Swing in early Funk and Jazz-Funk (1967-1971):
Micro-rhythmic and Macro-structural investigations

Guilherme S. Câmara

A Thesis Presented to
The Department of Musicology
University of Oslo
in Partial Fulfillment of the Requirements for the MA Degree
Spring 2016

Swing in early Funk and Jazz-Funk (1967-1971):

Micro-rhythmic and Macro-structural investigations

Guilherme S. Câmara

2016

Swing in early Funk and Jazz-Funk (1967-1971): *Micro-rhythmic and Macro-structural investigations*

Guilherme S. Câmara

http://www.duo.uio.no/

Trykk: Reprosentralen, Universitetet i Oslo

Contents

Abstract

The timing of rhythm section instruments in prototypical early period funk and jazz-funk tracks (1967-1971) was investigated in order to gauge to what extent 'swing' might be a vital rhythmic quality in funk-based grooves. Swing was defined as consecutive note pairings of the same subdivision level with long-short ratios between on- and off-beat equal to or higher than a theoretical threshold of 1.2:1. Sixteenth notes of instruments were measured both in terms of overall swing per measure ('global' mean swing) as well as per sixteenth-note pair ('local' mean swing). In nearly all excerpts analysed (twelve out of thirteen), either global or local swing was found in at least one instrument. Findings suggest that it is not clear-cut use of regular swinging subdivisions that seems to define the general microrhythmic character of classic funk grooves, but rather a subtle juxtaposition of straight and swung sixteenths which is manifested both within the fluctuating local swing patterns of single individual instruments, as well between the interaction of globally swinging and non-swinging instruments of the rhythm section. Utilizing the empirical results from the swing analyses, various ways in which swung sixteenth-note pickups and syncopation gestures may be perceived to interact with virtual referential metric structures as well as counter-rhythmic patterns were explored in light of interpretive and affective rhythmic theories of jazz and funk.

Acknowledgements

First and foremost, I would like to thank my supervisor Anne Danielsen for her invaluable guidance – her passion for combing scholarship and funk music have been tremendous sources of inspiration. Thanks as well to Hans T. Zeiner-Henriksen for his help and for always encouraging my academic efforts ever since my early days at the University of Oslo, and to Kjetil Klette Bøhler for the many interesting discussions on musicological research. Thanks to Alexander Roinesdal for his superb crash course in statistics, and to Chrisitan Coucheron for making me painfully aware of how much funk grooves do in fact 'swing', despite our differences in definition. Thanks to my dear family members who have always supported both my musical and scientific predilections, no matter which strange turns they took. Last, but definitely not least, thanks to Hedda Lingaas Fossum for her constant moral and emotional support, not to mention her exquisite editorial and proof-reading skills.

“It don’t mean a thing, if it ain’t got that swing.”

Duke Ellington/Irving Mills

1 Introduction

1.1 Swingin' Funk Grooves?

What is it about funk rhythms that make them 'funky' in the first place? Do Funk rhythms 'groove', or do they 'swing', and what is the difference? Funk is ubiquitously described as 'groove' music. In vernacular musical parlance, despite slight differences in use of terminology, the term has typically been applied to relate either to the manner in which musicians position their rhythmic events within the context of a repeating formal structure, or to connote the resultant general 'feel' or 'drive' that is engendered by such rhythmic interactions. More recently, in rhythm research, it has been associated more specifically with patterns of microrhythmic deviations from assumed isochronous beat and subdivision references on an order ranging from tens to hundreds of milliseconds – encompassing sounds which are often implicitly felt more often than heard when they occur on the threshold of auditory perception (see Butterfield 2006; Danielsen 2010; De Haas 2007, Friberg and Sundström 1995; Iyer 2002).

'Swing', on the other hand, has been used to denote similar meanings pertaining to a general 'feel' engendered by particular rhythmic interactions, although usually when speaking within the context of jazz styles more so than funk. It holds a greater amount of analytical use, however, when technically defined instead as the quality of rhythmic events on eighth- or sixteenth-note subdivision levels, which are divided into unequal durations. As such, the extent to which a rhythm 'swings' can be expressed more objectively in terms of 'swing ratios' between on-beat and off-beat notes. In an expanded sense, swing may therefore be considered as simply one kind of 'microrhythmic' expression[1] which emerges from the property of grooves. Other related forms of microrhythmic expression arise when separate sound events occur asynchronously at around similar times, for example when bass is positioned slightly ahead or behind a drummers beat.

Despite the fact that funk rhythms are generally held as comparatively straighter than jazz swing rhythms, the few scholars who have paid serious attention to funk-based rhythms have noted that musicians' sixteenth-notes are in fact *not* always played in a strictly isochronous fashion, but rather frequently in fact swung to varying, yet mostly subtle degrees (Danielsen 2006; Stewart 2000). Whilst many empirical studies on microtiming and swing have been conducted regarding jazz styles (Benadon 2006; Butterfield 2011; Collier and Collier 1996; Ellis 1991; Friberg and Sundström 2002; Honing and De Haas 2008; Rose 1989; Waadeland 2006, 2011), only a handful have collected sporadic data on funk rhythm (Butterfield 2006; De Haas 2007; Hughes 2003). None of these have

[1] Alternatively termed as 'expressive microtiming' (Clarke 1987) or 'participatory discrepancies' by (Keil:1987).

systematically attempted to scrutinize the extent to which the pioneers of funk rhythm swung their grooves.

