How do you Swing a Quarter Note? An Analysis of the Great Walking Bassists of the 1950s and 60s.

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Table of Contents:

Title:

How do you swing a quarter note? An analysis of the great walking bassists of the 1950's and 60's.

Research Question:

In theory, a bass player's walking quarter notes shouldn't swing, as they are not syncopated like eighth notes are for example; syncopation being a necessary condition of what it is to swing, in that it allows for the long-short lilt that people identify with swing music. In practice however, it is evident that certain bassists are able to create a swing feeling, through a highly complex, and often idiosyncratic approach to quarter note placement within the 'big beat,' as well as to sound production and articulation. By using sonic visualization software such as Audacity, I intend to measure where exactly each quarter note falls within a bar, compared to a mathematically or metronomically correct subdivision of the bar, in order to see if bassists are creating a more subtle version of the lilt required to swing eighth notes. My goal is to shed light on the unique and often highly mysterious properties behind swinging bass lines: are there strategies in common between bassists who are able to accomplish this in performance, or does each performer swing in their own inimitable way; do swinging bass lines rely on a temporal tension between bassist and drummer, or can the bassist swing his quarter notes all on his own; and to what extent are the timbral properties of an instrument and the attack with which a string is engaged relevant?

Motivation and Rationale for Undertaking this Research Project:

Before moving to Holland, the only drummers I was able to play with were students - of varying, though usually not professional abilities. As a result, it was not always clear whether the adjustments I had to make in playing quarter notes in those situations were simply a result of two amateur musicians trying to simultaneously navigate swing feel together, or whether these adjustments were part and parcel of the bassist-drummer relationship. Since moving here however, I've had the opportunity to work with several word-class drummers: a powerful experience, which spurred me to think more deeply about how I was playing quarter notes. Although they were all fantastic drummers, I still always found myself having to adjust, and as such it always felt different playing with each and every one of them: they were all swinging, and yet adjustments still had to be made on my part. I began to reflect upon the question of why, if they are all swinging, do I have to play my quarter notes differently with each of them? Or perhaps did I only *think* that I had to play differently? Clearly, there is more than one way to swing, and this research project is motivated by an attempt to find out why.

Description of the Research Process:

a) Select contrasting examples of bass players that, in my opinion, are swinging, from the period of the 1950s and 1960s. The bassists that I have investigated include: Paul Chambers, Ray Brown, Sam Jones, Israel Crosby, Ron Carter, Jimmy Garrison, Jimmy Blanton, Oscar Pettiford and George Duvivier.

b) Study selected examples using Audacity, both in an isolated fashion, and then in comparison with one another. This creates a visual data set that will then be used to examine what the similarities and differences are between each approach to swinging quarter notes in a walking bass line.

c) At this stage, if there are indeed more similarities than differences, I will then turn my attention to whether the push and pull of swinging quarter notes results from either tension or synchronicity (or some combination thereof) between a bassist and a drummer; as well as what effect the tonal shape of the quarter notes the bassist plays, as related to timbre and attack, have on swing feel.

d) Armed with this information, I will then examine my own instincts with regards to the spectrum and parameters of the various swinging quarter notes of each bassist studied: not with the intent of discovering (or imitating) some 'right way' of swinging, but rather to amplify my listening instincts in my own ability to swing a walking bass line. One major concern at this stage is whether such knowledge is generally worthwhile as a teaching tool, or whether it over-elucidates something that should necessarily remain mysterious.

Background

In order to begin to address the larger research question concerning how to swing a quarter note, I thought it necessary to survey the work that has been accomplished to date in this and other related fields, in an attempt to situate not only my own research question, but to identify possible limitations or opportunities for further work within wider field of discourse on jazz performance analysis and pedagogy.

> There is no essential groove, no abstract time, no "metronome sense" in the strict sense of metronome, no feeling qua feeling, just constant relativity, constant relating, constant negotiation of a groove between players in a particular time and place with a complex variety of variables intersecting millisecond by millisecond. Abstract time is a nice Platonic idea, a perfect essence, but real time, natural time, human time, is always variable. — Charles Keil (1995)[1]

The first major body of work I encountered was Charles Keil's studies of 'participatory discrepancies,' as discussed and elaborated upon in Matthew Butterfield's "Participatory Discrepancies and the Perception of Beats in Jazz." (2010) Keil's basic argument is that there is a shared articulation of the beat between the bassist and the drummer in the creation of swing, and he wants to know whether the push and pull of this shared articulation is what creates swing through what he calls 'productive tension.'[2] Keil's work is of particular interest, especially as compared to similar studies undertaken by pedagogues, ethnomusicologists and theorists, because Keil himself is a bass player, though he and one other bass player performed in the experiments used for his analyses: a potential drawback of his work.

