajectory:

Section	Motive:notated downbeat	Perceived downbeat:notated	Perceived downbeat:motive
Exp. P	LS	unshifted	L
Exp. S1	LS	unshifted	L
Exp. S2	SL	shifted	L
Dev.	SL	unshifted	S
Recap P	LS	unshifted	L
Exp. S1	LS	unshifted	L
Recap S2	SL	unshifted	S

Table 13: Trajectory of the [0 1] motive in the ⟨♩.,♪⟩ minimal meter in Brahms op. 111.1

25. Thanks to Nate Adam for this insight on popular music modulations.

5.1 Exposition

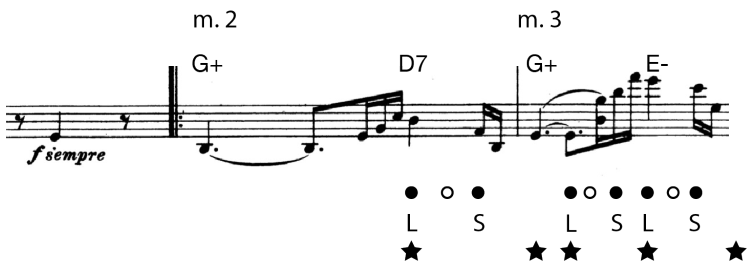


Figure 12: P theme (mm. 2-3), with the [01] motive annotated at the faster ⟨♩.,♪⟩ minimal meter.

The P theme indicates a LS rotation of the [01] motive with respect to the notated meter. By Povel-Essens and the harmonic changes on the notated dotted quarter pulse, the perceived dotted quarter pulse is identical with the notated one. As such, L has the slower pulse, which is the normal metric state.

Figure 13: S1 theme (mm. 38-39), with the [01] motive annotated at the faster ⟨♩.,♪⟩ minimal meter.

The S1 theme indicates an LS rotation of the [01] motive with respect to the notated meter, even more completely than the P theme. By association with the P theme, Povel-Essens, and the cello's articulation of two beats of the notated dotted quarter pulse, the perceived dotted quarter pulse is identical with the notated one. The motive's normal metric state remains: L keeps the slower pulse.

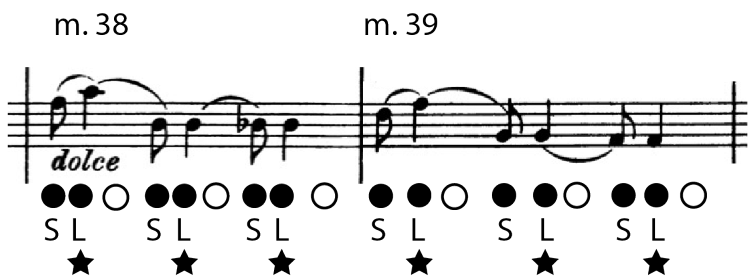


Figure 14: S2 theme in the second violin (mm. 38-39).

In the second secondary (S2) theme, the [0 1] motive is rotated to SL with respect to the notated dotted quarter pulse. Due to association with the primary and S1 themes and the Povel-Essens principle, this causes the perceived dotted quarter pulse to shift away from the notated pulse by an eighth. This shift, like at the slower minimal meter, comes with a dominant tonality theme. The normal metric state, in which L has the slower pulse, is maintained throughout the exposition.

5.2 Re-metricization in the development and recapitulation

A re-metricization of the motive at the eighth note pulse level occurs in the development at mm. 74-78, right before the first elided recapitulation (at m. 79). The cello articulates the first and second eighth note of each dotted quarter, which is SL with respect to the notated dotted quarter pulse. Association and the Povel-Essens principle suggest a dotted quarter pulse on the second of each pair of adjacent eighths. However, direct induction, through harmonic changes and the entries of new instruments on the first of each pair of eighth, triumphs. The perceived dotted quarter pulse thus aligns with the notated dotted quarter pulse. The S element carries the slower pulse, shifting away from the motive's previous metric state, and weakening the association of the L element with the slower pulse.

