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Slicing the Beat: Jazz Eighth-Notes as Expressive Microrhythm

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Until recently, jazz theorists have directed most of their analytical efforts to unscrambling aspects of pitch rather than time, mimicking the analysis of "art" music. The perceptual limitations involved in extracting and characterizing essential rhythmic nuances, as well as the limitations of standard music notation to convey these, have tended to deter rigorous study of the microrhythmic features of jazz performance. In pitch-oriented studies, temporal aspects have generally been neglected in favor of scalar- and harmonic-related topics (e.g., Cogswell 1994; Hermann 2004; Johnson-Laird 2002; Kenny 1999; Larson 2002; Steedman 1984; Toiviainen 1995; Tymoczko 1997). A few other studies have addressed the interaction between the pitch and time domains, although issues of microrhythm are left largely unexplored (e.g., Berliner 1994; Haywood 1994; Järvinen 1995). An important (and pioneering) exception is that of Pressing (1987), who recorded himself performing two free jazz improvisations and used a computer to extract timing, dynamics, and "legatoness" information. He found that some of the microrhythmic mechanisms sometimes interacted with melody and phrase structure.

Microrhythms in jazz have begun to receive increasing attention from jazz scholars over the last decade, partly as a result of the widespread availability of inexpensive and easy to use sound-editing software, and partly as a result of a collective need to catch up with an already advanced pitch-based analytical tradition. However, just as most research on jazz theory has shown a unilateral preference for pitch-related topics, the growing body of work devoted to microrhythm in jazz risks neglecting the interaction between the pitch and time domains. Such is the case with studies where timing considerations dominate the discussion and pitch information is either excluded from the discussion (Busse 2002; Collier and Collier 1994; Friberg and Sundström 2002; Prögler 1995), displayed but excluded from the discussion (Ellis 1991),

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or displayed and discussed using a "by ear" approach to microrhythmic function (Huang and Huang 1994; Iyer 2002; Pressing 2002).

In this study, I examine the nature of the jazz eighth-note in order to assess its expressive function, its relationship to melody and harmony, and its accordance with the "swing triplet" concept. The rhythmic unevenness of the eighth-note is one of the hallmarks of jazz. Scholars have addressed this complex stylistic attribute in different ways and to varying degrees. Waadeland (2001) used frequency modulation algorithms to create human movement curves that simulate varying physical approaches to rhythmic production, including that of uneven jazz eighth-notes. Other studies have tended to quantify the magnitude of the long-short ratio and its dependability on tempo by zeroing in on different elements of the jazz ensemble. Collier and Collier (1996) focused on the ride cymbal, Friberg and Sundström (2002) on the ride cymbal and on soloists, Rose (1989) on the rhythm section, Ellis (1991) on the saxophone, Reinholdsson (1987) on drummer Roy Haynes, and Collier and Collier (2002) on Louis Armstrong. Since these studies examine a relatively narrow pool of styles and performers, I chose to sample a broader selection in order to complement their findings.

The following discussion is informed by the *Beat-Upbeat Ratio* (BUR), which describes the temporal proportion between two subsequent eighth-notes ("eighths" hereinafter) by measuring and comparing their duration. The paper suggests three ways in which expressive microrhythm helps to articulate phrase structure. First, shifts in harmony and/or melodic character sometimes coincide with corresponding changes in BUR value at certain phrase demarcation points. Second, triplet-type phrasing, as reflected in higher BUR values, often increases at cadential phrase endings, resynchronizing the soloist with the rhythm section's higher BUR values and giving rise to rhythmic fusion. Third, motivic repetition involves a restatement not only of pitch and rhythm information, but also of microrhythmic features. This last idea is particularly pertinent to jazz improvisation because of the important role played by "licks" and motivic restatements. In addition to articulating phrase structure, BUR variation plays a role in defining a musician's stylistic profile. The BUR data that I collected support the long held assertion that different performers tend to gravitate towards different microrhythmic feels. Extensive and contrasting BUR histograms for five different post-bebop musicians suggest that different performers are characterized by their individual treatment of beat subdivision. I close the paper with an evaluation of these measurements as they relate to the "swing triplet" view and I propose reasons for its pervasiveness. I maintain (as do others) that the triplet provides an incomplete representation of jazz performance, especially in the bebop and post-bebop styles.

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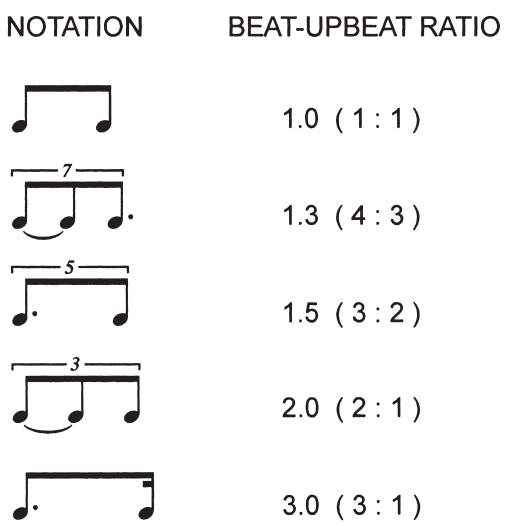
The Beat-Upbeat Ratio

A ratio is a useful way of characterizing the durational relationship between two successive eighths. The Beat-Upbeat Ratio calculates the proportion between them by dividing the durational value of the first by that of the second. Thus, two equally long (or "straight") eighths yield a BUR of 1.0, whereas a BUR of 2.0 represents a triplet configuration, i.e., a quintessential "swing" pattern of "ONE (two) THREE ONE (two) THREE ONE" etc., with the first note, as a tied eighth, being twice as long as the next (the "THREE"); between these two points in the long-short continuum lie a number of possible values that performers draw on to various expressive ends. I favor this nomenclature instead of the commonly employed "swing ratio," which introduces a subjective and highly qualitative term; one can easily imagine how applying a "swing ratio" to a MIDI file will probably fail to guarantee a swinging playback. Example 1 shows five possible ways in which the beat can be subdivided into a binary pattern. The purpose of this illustration is not to suggest that jazz BURs are determined by any particular *n*-tuplet subdivision, but rather to provide the reader with standard notation equivalents that can serve as reference points in the continuum of possible subdivision configurations. In this way, a BUR value can be assigned to every beat of a phrase that is composed of successive eighths, allowing us to observe how microrhythm varies in time across the musical passage. By measuring the

Example 1. Five BURs and their music notation equivalents.



duration of eighths in a given excerpt and calculating the ratio for each subsequent pair, we can begin to shed light on certain microrhythmic properties of jazz phrasing.

To make BUR measurements, I used the digital sound editor Sound Forge 4.0 on a home PC. I manually parsed the waveform of the recorded excerpt into its eighth-note components by using the software's Marker tool. I then copied these values onto the computer's clipboard and transferred them to Microsoft Excel, where I calculated BURs by dividing the value of the Beat-eighth by the value of the Upbeat-eighth. The excerpts are drawn from a varied pool of recordings representing different performers playing a range of instruments. I applied the following set of criteria when selecting the sources. The phrase should contain at least eight consecutive eighths (in order to ensure that the player is engaged in "eighth-note mode"), the quality of the recording should be good enough to permit accurate onset discrimination, the tempo should be slower than 250 beats per minute to prevent large margins of errors,[1] double-time phrases and non-"straight-ahead" styles (such as Latin) are avoided, excerpts need not make up a complete phrase and are sometimes a subsection of a longer musical statement, and all examples are in 4/4 time. I also avoided phrases that employ "ghost notes," "scoops" and other ornamentation or imprecise modes of attack. As a result, this article omits essential expressive elements that give jazz its rhythmic vitality. However, if I were to include these attack "imperfections," the data would become hopelessly unreliable. In this paper I hope to provide limited but accurate information, so that gradually the big picture will be completed as other writers continue to tackle the mysteries of jazz performance.