Keil's work could also be seen as a classic case of 'the simplest answer is usually the right answer,' in that his analyses tend to be overcomplicated. He performed perception tests on the general public to determine what the human brain can perceive in the discrepancy between two subjects sharing the articulation of a beat. Keil found that at 2 milliseconds apart, the public can perceive a discrepancy between the attack of the bass or drums, but that they cannot perceive whether the bass or the drums are leading in their shared articulation of a beat when the attacks are less that 20 milliseconds apart from one another, and in many cases even less than 30 milliseconds - which is already getting quite far apart. Interestingly, Keil found that the average discrepancy between the bass and drums in professional jazz ensemble recordings was between 13 and 17 milliseconds.[3] Thus, in general there's no way for our brains to tell which comes first in the shared articulation of a beat: bass or drums.

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[1] Charles Keil, "The theory of participatory discrepancies: A progress report," *Ethnomusicology* 39 (1995): 1-19, as cited in Matthew Butterfield, "Participatory Discrepancies and the Perception of Beat in Jazz," *Music Perception: An Interdisciplinary Journal* 27:3 (February 2010): 157, http://www.jstor.org/stable/10.1525/mp.2010.27.3.157 (last accessed January 14, 2014).
[2] Keil (1995), as cited in ibid, 158.
[3] Keil, as cited in ibid., 164.

Matthew Butterfield however, in his discussion of the work of Keil and many others, highlights an important finding, this time from Prögler, in that "'push' or 'layback' feels...cannot be brought reliably to the level of conscious awareness except by a small minority of individuals distinguished neither by formal music training nor musical taste [and] there is no reason to believe that [participatory discrepancies] are themselves exclusively or even predominantly responsible for the production of swing. There is simply insufficient evidence that asynchronous timing between bass and drums engenders 'a productive tension...which is central to swing.'"[4] Clearly therefore, based on the work of Keil, Prögler and Butterfield, all this leads one to conclude that there's something going on in the creation of swing feel between a bassist and a drummer aside from the placement of beats in time. This is an element that I will actively explore in my own analyses.

> Collier and Collier's exhaustive study of jazz tempos revealed the astonishing regularity and precision of the beat over the course of any given performance. Tempo shifts tend to be minute, rarely exceeding five percent, and tend to occur only at major structural junctures, such as the "bridge" in an AABA form, or with the entrance of a particular soloist.[5]

Another study mentioned in the Butterfield article, and that will also have a major impact on my own research going forward, is that of Collier and Collier - as cited above. In my own analyses I intend to investigate whether what they report, as related to the 'astonishing regularity and precision' of the beat in swing feels, is indeed true in the recordings I've selected. One important question their work raises in my mind however, is that if our brains cannot perceive these millisecond inflections of time, how can a musician consciously and consistently perform them? Collier and Collier, among others, still seem to be looking in the wrong place: i.e. the placement of beats in time. Still, their work is important in that it highlights that jazz rhythm sections, made up of real people with individual perceptions of time, can lock into each other with a highly regular, barely fluctuating beat. So, in eliminating what is actually going on in the creation of a swing feel, so far we can eliminate participatory discrepancies between players, as well as fluctuations both in beats within a bar and overall tempo.

> [Groove is] an isochronous pulse that is established collectively by an interlocking composite of rhythmic entities and an attentiveness to an additional unifying rhythmic level below the level of the tactus.[6]

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[4] J. A. Prögler, "Searching for swing: Participatory discrepancies in the jazz rhythm section," *Ethnomusicology* 39 (1995): 22, as cited in ibid.,166.

[5] G. L. Collier and J. L. Collier, *Jazz: The American theme song* (New York: Oxford University Press, 1993), 79-88, as cited in ibid., 168.

[6] Vijay Iyer, *Microstructures of feel, macrostructures of sound: Embodied cognition in West African and African- American musics.* (Unpublished doctoral dissertation, University of California, 1996), chapter two, 7, as cited in Guy Madison, "Experiencing Groove Induced by Music: Consistency and Phenomenology," *Music Perception: An Interdisciplinary Journal* 24: 2 (December 2006): 202, http://www.jstor.org/stable/10.1525/mp.2006.24.2.201, accessed January 14, 2014.

So the next thing that a good rhythm section does that might have a part to play in the creation of swing feel, is *groove*. Madison, who provides the quote directly above, also goes on to underline that groove does not need to swing, but swing needs to groove. This concept is essential in showing that groove is a necessary part of swing, but that it can exist on its own, whereas swing cannot exist without groove. For example, hip-hop, country music, R 'n B and rock 'n roll all groove, but none of them swing. Swing however, *always* grooves. Interestingly, and as related to Collier and Collier's work on the steadiness of tempi in jazz rhythm sections, all of the above genres of music groove as a result of their steady approach to time-keeping. I am interested to see if the bass players in my planned study also display a steady approach to the beats within a bar, as well as overall tempi, as this is now shown to be an integral aspect of how to swing a quarter note.