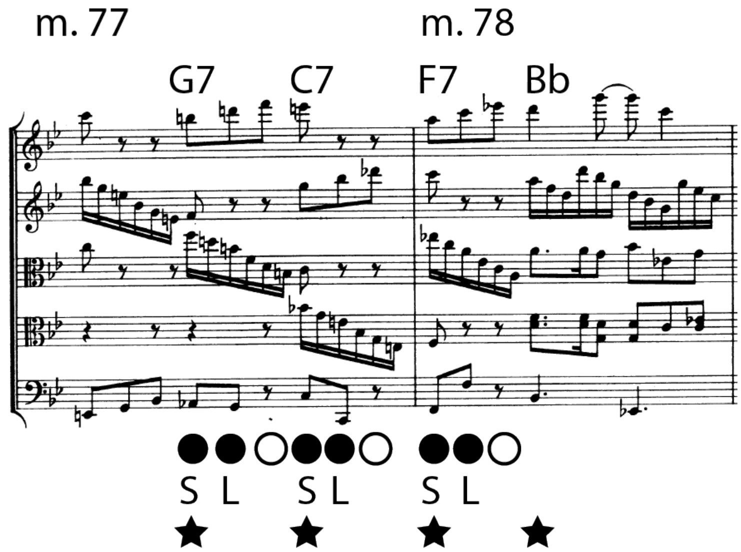


Figure 15: Mm. 74-75 in the development section.

In the recapitulation, after the P and S1 themes place the L element of the faster [01] motive on the notated dotted quarter pulse, S2 places the S element on the notated dotted quarter pulse. However, the motive's normal metric state is less strong associationally, as it has already been broken in the development. Inertia triumphs, maintaining the perceived dotted quarter pulse in line with the notated one.

The trajectory of the [0 1] motive in this faster minimal meter, summarized in Table 13, is nearly identical to its trajectory at the slower level, as shown in Table 1. This analysis shows the ability of the same motive to associatively induce meter across multiple levels within a single piece. It is conceivable that the metric associations developed on one level reinforced the other, creating a combined sense of rotation through the two secondary themes and of correction in the development and recapitulation rather than two parallel ones.

6 Conclusion and further avenues of inquiry

In this thesis, I have shown how the association of rhythmic motives or schemas can induce meter. In Brahms op. 111.1, a simple rhythmic motive generates a metric trajectory that maps onto the trajectory of the movement's sonata form. In Reich's NYCP, the relations between the sets of accented beat-classes similarly cause the downbeat to shift, before a new association keeps the downbeat stable as the set continues to rotate. "A quién le contaré yo" and "Gitana te quiero" show how style-general rhythmic schemas that are specific to a particular manner of accentuation can compete with each other to create temporary metric dissonance or work together to permanently shift the downbeat. Finally, I return to Brahms to show how rhythmic motives can co-occur at different metric levels, reinforcing the same metric trajectory at two speeds. All of my analyses have focused on the shifting of a downbeat pulse due to the shifting of a motive or schema. I will now use the Brahms movement to suggest further avenues of study pertaining to meter and rhythmic motives beyond how associations can shift a pulse.

6.1 Nested rhythmic motives

The first avenue is what could be induced by rhythmic motives beyond a meter; in particular, whether rhythmic motives can, through association, establish non-pulse elements of slower rhythmic motives, which in turn establish a meter associatively. One instance of a rhythmic motive that induces a certain pulse when repeated can establish a time-interval equivalent to the beat in that pulse as an element of a rhythmic motive, creating a nested hierarchical structure of motives that runs parallel to the metric structure.

For example, in Brahms op. 111.1, there is a common motive [0 2 4 6] in a nine-beat cycle. Figure 16 diagrams all of the instances of the motive [0 2 4 6], always in the rotation (0 2 4 6), with the long element last, at five different pulse levels between the end of the development and the beginning of the recapitulation. The span of the entire section is 27 bars, which has a prime factorization of 3^5 eighth notes, and thus has an unambiguous 5-deep triple meter. The 27-bar beat is divided into this motive (Figure 17), and thus has three 6-bar elements and one 9-bar element. The first 6-bar element and the 9-bar element are both articulated by instances of the motive. As a result, the motive (0 2 4 6) occurs at two different speeds at the same pulse-level, once with a dotted half unit (Figure 18) and once with a bar unit (Figure 19), with the dotted half-unit motive splitting the

6-bar element and the bar-unit motive splitting the 9-bar element.

6.2 Motive-pulse slipperiness: Spin-outs

Another avenue for future inquiry is the slipperiness between motives and pulses discussed in Section 1.3. As rhythmic motives and schemas orient time in music, there is an urge to characterize them as "non-isochronous pulses." In fact, Grant (2014, ch. 3) refers to the LS (0 2) motive I discuss in my Brahms analyses as an unevenly divided duple pulse in 17th-18th century European music, rather than as a particular expression of a triple pulse. While my definition of meter does not allow for the inclusion of non-isochronous rhythmic cycles as pulses, these motives do nonetheless act similarly to pulses, as one can count along with them and use them for orientation.