Phrase Structure

The following analyses support the notion that BUR variation can be closely linked to the structural organization of jazz phrasing. These examples are modest attempts to begin bridging the wide analytical gap that separates our increasing understanding of microrhythmic elements from our deep-rooted knowledge of jazz melody and harmony. In each graph, the y-axis plots the *Inter-Onset Interval* (IOI), or total duration of each eighth-note. The steepness of the straight line joining the nodes provides a visual indication of the durational relationship between adjacent eighths. Thus, a horizontal line represents a series of BURs at or very near 1.0, since the duration of both eighths in the beat is perceptually equal; musicians refer to these as "even" (or "straight") eighths. On the other hand, an alternation of long and short eighths traces a jagged contour of peaks and valleys, respectively. These BURs can be categorized as either *low* (roughly between 1.1 and

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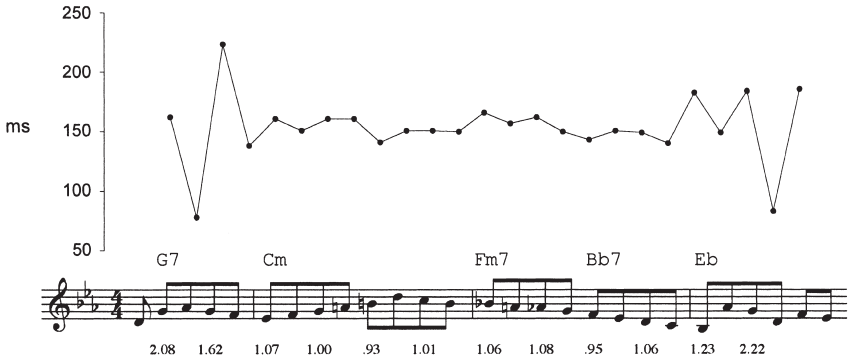
1.3) or *high* (1.4 and above). Thus, a low BUR means that the first eighth is slightly longer than the second, whereas the long-short relationship is more exaggerated in the case of a high BUR. The boundaries between these three categories (even, low, high) should not be interpreted as rigid cutoffs but as approximate markers in the fluid gamut of possible beat subdivisions. At the very least, this simple tripartite taxonomy can prove useful in the context of musical analysis.

From a melodic standpoint, the phrase in Example 2, by John Coltrane, may be divided into three subsections: a four-note stepwise anacrusis, an extended ascending-descending scalar pattern that forms the bulk of the phrase, and a final three-beat twirl. Coltrane emphasizes this inner structure by differentiating between BUR modes. While the middle part of the phrase is characterized by remarkably even eighths, their steepness—i.e., triplet feel—is considerably greater during both the opening and final beats of the phrase. During the two pickup beats, the high BURs—that is, the more triplety long-short pairs—help to increase the momentum of dominant harmony just prior to the downbeat resolution. The same is true of the final tag, although notice how instead of resolving on the downbeat of the last measure, Coltrane delays the arrival of the E♭ tonic by extending the B♭7 harmony for an additional two beats. The increase in BUR values at the end of the phrase may also help Coltrane re-synchronize with the rhythm section's higher BURs. (I will discuss this duality in more detail below.) Coltrane is playing consistently behind the beat by roughly 50 to 80 ms—about a fifth of the beat—so in reality the synchronization of soloist and rhythm section BURs will be in terms of their values, not in terms of a strict vertical alignment.

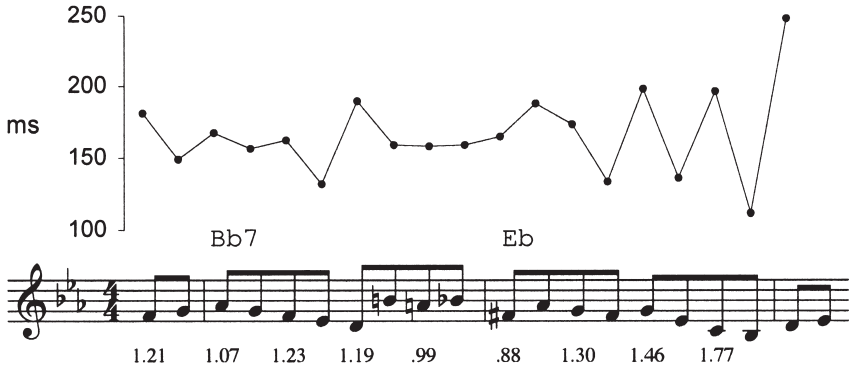
Example 2. John Coltrane, tenor sax, "I Hear a Rhapsody" (200 bpm), from *Lush Life,* Prestige OJCCD-131-2.



Example 3, by Lee Konitz, presents a similar delineation of melodic segments through changes in BUR value. As with the above example, the phrase breaks down into a three-part structure. Here, a middle section consisting of a quintuple chromatic approach to the pitch G is flanked by stepwise and leaping melodic figures. Konitz highlights the inner group by reducing its BUR values, providing a clear contrast with the low and high BURs of the outer segments. Notice once again how the BUR surge of the final beats helps to signal the end of the phrase and to drive towards the final tonic pitch E♭, the arrival of which is delayed by a full measure.

We see in Example 4a how Bill Evans articulates a sequence of four ascending arpeggios by maintaining an invariant durational structure. Each three-note group follows a dactylic long-short-short pattern that plays against the usual long-short relationship. Just prior to the final downbeat, Evans transforms the durational unit into the standard binary grouping, while simultaneously reversing the direction of the arpeggio. Recalculating the ratios of the first four beats according to a triple meter grid allows us to see that the four even BURs of 0.93, 1.05, 0.86, and 1.02—which, as we will see, constitute unusually even values (like straight eighths) for Evans's more triplet-oriented rhythmic style—give way to two hidden low BURs (or "UBRs") of 1.17 and 1.28. The apparent disappearance of long-short patterns during three-note melodic groupings was also observed by Collier and Collier (2002) in their analysis of Louis Armstrong's ending tag of "Cornet Chop Suey." In the current example, the phrase segmentation is further emphasized through variation in amplitude levels: Evans differentiates the dynamics within the three-note groups by accentuating the melodic peaks (Example 4b).[2] Taken together, these examples reveal an expressive mechanism that links register, loudness, and duration as a way of tracing the linear trajectory of the phrase (Example 4c).

Example 3. Lee Konitz, alto sax, "On Green Dolphin Street" (185 bpm), from *Satori*, Milestone OJCCD-958-2.



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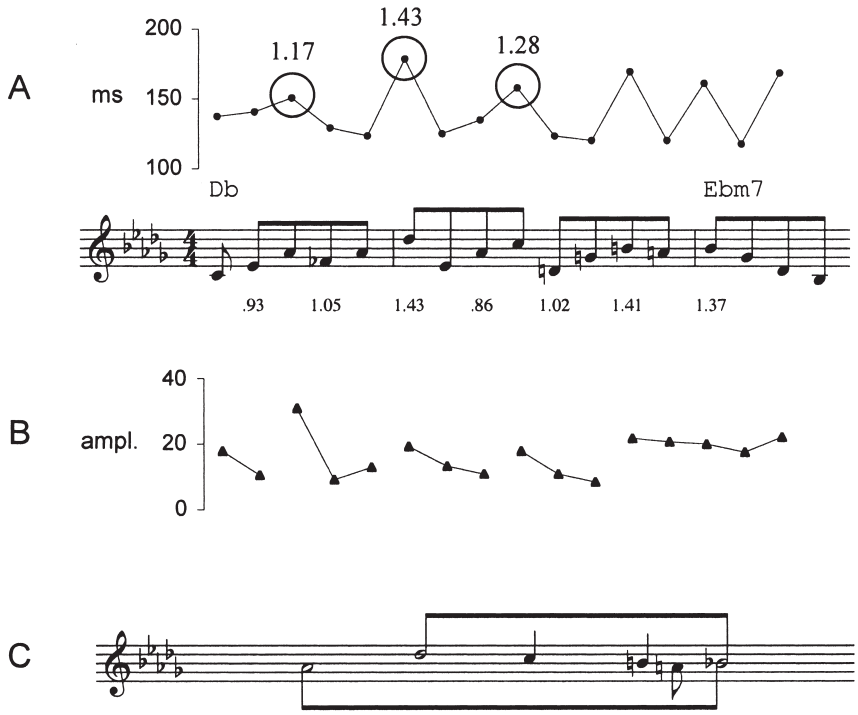
Example 4. Bill Evans, piano, "Love for Sale" (214 bpm), from Miles Davis, *58 Sessions,* Columbia CK 47835
(a) Binary long-short groupings yield even BURs that can be reinterpreted as ternary long-short-short durations. (b) Loud-soft-soft amplitude levels conform to the configuration of the three-note arpeggios. (c) Resultant linear progression.