'The Beat' in Music

In order to study why 'the beat' is so important to so many musical genres, perhaps it could be useful to investigate why it means so much to us as listeners. An interesting publication dealing with just this question is John Iversen et al.'s study entitled, "Top-Down Control of Rhythm Perception." (2009) In it, the authors assert that the location of the beat in music is suggested by physical cues (accent grouping, phrasing and melody), so ultimately, the cognitive interpretation of the beat is overlaid on top of the physical input.[7] To me, this suggests that when perceiving a regular pulse, our brains quickly stop sensorially reacting to the physical input and start cognitively participating in the creation of 'the beat.' This is proven by the fact that we are able to hear the downbeat of a syncopated rhythm even when it is never played, and that we can imagine the beat is moved to another place within the same pattern. The authors call this "flexible cognitive organization of perception."[8] For me this means that we are hardwired to detect regular patterns, as well as cognitively transpose and even create patterns that may not actually be there. This clearly suggests that our brains search for regular beat patterns while listening to music.

This is amply demonstrated in an experiment by Snyder and Large, as cited by Iversen et al. Here, neural responses to an isochronous sequence (a repeating, rhythmically ambiguous phrase) were measured using magnetoencephalography, or MEG. In one particular trial, listeners were exposed to a sequence in which every other tone was physically accented (louder). These accents were expected to produce a strong metrical interpretation within the minds of the listeners, and they did. When the pattern was changed by the omission of accents, the listeners' brains continued to experience a burst

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[7] John R. Iversen, Bruno H. Repp and Aniruddh D. Patel, "Top-Down Control of Rhythm Perception Modulates Early Auditory Responses," *The Neurosciences and Music III: Disorders and Plasticity* (2009): 58, http://www.nsi.edu/~iversen/pubs/Iversen_Repp_Patel_2009_MetricalInterpretationBrain_NYAS.pdf, accessed February 12, 2014.

[8] Ibids., 59.

of activity where the physically-accented tones had once been. This process is described by the authors as 'focal temporal expectancy.'[9] For me this is further evidence of our brains' hunger for steady metrical pulses.

Perhaps this is precisely why regular pulses groove to us: our brains cease listening and waiting for a physical stimulus, and transition to anticipating the beat to the point of perceiving a stimulus that may not even be there. Throughout all of the studies surveyed above, authors play around with the ideas of participatory discrepancies in attack, while this study and others prove that not only can we not accurately identify these discrepancies, but that we crave regularity so much that we go so far as to anticipate and thus participate in groove itself. So, what could a bass player possibly do to make his groove swing, where others' do not, if everyone is just always playing 'in time?' Based on my own experience as a jazz bassist, there are only two other parameters in the playing of quarter notes that affect whether or not those notes ultimately swing: quality of sound and articulation; in other words, parameters that can be said to be *external* to time, when temporal steadiness is a given.

[9] J. S. Snyder, and E.W. Large, "Gamma-band activity reflects the metric structure of rhythmic tone sequences," *Cognitive Brain Research* (2005) 24: 117–126, as cited in ibids., 60.

Analysis

At the beginning of my research project, like those cited above, I was searching for an answer to why some grooves can swing while others cannot. My expectation was to find subtle manipulations of the pulse within the bar, but no matter how hard I looked, and no matter how many recordings I studied, I could not find any evidence of this phenomenon. Furthermore, scientific studies have proven that our brains cannot perceive such subtle manipulations, and that on top of that we are hardwired to correct them, so how could musicians consciously and consistently perform participatory discrepancies? This led to the next, and most important question: why can a good jazz bass player swing while a metronome cannot?

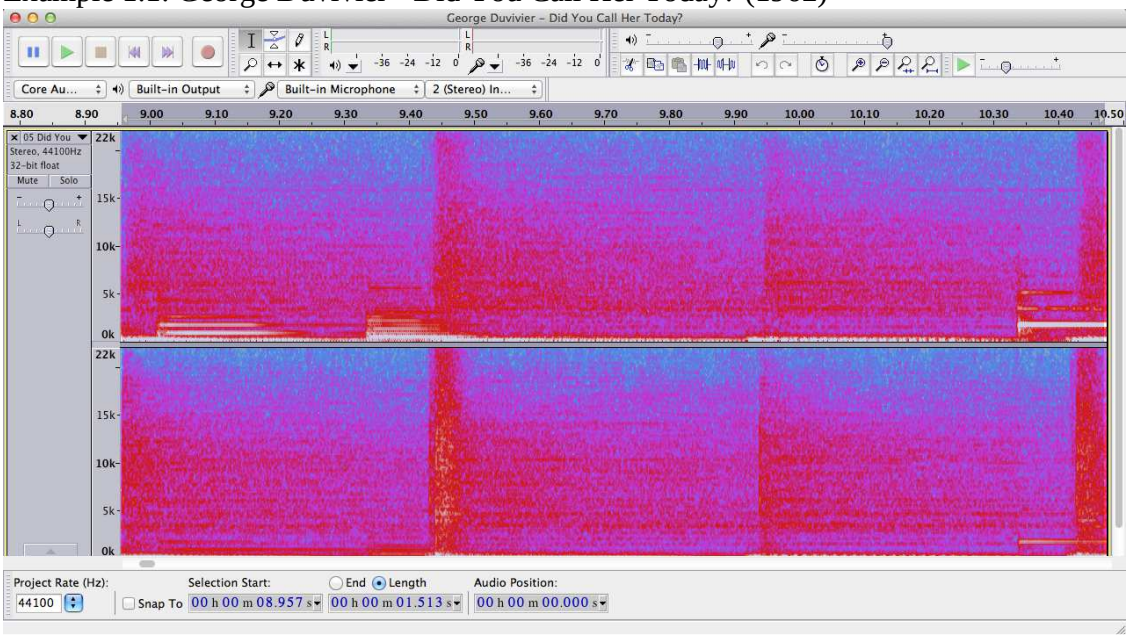
To begin with, I wanted to select recordings of bass players known to consistently swing throughout their careers, and recordings that were of a high sound quality where the bass sound was clearly audible. Secondly, in order to allow for maximum possible temporal flexibility, I selected recordings of tunes in medium tempi, as temporal manipulations in extreme tempi become blatantly obvious and, as a result, would not require sonic visualization analysis to be perceived. In other words, if there are temporal manipulations occurring that are difficult to spot, they are most likely to be found in medium tempi. As you can see in the following visual examples, every bassist I examined plays their quarter notes as strictly 'in time' as humanly possible. For some examples, I even slowed down the recordings significantly so that the image of each quarter note was magnified, and then measured the distance between their attacks in seconds, only to find negligible variations between them. These variations could even be explained by the margin of error related to how accurately one is able to measure the distances between attacks using only the selection/scrolling tools available by Audacity's software. Therefore, even in tempi most susceptible to temporal manipulation, it appears that no such manipulation exists.