In spin-outs, a particular interval between elements of a motive becomes a pulse. I use the term spin-out to refer to cases in which one of the intervals between elements of a motive becomes the seed for an isochronous pulse by being repeated without interruption from the different intervals in the motive: the result is that indirect induction is replaced by direct induction. I will give a brief example in a Minuet by Mozart, then give several examples from Brahms op. 111.1, from both the [0 1] and [0 2 4 6] motives.

6.2.1 Mozart's Sarabande Minuet

Mozart's Minuet K. 585 no. 5 opens with a Sarabande rhythm (Allanbrook 1983). The Sarabande rhythm establishes a triple meter, and projects a downbeat by accenting the beat after it. Of the three quarter notes in a bar of a Sarabande, the first two are articulated, and the third is not; there is often an eighth note anacrusis before the downbeat.

The first measure of the minuet follows this pattern, as the two quarter notes and anacrusis are established by the melody in the first violin and flutes, and the beat 2 accent is created by their trill. However, rather than proceeding with this rhythm and the dotted half or bar pulse it implies, the melody articulates a half note pulse until the Sarabande returns in bar 5. The Sarabande's

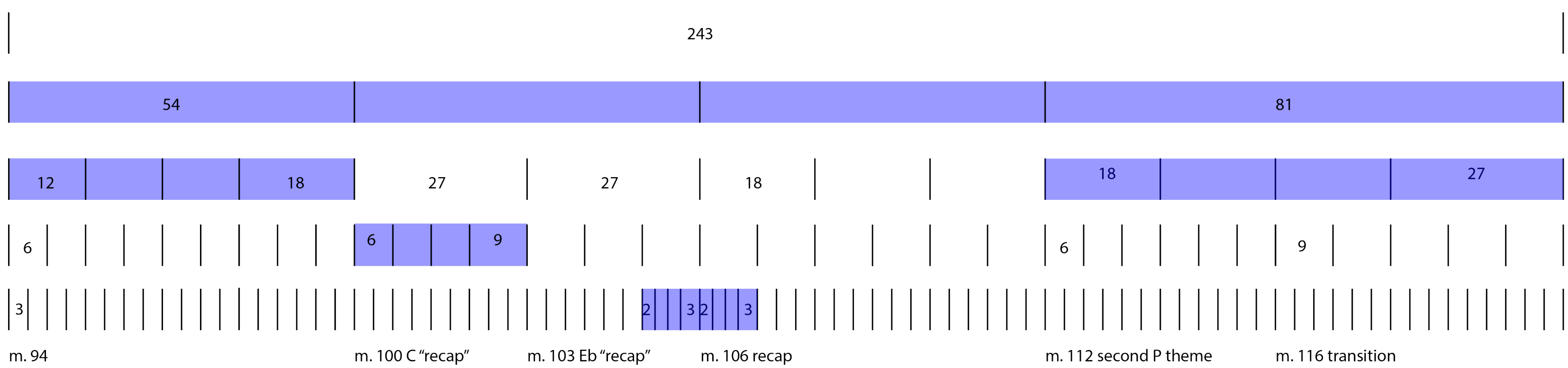


Figure 16: Instances of the (0 2 4 6) motive from the end of the development to the beginning of the recap.

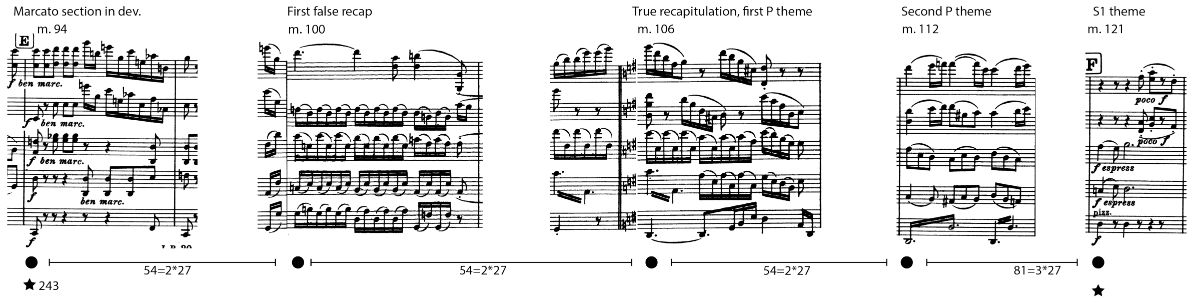


Figure 17: (0 2 4 6) motive in mm. 94-120. The unit is the 3-bar beat.