Example 5 illustrates the remarkable degree of microrhythmic malleability of which jazz musicians are capable. Like a gradually shifting pattern of lights shining on a fixed object, George Shearing systematically varies the phrase's BURs against the static backdrop of a cycled six-note figure. This motive is first cast as a series of rushed eighth-notes (or laid-back quintuplets) following a short-long pattern that is the exact reverse of the usual long-short inflection. Shearing slowly recalibrates these "inverted" BURs by turning the shorts into longs and vice-versa, transitioning through even, low, and high values until he reaches the triplet feel of the rhythm section. This process is clearly visible in the graph above the transcription, where the low dots represent short eighths and the high dots represent long eighths. Notice that the only exception in this ascending BUR trend is the 2.12 value at the end of the second measure, which helps to signal the barline, thus providing a welcome reference point within the microrhythmically evolving figure.

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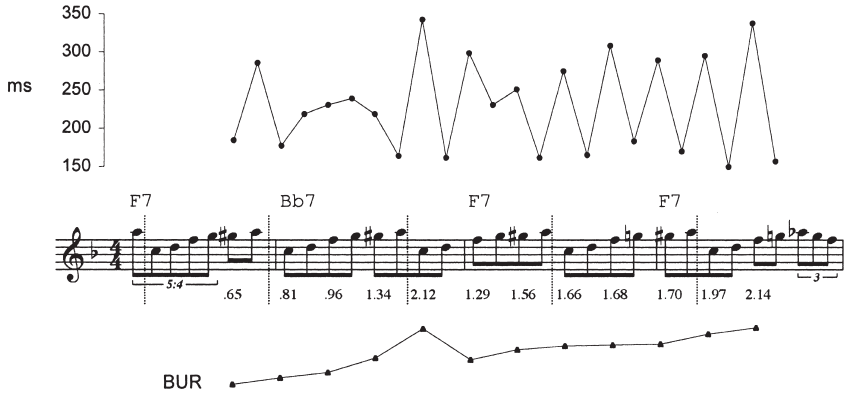
Example 5. George Shearing, piano, "Walkin'" (132 bpm), from *Walkin'*, Telarc CD-83333.



The BUR Surge

The increase in BUR value representing a more triplet-oriented feel at the end of each of the above excerpts is not uncommon; additional examples can be found throughout the transcriptions in the Appendix posted on the SEM website. This phrase-ending BUR surge might be explained in the context of tension/resolution. Since rhythm-section BUR values are generally higher (more "triplety") than those of soloists (Friberg and Sundström 2002), a soloist transitioning from low to high BURs is in effect "resolving" from a microrhythmically dissonant state to a consonant one. Friberg and Sundström (2002) found that, in relation to the drummer's ride cymbal pattern, soloists tend to delay downbeats and synchronize off-beats. The BUR surge theory complements this observation by suggesting that soloists tend to increase their BURs at phrase endings in order to synchronize both downbeats and offbeats with the rhythm section, thereby incorporating a phrase-ending expressive device. We should note, however, that soloist and rhythm section BURs might not be perfectly aligned if the soloist is playing behind the beat, as was the case in the Coltrane excerpt above. Furthermore, in the above Konitz excerpt the only accompaniment is Dave Holland's bass, so Konitz's BUR surge cannot be explained as a synchronization with the rhythm section because there is no rhythm section to speak of. Another way of thinking about the BUR surge effect is in terms of a figure and ground schema. Iyer (2002) maintains that lower BURs make the main pulse more difficult to perceive because of increased homogeneity, and that, conversely, higher BURs enhance the perception of the main pulse by facilitating the perception of a higher rhythmic structure. This, he argues, is a possible reason why jazz musicians "swing" their eighths. Adopting this plausible line of reasoning

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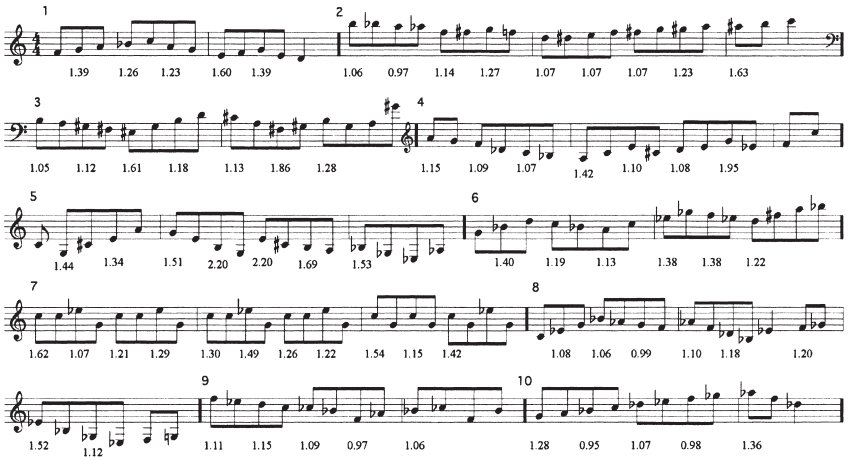
allows us to view the BUR surge as a way for performers to go in and out of focus in relation to the underlying tactus, concealing it with lower BURs and making it explicit with higher ones at structurally significant points.

BUR Variation

As we have seen, the juxtaposition of high and low BURs can be an effective way to highlight the structure of a phrase. Even when phrase substructure is not being spelled out via microrhythm, a considerable degree of BUR variability appears to be common. This is further evidenced by the transcriptions in the Appendix and in Example 6, where subdivision ratios within phrases often cover a wide range of values.

Example 6. Ten BUR samples
(1) Bud Powell, piano, "Sometimes I'm Happy" (153 bpm), from *Jazz Giant*, Verve P2 29937; (2) Red Garland, piano, "It Could Happen to You" (188), from *Relaxin' With the Miles Davis Quintet*, Prestige OJCCD-190-2; (3) Charlie Parker, alto sax, "Now's the Time" (167), from *Charlie Parker at Storyville*, Blue Note CDP 7 851082; (4) Phil Woods, alto sax, "Pennies from Heaven" (184), from *Bird Calls Vol. 1*, Savoy Jazz ZDS 1179; (5) Joe Henderson, tenor sax, "Isotope" (188), from *Inner Urge*, Blue Note CDP 584189; (6) Jimmy Hamilton, clarinet, "Trumpet No End" (224), from *Duke Ellington and His Orchestra: The Golden Duke* (Prestige 24029); (7) Wayne Shorter, tenor sax, "Speak No Evil" (142), from *Speak No Evil,* Blue Note CDP 746509 2; (8) Lester Young, tenor sax, "You're Driving Me Crazy" (116), from *The Complete 1936–1951 Small Group Sessions Vol. 4 (1946–1949)*, Blue Moon BMCD 1004; (9) Roy Elridge, trumpet, "Big Shoe" (128), from *Duke Ellington and Johnny Hodges Side by Side*, Verve 821578-2; (10) Freddie Hubbard, trumpet, "Speak No Evil" (see 7).