For the six examples listed below, I tried to find excerpts of the recordings where the bass was as isolated as possible; and in the excerpts of Paul Chambers, Ray Brown and Sam Jones, each bassist is playing a walking intro with drums, which makes it easiest to view their playing on the sonic visualization software. For the other three examples (Jimmy Garrison, Ron Carter and George Duvivier), I simply selected a few bars where the soloist is not so busy, which also allows for a clearer visualization of the sound data.

In each image, time elapsed between attacks, measured in seconds, is displayed horizontally, while frequency is displayed vertically, and therefore the bass tones are represented by the very darkest colors at the very lowest portion of the image. I elected to use the spectrogram display rather than the typical waveform display, specifically because in the spectrogram display it is possible to distinguish between the different frequencies of the instruments, and thus easier to detect when each instrument attacks. In the waveform display on the other hand, making this distinction is much more difficult, if not impossible, unless the bass is playing alone. You'll notice that each spectrogram display is divided between the left and right channels, with an upper window and a lower window dedicated to each. Without knowing the specifics of how each recording was

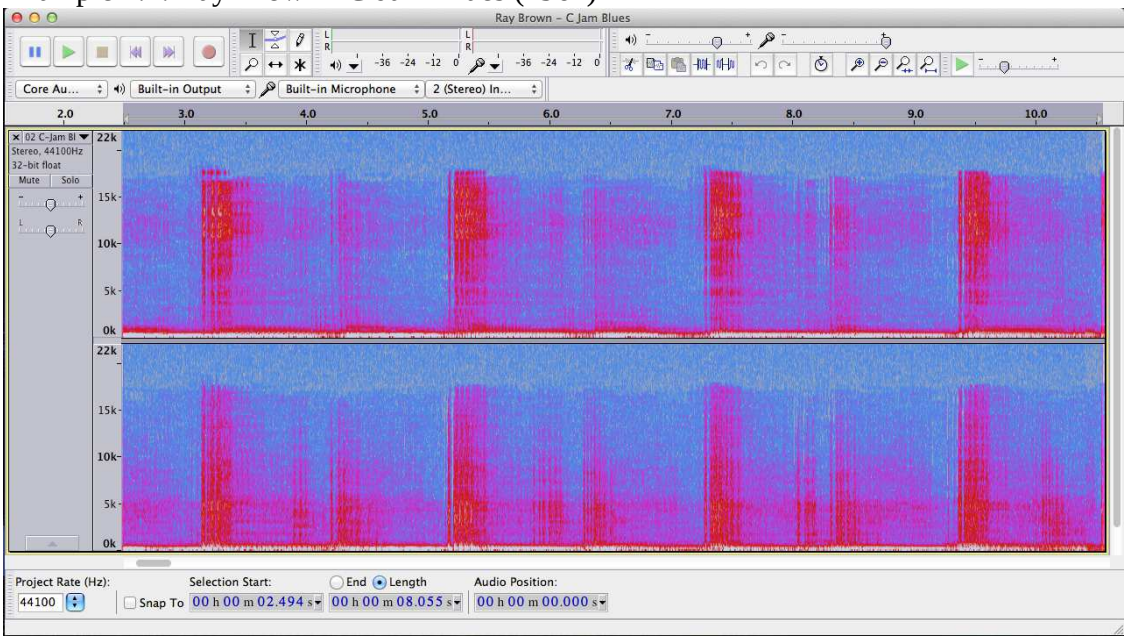
made, it seems as though the bass comes through more or less on both channels. As each example is taken from an ensemble recording, usually recorded in one room, it can be difficult to know what to look for or even what one is seeing when looking at these spectrograms. However, the basic rule is that the low frequencies show up at the bottom portion of each window, and the high frequencies show up at the top of each window. That being said, when you have a combination of bass, left hand piano and bass drum all attacking at the same time, the display of the lower frequencies becomes a bit muddled as result - making careful listening while analyzing the visual display even more vital. Another important point to note is that the dramatic vertical attacks you can see in each display represent the drum set, but because we are focused here on the bass attacks, one must be careful not to be distracted by the display of the drumset. To focus on the bass, one must zero in on the very darkest portion in the bottom few millimeters of the display.