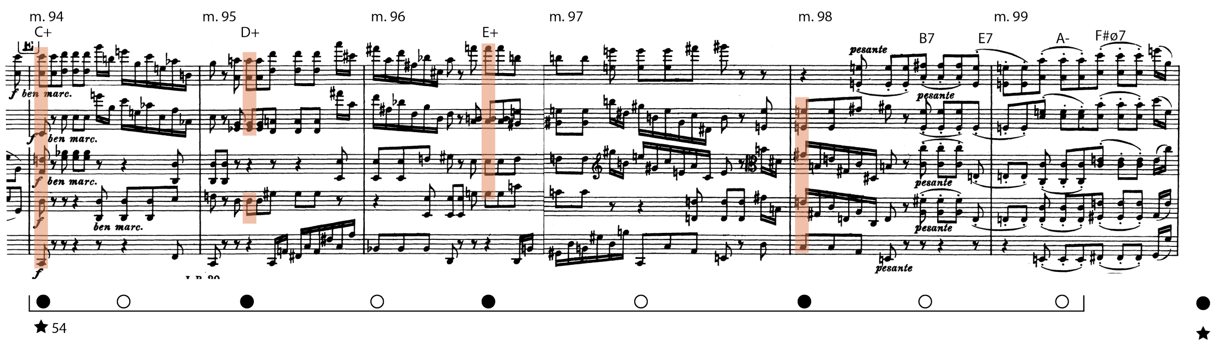


Figure 18: [0 2 4 6] motive in mm. 94-99. The unit is the dotted half note.

quarter+half rhythm is flattened into a repeating half note, filling out the three bars between the accented second beat of the first bar and the accented second beat of the fifth bar with 6 half notes. The first of these half notes, in m. 1, is subsumed into the Sarabande, and the last (starting on beat 3 of m. 4) is cut short by the m. 5 Sarabande rhythm establishing a downbeat halfway into it. The dotted half or bar pulse lasts for m. 1, a hemiolic half note pulse spins out of the Sarabande rhythm for mm.s 2-3, and m. 4 is back-propagated as a bar beat by the Sarabande in m. 5. The bar pulse continues uninhibited in the second half, supported by the great over-articulation of the notated downbeats in m.s 6 and 8, and by the Sarabande-esque accent on beat 2 of m. 7 by the cello and oboe.

The purpose of this analysis is to show how what begins as a rhythmic motive or schema, in that case the Sarabande, can spin out into an isochronous pulse that supplants the pulse that the motive was suggesting. This occurs in Brahms op. 111.1 with both the [0 1] and [0 2 4 6] motives. In the

Figure 19: [0 2 4 6] motive in mm. 112-120. The unit is the bar.

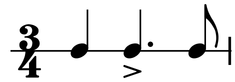
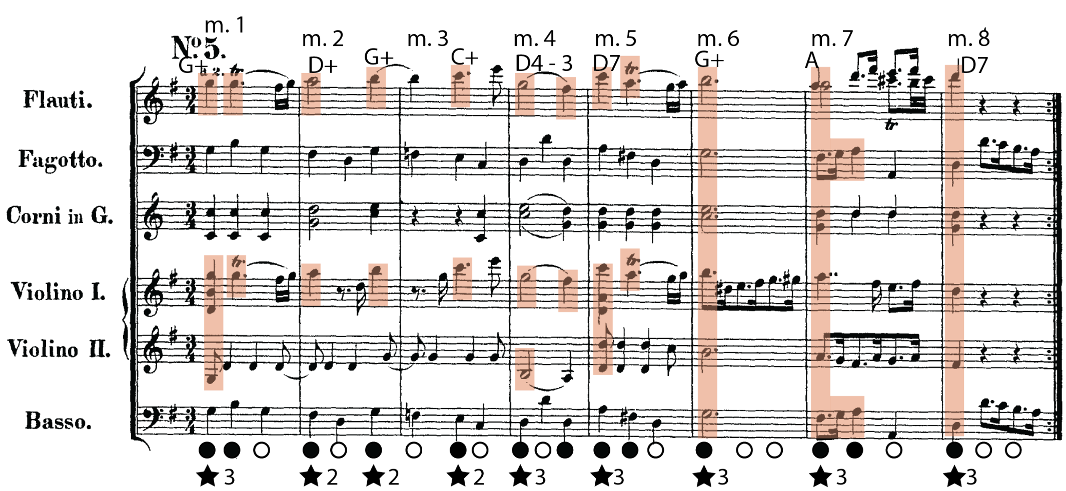


Figure 20: A schematic of a Sarabande rhythm.



case of the [0 1] motive, only the longer interval spins out. The spinning out of the shorter interval would not clearly contradict the motive, as it is the motive's unit pulse. In the case of [0 2 4 6], both elements, the quarter and the dotted quarter, spin out into pulses, directly contradicting the motive, though not always contradicting the established meter.