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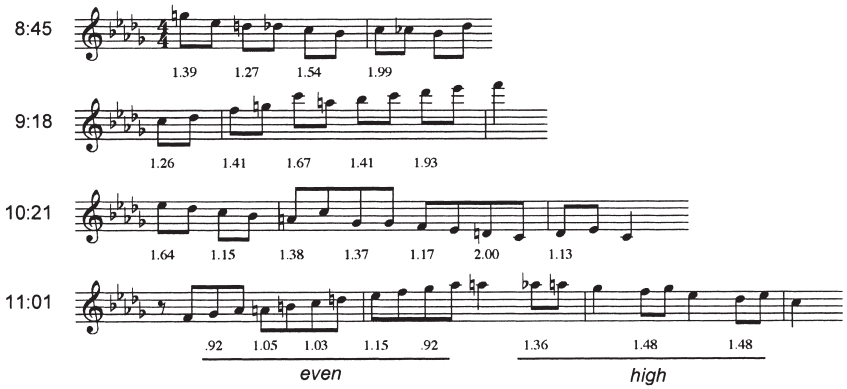
Whether working to articulate the phrase's inner form or not, such BUR contrasts occur within a beat-by-beat temporal framework, and thus operate on the level of echoic memory (roughly up to four seconds). This sort of contrast can affect our "on the fly" perception of phrasing. Often, the contrast between high and low BURs occurs not within but across phrases that can lie a few measures or perhaps even a few minutes apart from each other. These nuances can contribute to the solo's expressive depth by establishing cognitive connections between the beat-by-beat microrhythmic variation and the longer-spanning realms of short-term memory (roughly up to a minute) and long-term memory (roughly a minute or more). Walter Bishop, Jr.'s piano solo in "Melody for Melonae" serves as an example (Example 7). During most of his solo, Bishop articulates eighth-note runs with predominantly high BURs. He contrasts this articulation towards the end of the solo by playing an exclusively evenly-BURed passage. Notice how he caps off the phrase by returning once again to the higher BURs that permeate his solo. Later we will see how different members of the group infuse the music with their individual microrhythmic feels, collectively saturating the possibilities of beat subdivision to expand the expressive dimensions of a performance.

Tempo plays a role in the perception of BUR variation. A few studies have shown that tempo and BURs are inversely proportional—that is, that eighths become more even at faster tempos. Friberg and Sundström (2002) measured the "swing ratios" of ride cymbal patterns as played by four expert jazz drummers. On average, ratios decreased as tempo increased. Collier and Collier (1996) obtained similar results when jazz drummers were asked to perform on a MIDI drum pad, a tendency further supported by

Example 7. Walter Bishop, Jr., piano, "Melody for Melonae" (198 bpm), from *Jackie McLean, Let Freedom Ring*, Blue Note 80908.



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data gathered from MIDI wind controllers in Ellis (1991). These findings are not supported by the data gathered in the present study, where a statistical analysis failed to detect a negative correlation between tempo and BURs. With the polar opposite exceptions that (a) soloists iron out their eighths at very fast tempos, and (b) 12/8–feel is more commonly associated with slower tempos, there seems to be no systematic interdependence between tempo and subdivision ratios. It is especially important to stress that slower tempos do not necessarily yield higher BURs, as many excerpts throughout this paper can attest. Rather than trying to pin a correspondence between BUR and tempo, perhaps a more rewarding endeavor is to think about how different ratios are perceived at different tempos. It seems safe to assume that, no matter what the tempo might be, the difference between BURs 1.10 and 1.84 will be easily registered by an experienced listener, but that between 1.22 and 1.26 will not. Even though an exact assessment of BUR discrimination thresholds is beyond the scope of this study, we can contextualize the numbers by digging a little deeper into the meaning of uneven subdivision. A long-short relationship implies a deviation from the isochrony of even eighths. By definition, a BUR is a *relative* indicator because it compares items relative to each other. Thus, the long eighth might be said to stand in a 1.5 to 1 ratio to the short eighth, comprising 60% of the beat, instead of an isochronous 50%. The deviation from isochrony can also be characterized in *absolute* terms, such as "the long eighth extends beyond the midpoint of the beat by 23 milliseconds." The quantity 23 ms is an absolute representation, unlike a ratio or a percentage. So, what role does tempo play in determining the magnitude of perceivable BUR change? At 120 beats per minute, for instance, there is a difference of 23 milliseconds between BURs 1.0 and 1.2, whereas at twice the tempo the difference between the same ratios is only 12 milliseconds. Therefore, at slower tempos the distinction between different BUR values may be more readily perceived than at faster tempos, though it is difficult to determine how large of a millisecond difference listeners are able to discern. For monotonic IOIs under 250 ms, listeners can discriminate changes as small as 6 ms (Friberg and Sundberg 1995), but this figure is far from being ecologically valid and is likely to be significantly higher in the busy context of a jazz performance.

Duplication

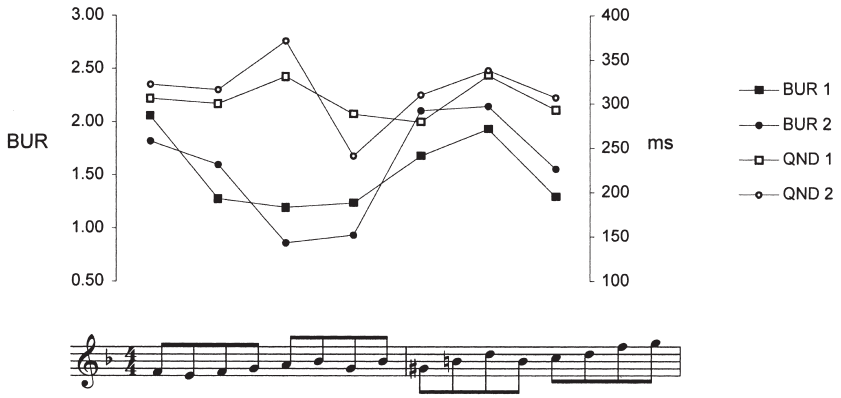
The previous example compares different phrases to show how their microrhythmic profiles differ. Now let us broach the question of how subdivision ratios are affected when the same phrase or motive is repeated. In other words, does a restatement of a given series of pitches entail a corresponding transference of microrhythmic information? Since motivic

repetition is an essential building block of jazz improvisation, it would be helpful to understand how microrhythm plays into this context. As I will show, in some instances melodic repetition involves a restatement not only of a pitch sequence but also of the original BUR values ascribed to those pitches; I will refer to this phenomenon as *duplication.* In the following examples, an additional parameter is introduced. I calculated *Quarter-Note Duration* (QND) by summing the durations of the two (beat and upbeat) eighths (or IOIs) comprising the beat. Combined, the data afforded by both QNDs and BURs provide a two-pronged view of duplication. If we can show that two microrhythmic indicators remain nearly unchanged when a phrase is repeated, obviously this allows us to formulate a stronger case for duplication than if only one indicator were used.

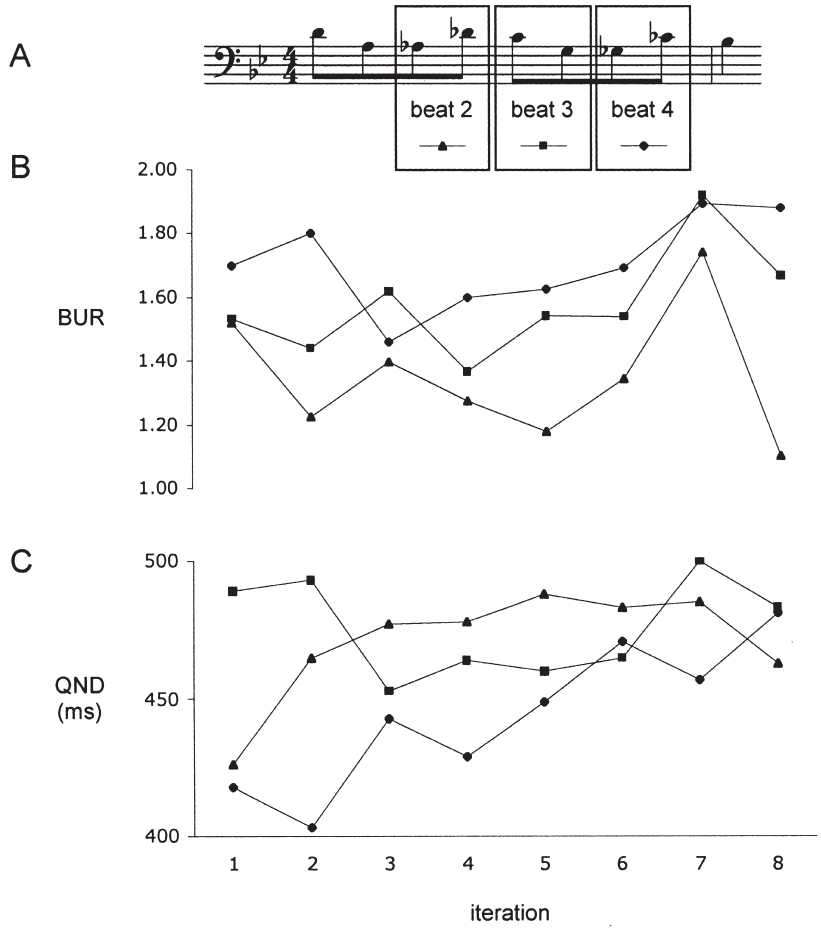
Consider the excerpt extracted from two identical phrases occurring at different points in a Miles Davis solo (Example 8). The two phrases open choruses 5 and 7 of the blues "Straight, No Chaser." In order to assess whether duplication is taking place, their BUR and QND levels are displayed graphically side by side. The microrhythmic similarities between the two excerpts can be seen in both parameters' sine-like shape, and they are reflected in the correlation values: r(BUR)=.78, r(QND)=.73. As illustrated by the solid dots and squares above the transcription, both versions of the phrase begin with a triplet feel, then dip towards straight eighths in the second half of the first bar before repeating the same rise-and-fall pattern in the second bar.