Example 1.1: George Duvivier - Did You Call Her Today? (1962)



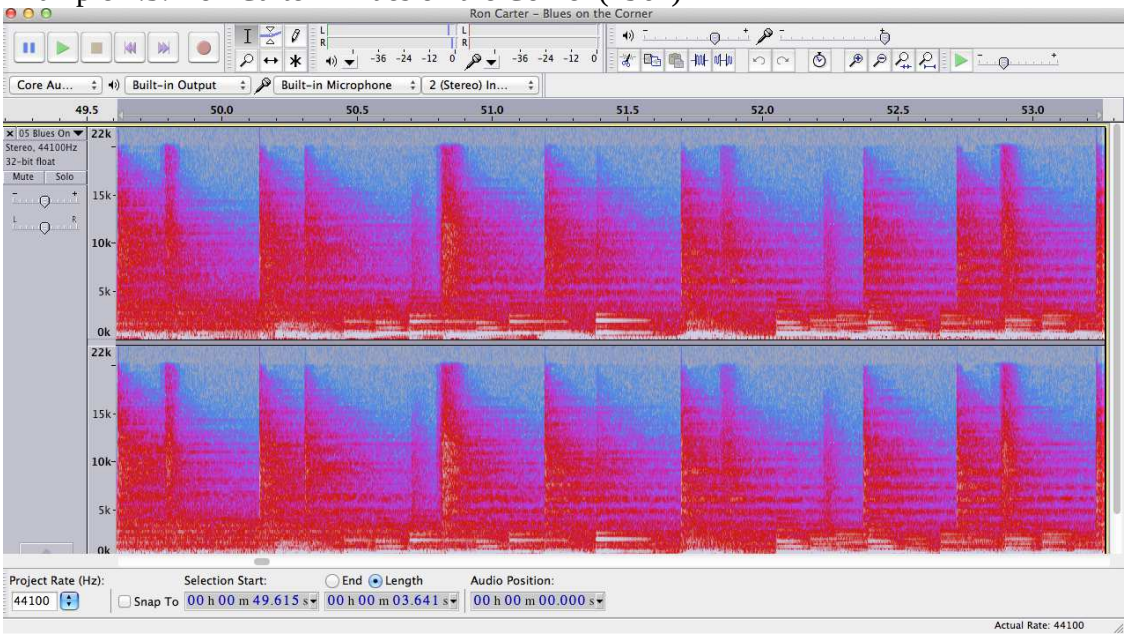
Here you see one bar, with four beats, where drummer Clarence Johnston and bassist George Duvivier are enjoying a particularly tight hook-up, making the image clean and easy to read. Playing in this excerpt are bass, drums and pianist Hank Jones, the latter of which is represented by the bright white marks, showing the typical decay of a keyboard attack.

Example 1.2: Ray Brown - C-Jam Blues (1962)



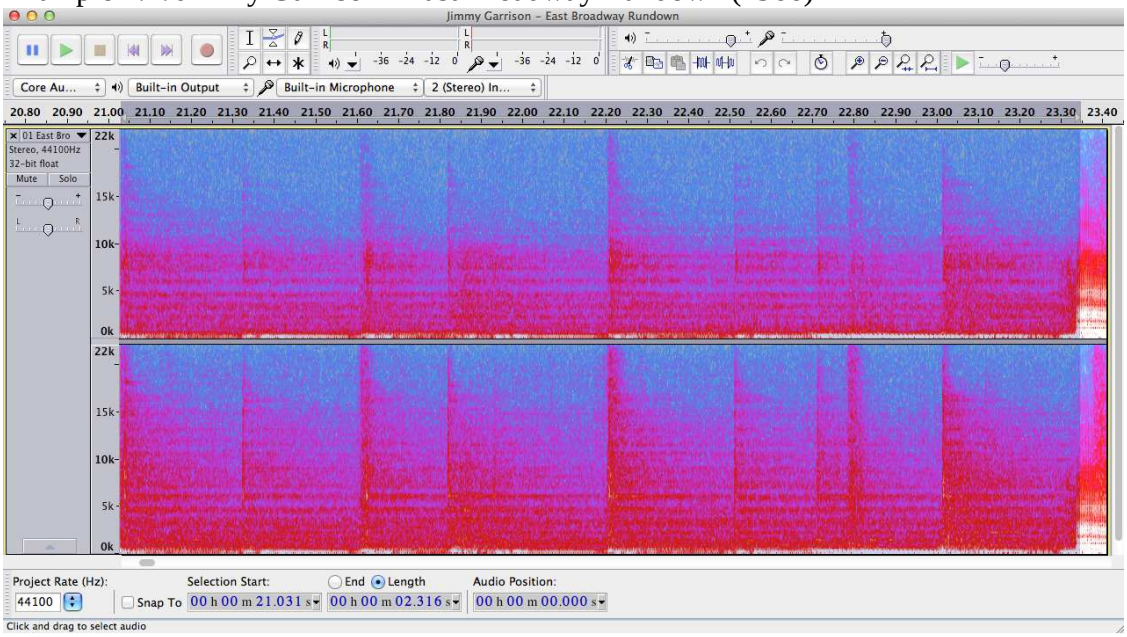
Here is an example of two bars of a walking bass intro, where only the bass and drummer Ed Thigpen are playing. The thick vertical lines are where the bass, the brushes and the high hat are playing together, while the vertical attacks between them are where just the bass and brushes play together. Here we also have an astonishingly tight relationship between bass and drums, and a highly regular bass beat.