6.2.2 [0 1] in Brahms

A clear illustration of the spin-out of the [0 1] in the Brahms movement occurs in the transition to the secondary theme of the exposition. The transition starts with the rhythmic motive in its SL rotation with respect to the notated downbeat. As a result, the downbeat is shifted to the second dotted quarter of the notated bar. However, in bar 23, the rhythmic motive gives way to a series of dotted half notes that don't alternate with dotted quarters.

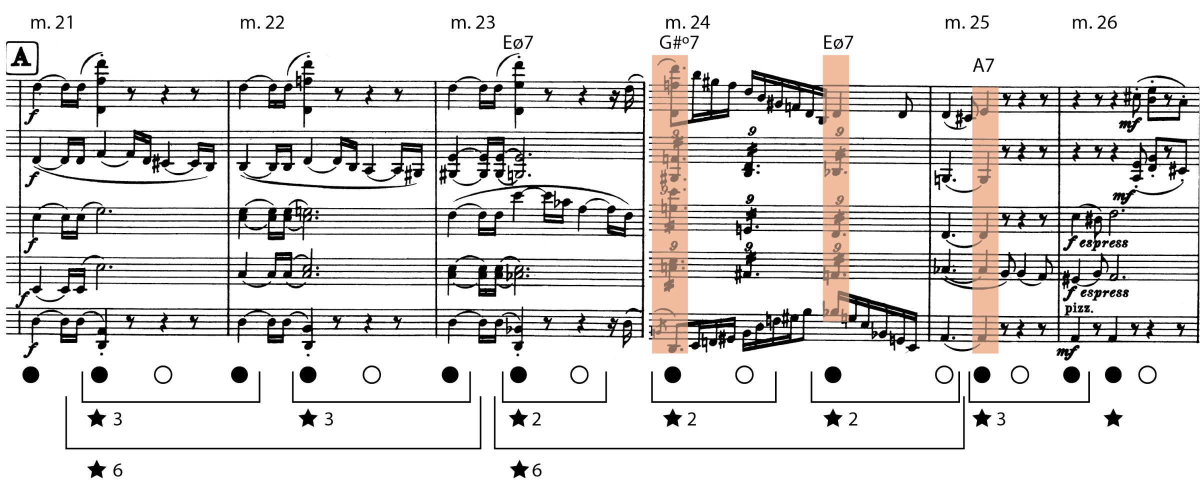


Figure 21: Transition to the secondary theme, mm. 21-26.

The 2-bar hyperbeat from the second dotted quarter of m. 23 to the second dotted quarter of m. 25 is divided into three dotted half beats. This hyperbeat is in a hemiola relationship with the 2-bar hyperbeat from the second dotted quarter of m. 21 to the second dotted quarter of m. 23, which is divided into two bar beats through motivic association by (0 2). The long-short motive turns into a simpler pattern of repeated longs, which become a pulse although they were not a pulse in the rhythmic motive they came from.

6.2.3 [0 2 4 6] in Brahms

The [0 2 4 6] motive spins out three times in the closing area of the exposition. The rotation of the motive is (0 2 4 7), putting the longer beat third.[26]