The next example looks at duplication in the context of the jazz "head" (song melody). Example 9a contains a fragment from the melody to "Good Bait" as performed by John Coltrane. The same figure occurs a total of eight

Example 8. Miles Davis, trumpet, "Straight, No Chaser" (192 bpm), from *A Retrospective*, Deja Vu DVCD 2039.



Example 9. John Coltrane, "Good Bait" (128 bpm), from *Soultrane*, Prestige OJCCD-021-2
(a) Melody fragment, (b) BUR and (c) QND comparisons across all eight occurrences for beats 2, 3, and 4.



times, on measures 7, 15, 23 (a perfect fourth higher), and 31 of the opening and closing AABA choruses. The BUR comparison (Example 9b) of the fragment across all eight occurrences brings to light that in all instances except the third and seventh (which present almost negligible deviations), BUR values for beats 2 through 4 are arranged in ascending order (beat 1 BURs are randomly distributed and have been omitted from the graph). Notably, this ordering confirms the BUR surge effect discussed earlier. The

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QND comparison (Example 9c) further strengthens the microrhythmic link between all eight versions by revealing an interesting durational hierarchy: beat 2 usually has the greatest duration; it is followed by beat 3, which in turn is longer than beat 4 seven out of eight times. Comparing this ordering to that of the BURs, we notice that they are negatively correlated: omitting the unstable beat 1, r =-.52. Simply put, BUR values increase through the bar, whereas QNDs decrease. The combination of rising BURs and shortening beats helps to propel the melody towards the final downbeat.

Musical Personality

A performer's musical personality is defined by a variety of factors, including timbre, phrase repertoire, and rhythmic feel, of which beat subdivision is a significant component. Jazz critic and writer Martin Williams is quoted by Berendt (1992:192) as saying that "each of the great players has found his [*sic*] own way of pronouncing the [swing] triplet, expressed or implied—and Roy Eldridge's triplet doesn't sound like Louis Armstrong's; Miles Davis' didn't sound like Dizzy Gillespie's; Lester Young's triplet was unlike Coleman Hawkins'; and Stan Getz's is unlike Lester Young's." To which Berendt correctly adds that "there doesn't exist . . . any form of notation, graphic representation, and computer analysis capable of satisfactorily registering the subtlety of these rhythmic processes, which differ not just stylistically but also in terms of specific distinctions between groups and individuals." Figure 1 takes a baby step towards quantifying such rhythmic processes. It brings together BUR histograms for five performers who as a group provide a representative sample of the post-bebop style: Miles Davis (trumpet), John Coltrane and Dexter Gordon (tenor saxophone), Julian "Cannonball" Adderley (alto saxophone), and Bill Evans (piano). (The data in this graph are drawn from the transcriptions in the Appendix on the SEM website.) Each column in the graph represents the number of BURs that occur within a given slice of the BUR continuum across all excerpts. Interestingly—but not surprisingly—, each player's distinctive rhythmic style is reflected in the profile of his distribution curve. For example, while the predominant BUR value for Adderley, Davis, and Evans is 1.2—closer to even eighths—, that figure denotes a lower limit in Evans (whose more "triplety" values are heavily distributed towards the right side of the graph) and a central peak in Adderley and Davis. Similarly, the cluster around 1.1 is strictly exclusive in Gordon's case but smoothly foregrounded in Coltrane's. These observations are summarized in Figure 1b, which illustrates the apportionment of values in the 0.9 to 1.7 zone by splitting it into its lower, middle, and upper thirds. That such differences exist across performers underscores the notion that expressive features of "time feel" serve to define the stylistic profiles of jazz

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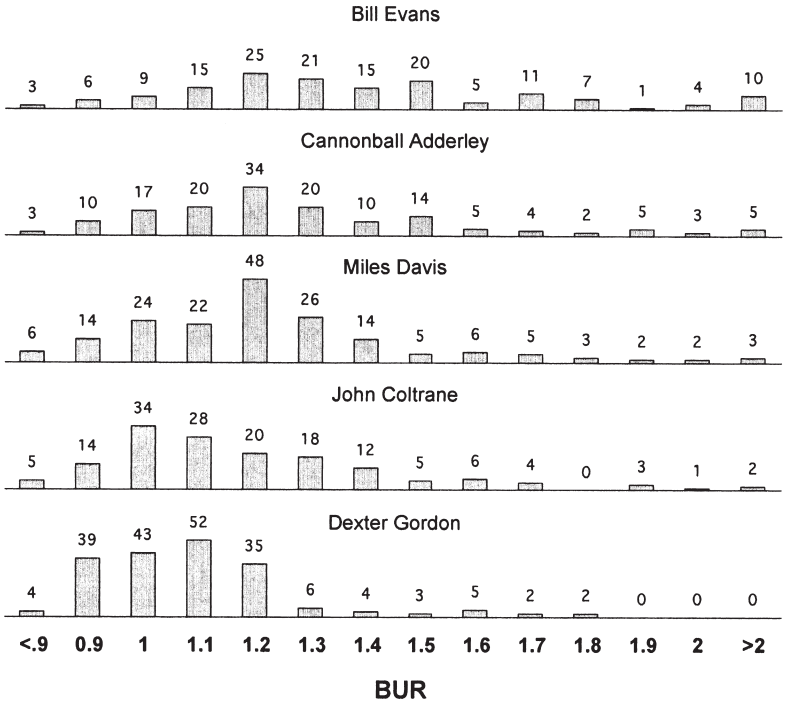
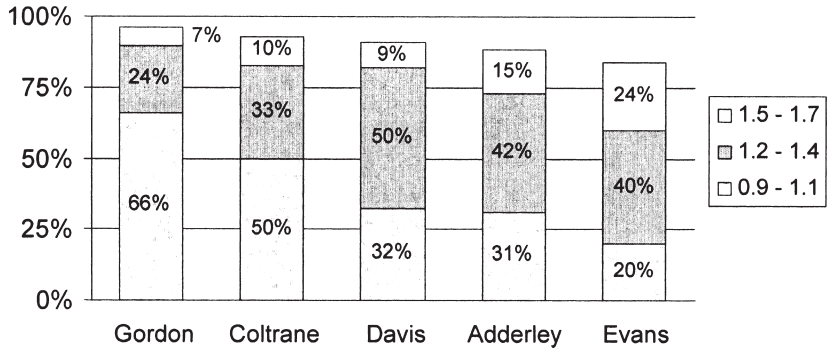
Figure 1. Performer profiles
(a) Individual BUR histograms and (b) BUR distribution (n=152 for all except Davis, n=153).





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musicians (Bauer 1993; Benadon 2003; Busse 2002; Huang and Huang 1994). Hence it seems appropriate to amend Friberg and Sundström's (2002:341) suggestion that one should "distinguish between instruments and function (solo/accompaniment) when discussing swing ratios" by adding "individual performers" to the mix. Thus, in the same way that different jazz performers bring their own melodic, harmonic, timbral, and rhythmic conceptions to a given performance, the blending of their unique microrhythmic approaches contributes to the musical richness of an ensemble performance. In the blues "Sonny's Crib," for instance, Curtis Fuller's high BURs stand in sharp contrast to the other three soloists' more even subdivisions. In "Jinrikisha," the different types of long-short groupings articulated by Joe Henderson, Kenny Dorham, and McCoy Tyner give rise to three BUR layers, each exploring a different region of the long-short continuum (Example 10).