Example 1.3: Ron Carter - Blues on the Corner (1967)



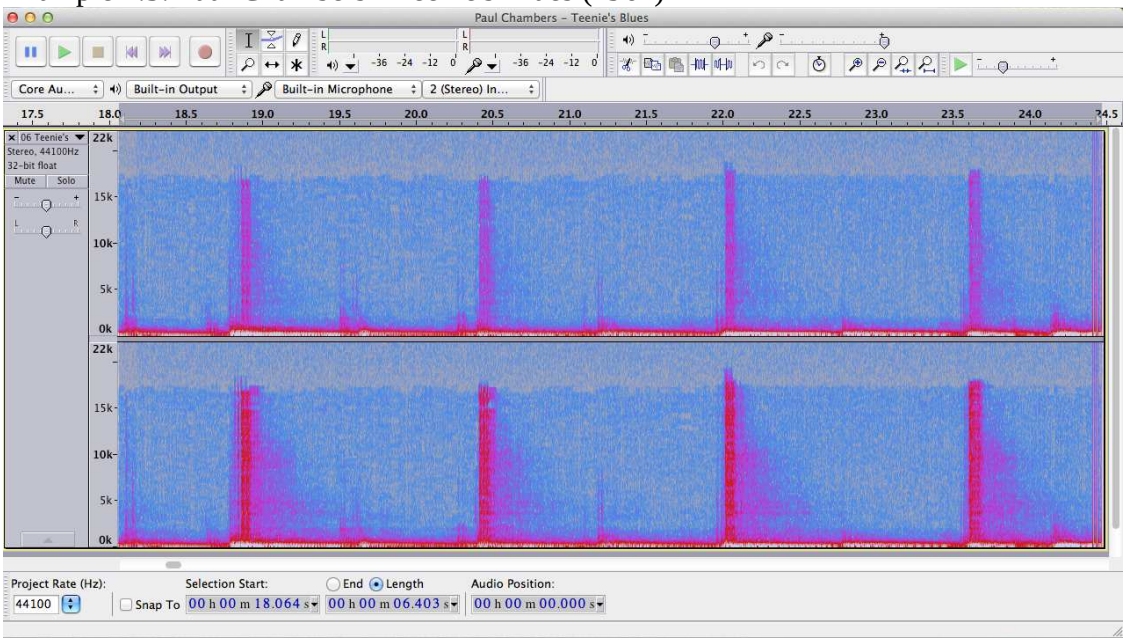
Here we have an image that is slightly muddied by the fact that here the bassist is playing with drummer Elvin Jones, famous for his loose time feel, and pianist McCoy Tyner who plays with a very heavy left hand and often in the low register. Even though it is slightly hard to read, the bass beats in this recording are still highly regular: the bassist is holding everything together.

Example 1.4: Jimmy Garrison - East Broadway Rundown (1966)