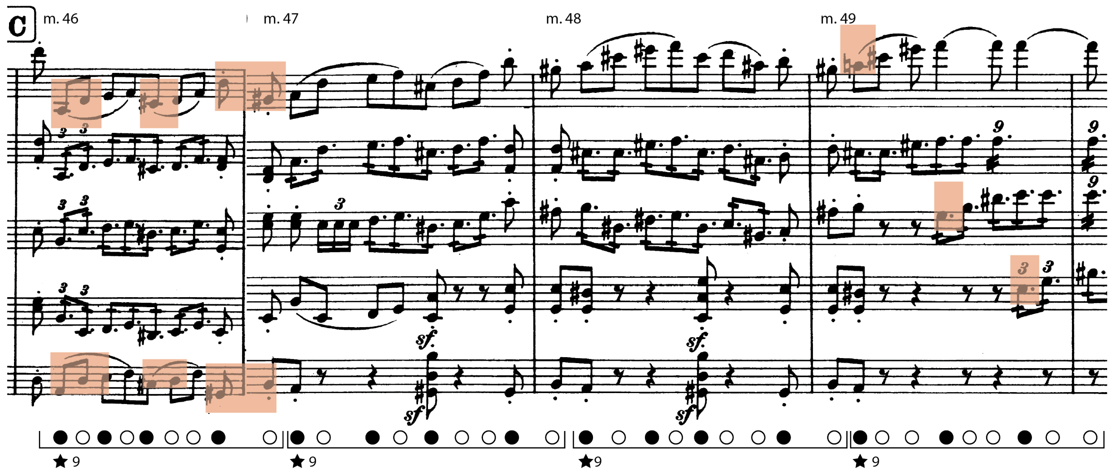


Figure 22: The first spin-out in the closing area, mm. 46-49

The first spin-out occurs after three repetitions of the motive. The longer element, the dotted quarter, is transplanted to the beginning of the bar pulse, and is repeated three times. As such, the meter does not change with this spin-out, but the dotted-quarter pulse becomes directly established rather than filled in as the only possible option between the associatively established bar pulse and directly established eighth note pulse.

The quarter note interval between accented beats returns immediately in m. 50, and is followed by the G# diminished triad in the cello characteristic of the long element (dotted quarter) of the motive in mm. 46-48. However, the next accent is four eighth notes later, indicating a continued quarter note pulse rather than the motive's interspersed dotted quarter interval. The pattern of accents starting at the G# diminished chord forms the [0 1] motive at the level of the quarter note to the dotted whole, thus placing a slower (6-unit, or dotted half) pulse on the G# diminished. The remaining eight eighth notes before the long G# diminished on the second eighth note of m. 52

26. This is atypical in the piece: the motive is usually in either the (0 3 5 7) or the (0 2 4 6) rotation, putting the long element first or (more typically) last.

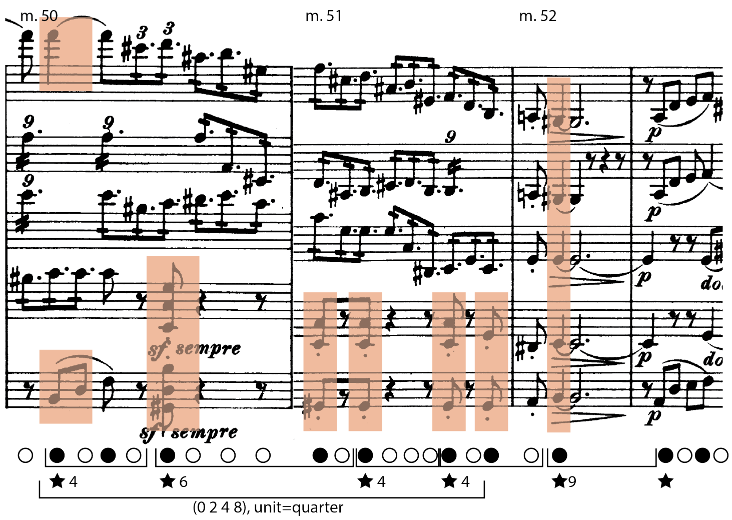


Figure 23: The second spin-out in the closing area, mm. 50-52

divide evenly into two 4-unit (half note) beats. The result is that the whole of this spin-out, a 2-bar phrase, expressed the [0 2 4 6] motive at a new pulse level, with a quarter note unit, and in a unique rotation in the piece: (0 2 5 7), where the long interval is second. The bar and dotted quarter pulses sustained by the motive are negated by the spin-out's quarter and dotted half pulses.

Figure 24: Third spin out in the closing area, mm. 53-55. Features arguing for the bar beat starting on the fifth eighth note of m. 53 are highlighted.

The third spin-out, like the first, repeats the three-unit (dotted quarter) element as a pulse. Unlike the first spin-out, however, the long element repeats from its location within the cycle, rather than being transplanted to the beginning. The bar beat is established with a direct dotted quarter pulse, though it is displaced by four beats with respect to mm. 46-49. This is quite a striking downbeat shift, five eighth notes away from the notated placement.

In my thesis, I hope to have shown the value of associative metric analysis in determining the downbeat. With my concluding discussion of nested motives and spin-outs, I argue that there is much more value to be gained from this general mode of analysis than I have been able to reap in this work alone.

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