The Question of the Swinging Triplet

The overall abundance of BUR values between .90 and 1.2 in the foregoing examples suggests that even eighths are more frequent in jazz than is generally acknowledged. There is also a noticeable preponderance of BURs in the 1.2 to 1.4 range. If this range represents roughly the threshold where the unevenness of eighth duration becomes perceptible to the listener (a big "if" that will require empirical corroboration), we could then surmise that jazz soloists aim to articulate a feeling of long-shortness at its "mildest" possible state. At the same time, there is a widespread belief that in jazz music a sequential pair of temporally uneven eighth-notes conforms to a triplet subdivision, with the duration of the first note accounting for two-thirds of the beat. While this notion is likely to be qualified by many listeners and performers, it is prevalent among jazz students and educators, and as summarized in the table below, it abounds in the literature, beginning with Martin Williams's above quote. For further proof of this almost universal conviction, we can turn to the numerous jazz lead-sheets that bear the conventional inscription at the top showing two eighths, followed by three eighths, the first two of which are tied, with a triplet bar over the three, that is, indicating that two notated eighths are to be played in a standard "swing" feel. This inscription most commonly appears on big band swing charts, a style that, possibly owing to the greater number of musicians playing simultaneously, tends to be more regimented toward triplet subdivision. However, the triplet decree is hardly limited to swing style big band charts. In Kernfeld's (1995:15) transcription of a Jimmy Hamilton clarinet break, the heading "swing eighths" is used to avoid "cumbersome triplet notation," even though the actual BUR values lie nowhere near the triplet (see #6 in Example 6 above).

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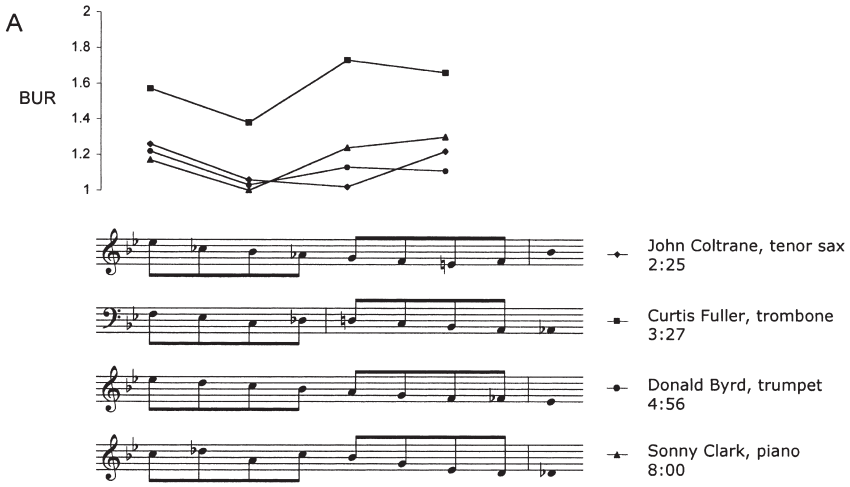
Example 10. Contrasting BUR approaches
(a) "Sonny's Crib" *(alternate take)* (170 bpm), from *Sonny Clark, Sonny's Crib*, Blue Note 97367; (b) "Jinrikisha" (166), from *Joe Henderson, Page One*, Blue Note 84140.



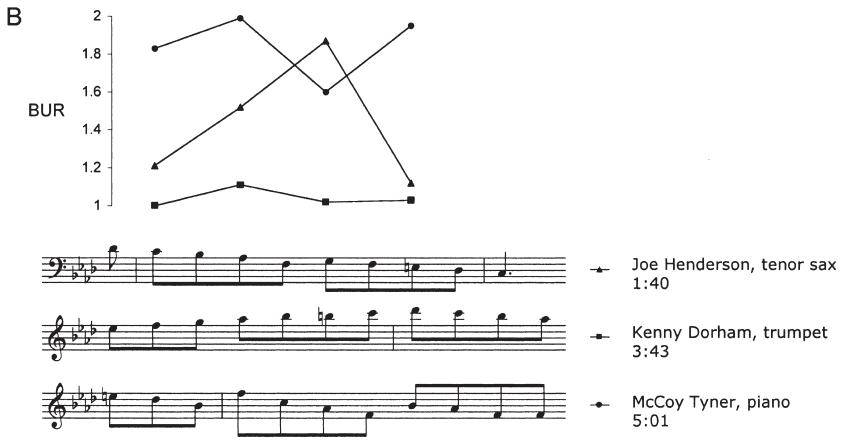


Table 1. The "Jazz Triplet" in the Literature

. . . the rhythmic interpretation of the jazz improviser's most consistently used rhythm, the eighth-note pattern . . . becomes a long-short triplet pattern. (Coker 1964:46)
The rhythm of legitimate jazz . . . included triplet swing . . . (Robinson 1994:11)
Jazz musicians do not usually notate swing rhythm the way that it sounds, because indications of a triplet subdivision of the beat clutter the page. (Kernfeld 1995:15)
. . . each measure [divides] into four beats, and each beat into three pulses. (Bilmes 1992)
[Charlie Parker] supplied linear substance and an eighth note triplet approach to phrasing that was perfectly right . . . (Crouch [1989] 1996:1026)
When a jazz musician is given a passage of quavers . . . the resulting rhythm is nearer to a triplet . . . (Dankworth 1968:39)
Conventional jazz rhythms . . . are based on a triplet structure, that is, on a ternary rhythm feeling. (Berendt 1992:192)
A value of 200 [percent] produces perfect, triplet-feel swing. (Finale 2005:43–44)
The ratio of 2:1 was used in this experiment, as this is the default ratio most commonly employed by jazz educators. (Abel 1996)

This study's BURs seldom exceed 1.5 and most often lie between 0.9 and 1.4—a remarkable deviation from the 2.0 neighborhood of the legendary swinging triplet. While the examples presented in this study represent an infinitesimal fraction of the jazz discography, the fact that they were selected at random (that is, without a bias for non-triplet phrasing) indicates that these observations are likely to hold true across many other bebop and post-bebop performances. This window of values is also lower than those proposed by other writers. Ellis's (1991) analysis of beat subdivision ratios as exhibited by three saxophonists yielded average values of 1.47 to 1.87. Collier and Collier (2002:465) write that "there is good reason to believe that the swing eighths ratio . . . ranges between 1.4 to 1 and 1.7 to 1," whereas Pressing (2002:303) suggests instead a slightly lower range of 1.3 to 1.6. In any case, the combined evidence disproves the idea that jazz eighths are, as a rule, carved from a triplet mold. While no single model can account for the infinite range of variation in eighth pairs, triplet-type subdivisions seem not only infrequent but also remotely distanced from the majority of ratios found in this study. As I remarked earlier, BUR values are non-uniform within phrases, often oscillating considerably from beat to beat. Where writers have succeeded in avoiding the triplet as a default value, they have failed instead in proposing a predetermined BUR, be it 1.50 (Gridley et al. 1989), 1.63

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(Biles 1994), or 1.75 (Iyer 2002). Doubting the triplet's supremacy seems wise both because it appears to be an inadequate value and because adhering to any fixed ratio constitutes a misrepresentation of the rich variety of expressive microstructures found in jazz. Rather than replacing the triplet paradigm, our aim as jazz scholars should be to emphasize the absurdity of ascribing to any rigid formula whatsoever.