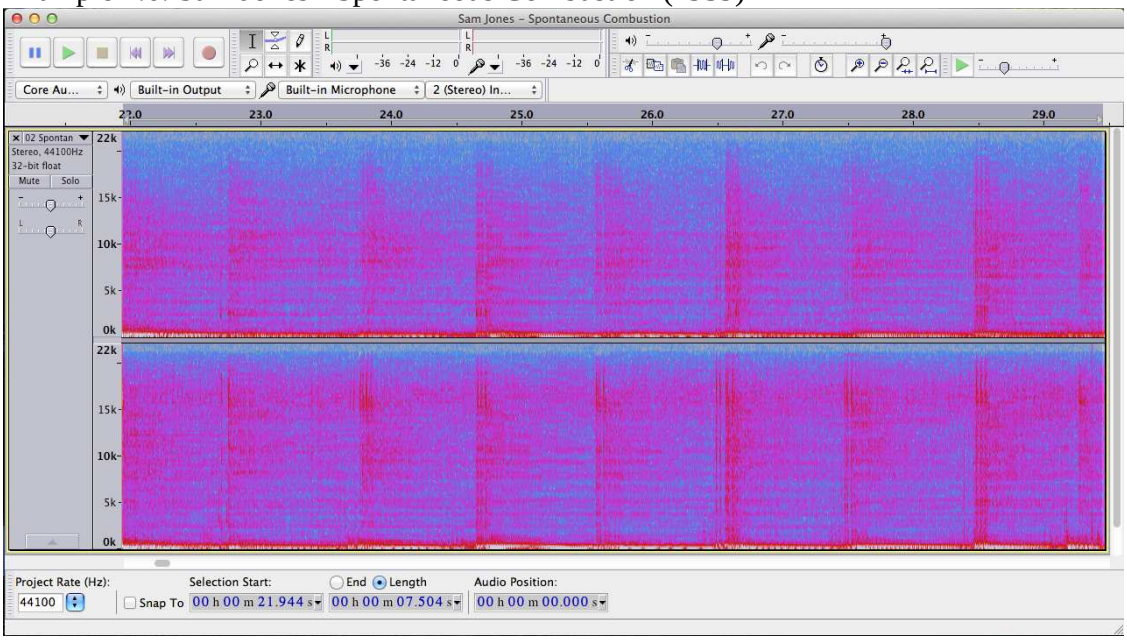
This is another recording of two bars in which drummer Elvin Jones is playing quite loosely, but nonetheless, bassist Jimmy Garrison maintains a very strong and regular beat.

Example 1.5: Paul Chambers - Teenie's Blues (1961)



This is also two bars of Paul Chambers playing a walking intro with drummer Roy Haynes, playing high hats on the two and four (the tallest vertical peaks), with the bass attacks visible on their own. Thus here you have an example where the bass is playing truly on its own on beats one and two (the smaller vertical peaks). Still however, this is an extremely regular example of time feel.

Example 1.6: Sam Jones - Spontaneous Combustion (1959)



Here too we have a two bar example of a bass and drums intro, featuring Sam Jones with Louis Hayes playing an obviously steady beat.
All of the above examples will be played during my final presentation, allowing the jury to both see and hear how steady these bassist play regardless of what is happening in the rhythm section around them. In general, while all of the bassists in these examples are undoubtedly swinging, as will be obvious upon playing the excerpts, these examples are a clear illustration of the premise that bassists are not manipulating time in order to create a swing feeling, nor does swing result from the participatory discrepancies between bass and drums discussed earlier, and upon which many performance analysts seems so focused. Clearly, the bass players are approaching time in the same way, regardless of the various approaches of the drummers with whom they play. While at the outset of my research I too was focused on temporal manipulation as a key element of creating swing feel, these results confirm my growing suspicions (especially after having surveyed work done to date on the issue) that there is something else going on here. Steady time is of course a given, but it is not what is creating the swing feeling, leading me to ask what makes a groove start to swing?

To me, the only remaining parameters are sound and articulation: elements that cannot be satisfactorily and definitively analyzed within sonic visualization software such as that used to carry out the above analyses. While some programs such as Sonic Visualiser can measure loudness (dynamics) and decays of attacks, these analyses are typically carried out on solo recordings, and even then, the results still do not reflect the multidimensionality of sound itself (i.e. aside from loudness and decay). If you consider the language used to describe sound, we use words to describe color, texture, material, lightness/darkness, and even descriptions of emotional states and intention. To date, there is not a sonic visualization software in existence, and perhaps nor should there be, that comes close to quantifying or mimicking human modes of listening to or producing sounds, much less reading the meaning those sounds engender. These processes lie firmly within the intuitive, heuristic and ephemeral language and understandings of musicians, as well as educated listeners.

Critical Discussion/Analysis:

While all jazz musicians would agree that timing, and specifically a 'swinging' time feel, is fundamental to the genre, few attempts have been made to successfully quantify or explain how different jazz bassists develop their own individual sense of swing feel. Having read much of the work done to date on the issue, and having carried out my own analyses of selected bassists - combined with my own in-depth practical experience playing with a variety of world-class musicians - I've discovered that the very human element of bassists' sound production and articulation, with steady time as a given, can be the only driving force behind a swing feel. It seems as though having a 'fat' sound in particular is extremely important to the creation of a swing feel. In fact, during Charles Kiel's experiments on the general population, regardless of whether the bass or the drums were attacking the beat first, when the bass had a 'fat' sound, it was always perceived to be driving the rhythm section, in that it seemed to be attacking the beat first - even, most interestingly, when it was in fact behind.[10] This points obviously to sound as a key factor in creating a swinging feel, especially as related to the forward directionality so important to creating that feel.