The fact that the triplet concept is deeply engrained in the jazz discourse and upheld by writers of varied scholarly perspectives only serves to perpetuate its popularity. Yet, it is not among this paper's goals to deny the existence of triplet-type eighths, but merely to downplay their ubiquity. To be sure, exclusively-tripleted phrases do occur (see, for example, Bill Evans #23 in the Appendix), though seemingly not often enough to bolster the claim that jazz eighths are fundamentally triplets. So why is triplet subdivision often touted as an indispensable component of jazz performance? For one, because jazz soloists often fill in the beat with triplets, giving the triplet a prominent role. Also, because the triplet representation is the simplest possible way to denote a division into two unequal parts (long and short), owing to the fact that the number 3 is the lowest-order prime to contain an asymmetrical binary grouping (2 + 1). While other representations may provide more accurate descriptions of the actual durational ratios taking place in jazz eighths, they can seem unnecessarily convoluted. It would be more or less true but highly impractical, for example, to say that Miles Davis phrases his eighth-notes with an eleven-tuplet feel of 6:5 (a typical BUR of 1.2). Therefore, the triplet view may owe its pervasiveness to the psychological convenience of converting complex ratios into simple ones. Povel (1981) asked both musically trained and untrained subjects to listen to different short-long sequences consisting of two durations whose ratios ranged from .25:1 to .8:1. When subjects were asked to reproduce these patterns, they tended to lengthen or shorten the shorter duration towards .5, thus aiming for a short-long ratio where the short value was one half of the long value. Thus, while patterns in a 1:2 ratio were correctly imitated, imitation of all other patterns followed a systematic deviation from the ratio in the stimuli toward an interval relation of 1:2. This tendency is viewed by Povel as an attempt to fit the stimulus into an internal mental structure that favors a simple ratio. On the flipside, Collier and Wright (1995) show that musicians tend to perform triplets at ratios lower than the expected 2:1. Hence the conviction that triplets are basic to jazz may arise from the belief that a BUR of (say) 1.6 is how triplet eighths actually sound, coupled with the lack of importance conferred to small deviations from that value. In other words, if a listener associates the triplet construct with a BUR of 1.6, then a BUR of 1.3 (perceptually slightly different for an experienced listener) might seem too insignificant a variation to warrant scrapping the triplet terminology.

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Another reason for the triplet's prominence is that jazz drummers typically emphasize the lateness of the upbeat eighth which precedes beats 1 and 3. One of the quintessential sounds of jazz is the ride cymbal (or hi-hat) "laying down the time" with a long-short pattern more akin to a triplet than to other higher-order tuplets. Rose (1989) reported a mean BUR of 2.38 in play-along rhythm sections, and Prögler (1995) observed consistent "ridetap pickup" BURs of 3.4 -3.7 at 120 bpm in the playing of Charlie Keil.[3] Replacing the somewhat artificial laboratory setting with real life performance situations, Friberg and Sundström (2002) analyzed the playing of four well-known drummers to discover tempo-dependent BURs ranging from 1.0 to 3.4, with the triplet occurring at around 200 bpm. Since the ride cymbal often serves as an anchor for group coordination, its rhythmic template projects onto the rest of the drum set, other rhythm section instruments, and the global sound of the ensemble. Recall that this study only includes phrases with strings of eighths in soloistic passages. It is likely that actual triplets may be occurring with greater frequency within more rhythmically varied phrases (see Pressing 1987:147), as well as in rhythm section accompaniments. Also, many jazz compositions are conceived in a 12/8 feel (think "The Pink Panther"), so we should not be surprised to encounter high BURs in such contexts. In those cases, the triplet eighth is an attribute of a specific composition or performance, not the norm for jazz in general. "Good Bait" and "Walkin'," above, were two such examples; Example 11 provides two additional ones. In "Big Butter and Egg Man," the triplety feel is made explicit during Wynton Marsalis' presentation of the melody and Reginald Veal's bass accompaniment, so that when solos come around it makes perfect sense for BURs to continue along this rhythmic vein. Even here, however, lower BURed phrases still manage to make an appearance early in the solo. Bobby Timmons's "Moanin'" is another triplet-feel composition, a feature reflected in the solos' rhythmic slant—though again, lower BURs are clearly present, most noticeably in the bass solo.

Most of the recordings examined thus far were made during the bebop and post-bebop eras (roughly 1945–65), and it is conceivable that a parallel analysis of the preceding twenty-year window might yield results more supportive of the triplet eighths theory. Did pre-bebop musicians phrase their eighths with a more triplet-oriented feel than observed thus far? Gunther Schuller (1968:257) writes that "the eighth-notes [in Fletcher Henderson's band] are played very much as a dotted eighth-sixteenth pattern," whereas "at the same time (1923) the [King] Oliver and [A.J.] Piron orchestras were playing a more loping, triplet rhythm." These remarks are probably accurate as far as these bands' overall rhythmic inflection is concerned, although the poor quality of the acoustical recordings makes Schuller's assertion difficult to substantiate through spectrogram analysis. The assortment of rhythmic

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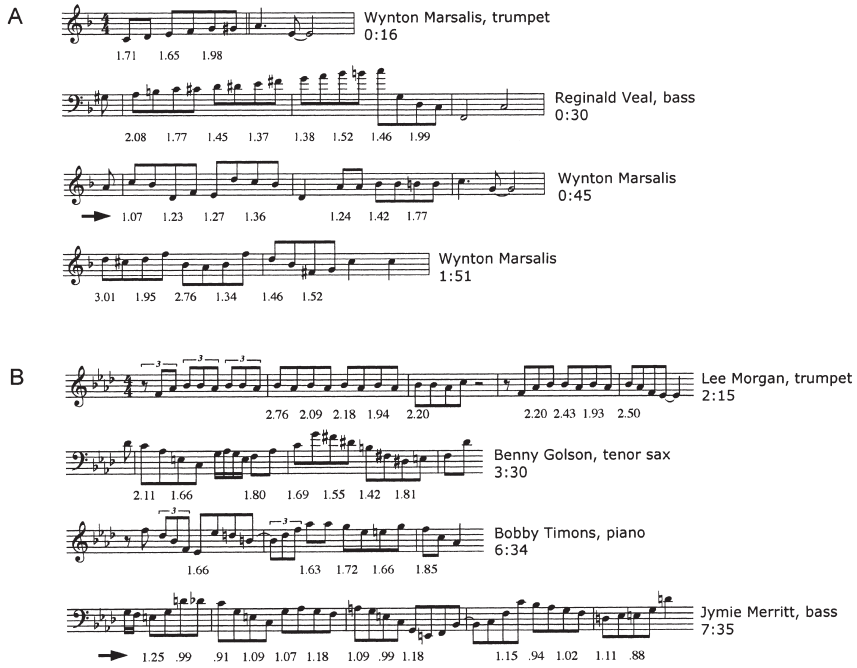
Example 11. High BURs in triplet-based compositions (a) "Big Butter and Egg Man" (116 bpm), from *Wynton Marsalis, Standard Time Vol.3*, Columbia CK 46143. (b) "Moanin'" (126), from *Art Blakey and the Jazz Messengers, Moanin'*, Blue Note CDP 46516 2.



approaches seems to occur simultaneously as each player in the ensemble subdivides the beat according to his or her own taste, contributing to the kaleidoscopic richness of rhythmic and melodic activity that Schuller (1968:85) calls a "horizontally spun-out block of sound." For example, most of Johnny Dodds's clarinet obbligatos (accompaniment lines) in King Oliver's Creole Jazz Band are played in even eighths, offsetting the more uneven cornet rhythms of Oliver and Armstrong, which in turn pale in comparison to "Baby" Dodds' woodblocks. But even within the more triplet-oriented lines, players did not adhere strictly to triplet subdivisions, preferring instead slightly lower values. Collier and Collier (2002) report an average BUR of 1.61 for Louis Armstrong's solos in "Cornet Chop Suey" (1926) and "Potato Head Blues" (1927). This value is decidedly high but comfortably shy of the triplet threshold. Clarinetist Jimmie Noone's 1923 solo in "Camp Meeting Blues" yields lower values still. Additional evidence from the pre-bebop years can be found in Duke Ellington's band. Saxophonists Harry Carney (baritone) and Otto Hardwick