Related to this forward directionality of sound production is the element of 'bounce' that all great bassists, including those surveyed above, seem to possess. Guy Madison's studies also connect this forward intentionality of sound to a feeling of driving forward, movement and 'bouncing,' in what he calls the 'Factor II' of making a groove swing. Listing the parameters associated with Factor II he asserts that, "Factor II...goes together with Driving, Intensive, and to some extent with Rapid and Bouncing. Both Driving and Intensive seem to reflect movement induction."[11] Highlighting the gap between theory, experimentation and real-life music-making however, Madison goes on to concede that, "it is not clear what bouncing might correspond to in acoustic or musical terms." Any jazz bassist of course, should know how the quality of 'bouncing' translates in musical terms: it is a roundness of sound, combined with energy, intention and happiness.

Regarding the application of my research to my own practice both as a performer and a pedagogue, I've identified the following parameters in order to help myself and others develop and understand how to swing a quarter note, while understanding that it is a purely aural tradition that can never, and perhaps should never, be understood in any way other than by listening and playing.

- 'Fat' sound
- Strong attack
- Regular pulse

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[10] Charles Keil, "The theory of participatory discrepancies," *Ethnomusicology* 39 (1995): 1-19, as cited in Matthew Butterfield, "Participatory Discrepancies and the Perception of Beat in Jazz," 165.

[11] Guy Madison, "Experiencing Groove Induced by Music: Consistency and Phenomenology," 206.

- Variety of articulation

Everything that swings has the above characteristics, while everything else is style and character. All a bassist can do is experiment with the above ingredients, and find out how to expertly manipulate them in a variety of ways. On top of all of these concepts there are a number of physical things one can do to cultivate a sound that can swing. Firstly, the height of the string action (the distance between the string and the fingerboard) should be in the high range, as it allows for the maximum movement of the string, thus making the resonance and roundness of the sound bigger. A strong left hand position seems important as well, where the weight of your arm and body is focused on the very tops of the fingertips: this helps to reproduce the sound of a plucked open string, which is the biggest sound you can get, while playing in all positions on the bass. Right hand position is also important: it must always be at the bottom of the fingerboard, as the tension is greater closest to the bridge, thus allowing for a quick reaction of the string after it is plucked, rapidness and intensity being factors in driving the beat forward. This quickness of attack seems to go a lot further towards creating a big sound than sheer force. The instrument must be allowed to breathe. How bassists pull the strings of the instrument with their fingers seems to vary greatly from player to player, and seems to vary according to factors such as the player's height, weight, length of arms/fingers, and size of hands. Finally, it is also essential to have a powerful but relaxed standing position when playing, free of stress.

Conclusions:

At the beginning of this research project, I was interested in how and why a bass player's walking quarter notes swing, and I hypothesized that this quality of swing came down to subtle manipulations of quarter note placement within a bar, both on the part of the bassist and in conjunction with the drummer. After a comprehensive survey of major publications accomplished to date in and around this issue, I began to have serious doubts about the role of temporal flexibility in creating a swinging walking bass line. As discussed before, most of these studies focused on the placement of beats in time, particularly as related to the 'participatory discrepancies' between bassists and drummers. The results of these studies tended to suggest that a) such discrepancies would be impossible for musicians to consciously and consistently perform and, b) that the human brain is both unable to accurately perceive such discrepancies, and actually tends to 'need' to correct them.

Nonetheless, I decided to investigate for myself just what was happening, from a temporal point of view, in a selection of excerpts of great walking bassists of the 1950s and 1960s. By using sonic visualization software, I measured where exactly each quarter note of each bassist's walking lines fell within a bar, compared to a mathematically or metronomically correct subdivision of the bar, and discovered that rather than creating subtle temporal lilts within the bar, bassists *are* the metronomic subdividers of the bar. In all of the excerpts analyzed, not only were the bassists playing with an extremely strict pulse, they did so regardless of the drummer with whom they played. My initial goal was to shed light on the unique and often highly mysterious properties behind swinging bass

lines. It seems as though in a rather roundabout way, I have accomplished this. While steadiness of time is clearly the foundation of a groove, swing in and of itself, is a complex negotiation and amalgam of sound and articulation factors: parameters that remain highly elusive to quantification.

I have recently discovered in my own playing, that regardless of which drummer with whom I am playing, that my time feel needs to remain strong and unchangeable by what it is they are doing. This allows me to swing immediately and consistently on my own, or with whomever I am playing, provided the drummer is competent. All of this together answers my initial questions of: Do swinging bass lines rely on a temporal tension between bassist and drummer? No. Can the bassist swing his quarter notes all on his own? Yes. To what extent are the timbral properties of an instrument and the attack with which a string is engaged relevant? Extremely. In undertaking this study I was also interested in the opportunity to think critically about a major parameter of jazz bass performance that is highly ephemeral and rarely quantified, though at the end of this project I now realize that that major parameter, while reliant on time, is actually sound and articulation. The outcome of my research will also be relevant to my teaching activities, as I feel now that I understand much more about how 'swing feel' might be visualized, taught and understood. This work has also made me a much more confident and relaxed performer, as I now realize that instead of anxiously negotiating time with a drummer, I now know that I can just play.

During my final presentation I plan to share the results of my comparative source analyses; share audio examples and corresponding visualizations of the various approaches to swinging quarter notes; discuss the implications of these results for my own practice; and provide several live examples of those implications.

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