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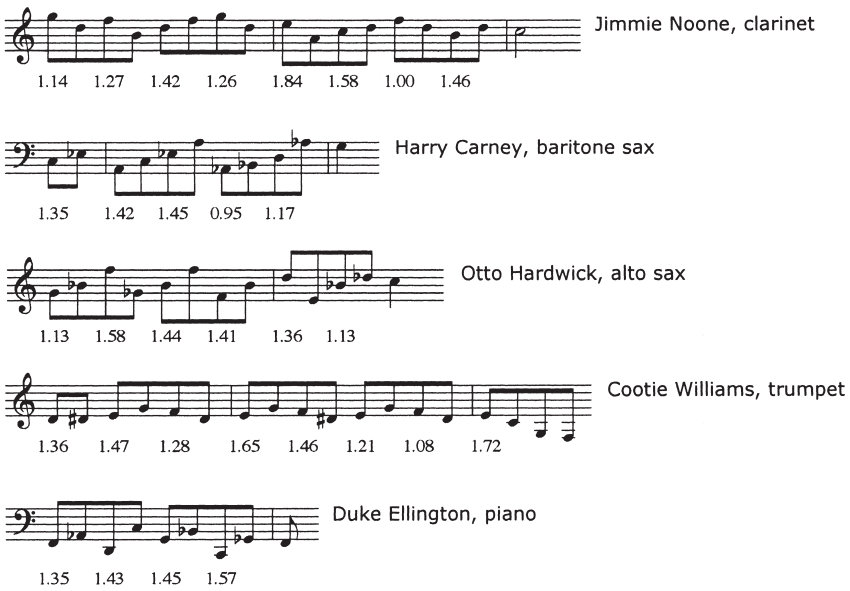
(alto) subdivide their beats at average ratios of 1.3, trumpeter Cootie Williams averages 1.40, and Duke Ellington's left-hand vamp of 1.45 is slightly more pronounced but well below the triplet's 2.0 mark (Example 12).

Final Remarks

This paper offers some evidence in favor of expressive connections between pitch, phrase structure, and microrhythm. Such interrelationships, whenever present, are not always as clear-cut as the foregoing examples might imply. That certain connections can be found between the pitch and temporal domains by no means guarantees their presence in every situation, so any generalities about links between phrasing and microrhythm must be advanced with caution. Lest the reader be led to believe that jazz comes in a neatly organized package where rhythm and melody align with perfect accuracy, I must emphasize that these examples, however thought-provoking

Example 12. Pre-bebop BURs
Noone: "Camp Meeting Blues," 1923 (180 bpm), from *King Oliver's Creole Jazz Band, The Complete Set*, Challenge Records 79007; Carney: "East St. Louis Toodle-oo," 1927 (134), from *The Centennial Collection*, Bluebird 60090; Hardwick: "Black and Tan Fantasy," 1927 (118), ibid.; Williams: "Concerto for Cootie," 1940 (100), ibid.; Ellington: "Echoes of Harlem," 1936 (100), from *Ken Burns Jazz*, Columbia/Legacy C5K 61432.



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and possibly compelling, represent the exception rather than the rule. They are not descriptors of a general trend. Neither would I insinuate that these links are a result of conscious thought processes on the part of the performer; such a discussion is beyond the scope of this paper, and concluding one way or the other would not detract from the analyses. What is more, some BUR values may derive from an unintentionally anticipated or delayed attack, resulting from (say) a tangled fingering or (in the case of wind instruments) the player taking a breath, rather than from a conscious effort to articulate eighths with a specific feel. Indeed, the microtemporal nuances on which my arguments are based are—as the name implies—minute in scope. Musical features such as contour, tempo, timbre, and articulation may cause some BURs to be perceived differently from what the numbers indicate. A listener might perceive two attacks as being closer together if the upbeat's loudness is greater than that of the subsequent downbeat, or further apart if there is a break between the offset of the first note and the onset of the second. The size and direction of the melodic skip may also influence our sensitivity to temporal proximity between two events. Questions of this kind have been explored in the music perception and cognition literature, though to the best of my knowledge they have yet to be addressed empirically in the context of jazz music. These are not trivial disclaimers. Nonetheless, I am reluctant to attribute the above findings to mere coincidence. I chose to examine these excerpts because my ears detected something that seemed worth exploring, and it is encouraging to corroborate such intuitions through the integration of music theory and raw numerical measurements. Time will tell, in the form of continuing dialogue and research, whether these theories merit validation. In the meantime, the findings reported in this study should prove insightful not only to jazz performers, scholars, and educators, but also to artificial intelligence researchers seeking to emulate aspects of jazz through algorithmic modeling. In the realm of jazz theory, the quantitative data contained herein will hopefully enrich our already vast and widely disseminated knowledge of harmonic practices, and may serve to further the design of theoretical frameworks for jazz improvisation. Finally, it is hoped that the automatic adherence to a triplet philosophy will be contextualized if a better understanding of the intricate mechanics of jazz performance is to be gained.

Notes

1. There is often a small but potentially significant element of uncertainty when marking attack points. While two conditions for the selection of excerpts were the fidelity of the recording and the transparency of the attacks, no phrase was entirely free of noise or onset ambiguity. For example, legato playing involves a moment of indistinctness where the pitch is transitioning from one eighth to the next, particularly in wind instruments. Also, the time

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span between a note's attack and the emergence of pitch information can vary not only from instrument to instrument, but also from note to note. In all cases, I made every effort to be as consistent and accurate as possible when tagging the onset of an eighth. While these areas of ambiguity seem minute in scope (estimated to lie around ±5 milliseconds), they can add up to a significant percentage of the overall measurement because the magnitude of the error increases proportionally with the metronome marking. Hence at tempos faster than 300 beats per minute, measurement inaccuracies as small as 5 ms yield an error of about 10%. For this reason, all excerpts were selected from performances where the duration of the quarter note is no less than 240 milliseconds (equal to or slower than 250 beats per minute). This cutoff point is further supported by the informal observation that performers even out their eighths at very fast tempos. The lower limit on slower excerpts was automatically determined by the fact that many performers usually switch to double-time playing when the quarter note lies around 150 beats per minute or less.

2. Amplitude levels were estimated using Sound Forge's Statistics tool, which measures the "maximum sample value" on a scale from 0 to 32,767.

3. Prögler presents the data in milliseconds, which I converted to BURs.

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Discography (see Appendix on website)

Adderley, Julian. *Somethin' Else*. Blue Note CDP 546338). SE
Adderley, Julian. *The Cannonball Adderley Quintet in San Francisco*. Riverside OJCCD-035–2. SF
———, and Coltrane, John. *Adderley & Coltrane*. Emarcy D116399. CC
———, and Evans, Bill. *Know What I Mean?* Riverside OJCCD-105–2. KW
Coltrane, John. *Newport '63*. Impulse! GRD 128. 63
———. *Coltrane's Sound.* Atlantic 1419–2. CS
———. *Coltrane*. Prestige OJCCD-020–2. CO
———. *Giant Steps.* Atlantic A2 1311. GS
———. *Lush Life.* Prestige OJCCD-131–2. LL
———. *Soultrane*. Prestige OJCCD-021–2. SO
Davis, Miles. *'58 Sessions*. Columbia CK 47835. 58
———. *The Miles Davis Collection - A Retrospective*. Deja Vu DVCD 2039. AR
———. *Kind of Blue*. Columbia CK 64935. KB
———. *Milestones*. Columbia CK 85203. MI
———. *Relaxin' With the Miles Davis Quintet*. Prestige OJCCD-190–2. RE
———. *Steamin' With the Miles Davis Quintet*. Prestige OJCCD-391–2. ST
Evans, Bill. *Explorations*. Riverside OJC20–037–2. EX
———. *Moon Beams.* Riverside OJCCD-434–2. MB
———. *At the Montreux Jazz Festival.* Verve 827844–2. MJ
———. *Portrait in Jazz*. Riverside 1162. PJ
Gordon, Dexter. *GO*. Blue Note CDP 546094. GO
———. *One Flight Up.* Blue Note CDP 7 84176 2. OF
———. *Our Man in Paris.* Blue Note CDP 7 46394 2. MP
———. *A Swingin' Affair*. Blue Note CDP 7 84133 2. SA
Jackson, Milt and Coltrane, John. *Bags & Trane*. Atlantic 1368–2. BT
Parker, Charlie. *Masterworks 1946–1947*. Giants of Jazz CD 0217. CP

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