1.2 Research questions

In this thesis, I will explore the rhythmic properties of salient accompaniment instruments in seminal early funk and jazz-funk grooves, using a two-part approach investigating both the micro- as well the macro-structural level, macro here understood as the level of rhythmic figures within the basic groove pattern (the basic unit) of one or two bars. The micro-level investigation will involve empirical quantitative methods in order to objectively determine to what extent microrhythmic expressive patterns such as swing are present. In the macro-level analysis, more interpretive structural and affective theories of rhythm will be applied to explain why such microrhythmic expressions are used by funk and jazz-funk musicians.

More specifically, in Part I the object of analysis will be microrhythmic variations seemingly present in the basic units of funk-based grooves at the sixteenth-note subdivision level. Via measurements in the waveform and sonogram representations of grooves, we will attempt to answer some of the following questions:

1. Do instruments swing their sixteenths on average? If so, to what extent do they swing (what is their Global Mean Swing Ratio)? And might there be any systematic relationships/correlations between such swing and Tempo, or between the swing of individual instruments (Inter-Instrument Global Swing Mean Ratio)?
2. Is there any relationship between the mean durations of sixteenth-note off-beats (Global Mean Absolute Second Note Duration) and Tempo which may suggest a lower limit of the short durations in the long-short swing pattern?
3. Do instruments tend to position their on-beat sixteenths (or all their eighth-notes) either in synchrony with drums (‘on the beat’) or asynchronously (‘behind’ or ‘ahead of the bear’).
4. Does the Swing Ratio of individual instruments fluctuate from beat to beat within a measure in a systematic fashion, that is, are there stable Local Mean Swing Ratios for each beat or do they vary considerably, showing irregular patterns instead?

Some of these questions are designed in order to directly compare and contrast with existing studies of microrhythmic variation, primarily conducted on jazz swing styles (Butterfield 2006, 2011; Friberg and Sundström 2002; Honing and De Haas 2008), and to a lesser degree on some funk as well (De Haas 2007). The remaining questions are motivated purely by the aim to contribute new research about possible unique microrhythmic patterns present in funk -based styles.

In Part II, we will be concerned with the relationship between microrhythmic expression and

virtual beat references and subdivisions, as well as wider macro-structures, such as counter-rhythmic figures. Empirical results from Part I will be examined in light of more interpretive rhythmic theories, in order to discuss differences in the design of patterns of swing in jazz and funk, and also explore *why* funk and jazz-funk musicians may apply various degrees of swing and other forms of microrhythmic expression to their grooves.

1.3 Theory and Methods

The work in this thesis draws on two traditions of rhythm research, the first of which is based on interpretative analyses of groove that attempt to combine structural theories of rhythm with affective experiences of groove in funk or 'swing' in jazz. This is the main approach of Danielsen's groove studies (2006, 2010) and is also an aspect of Butterfield's work on microtiming (2006, 2011). Secondly, the thesis draws on empirical rhythm studies from music psychology and music cognition, in particular the more specific studies of microrhythmic expression such as the aforementioned works by Butterfield (2006), but also Friberg and Sundström (2002), Honing and De Haas (2008), De Haas (2007) and many others. For a more thorough presentation of theory and methods relating to the microanalysis sections, see chapter 2, and for those pertaining to structural rhythmic theories in affective groove analysis, see chapter 4.

1.4 Historical Connections - Funk and Jazz

"When people talk about soul music they talk only about gospel and R&B coming together… Jazz [is what made my music] so different and allowed it to change and grow after soul was finished…"
James Brown (Brown 1986, p. 120).

As the quote above shows, James Brown readily acknowledged that what inspired his stylistic developments after his 'soul' period in the mid to late 1960's – that is, when he and his musicians are generally held to have begun developing funk as distinct style – was the genre of jazz. His bands throughout the 60's included many jazz musicians in much the same way that other R&B and soul powerhouses of the era did, such as Motown label's house-band The Funk Brothers, as well as that of Stax's Booker, T and the MG's. Several instrumental albums by James Brown and band during the period, such as *James Brown Directs And Dances With The James Brown Band* from 1964, clearly showcase his bands' proficiency in jazz styles, not least demonstrating their particularly affinity for the swinging grooves of the so called 'funky hard bop'/'soul-jazz' tendency. Alexander Stewart tells us that Brown's "use of ninth chords, chromaticism, extended improvisation and 'modal' harmonies… confirm his interest in jazz… [and] because of these affinities… his music was appreciated by many

jazz musicians and in turn influenced the development of jazz/funk fusions by Miles Davis, Herbie Hancock and others," (2000: 309).

Whilst it is accurate to say that these highly visible jazz figures[2] were party to the development of funk and jazz hybrid forms, the majority of contributions to 'jazz-funk' as a distinct style (but modelled closely on the rhythms and forms of James Brown's early funk), came instead from relatively unknown artists signed to independent jazz record labels (e.g. Blue Note, Prestige and CTI) such as Lou Donaldson, Lonnie Smith, Reuben Wilson, Grant Green and many others. Most such artists were already active proponents of jazz styles which were deemed to skirt the realm of the popular, and were consequently the first to venture into funk-based territory almost immediately after 'funk' had begun to crystallize in 1967 with the release of what many historians and critics consider to be the first 'true funk' track: James Brown's *Cold Sweat* (Danielsen 2006; Vincent 1996). Instead of utilizing funk in a free experimental fashion as a means to an aesthetic genre-challenging, avant-garde endeavor like Davis (and Hancock to a lesser extent), these artists gave more fully into the novel rhythms and adopted funk's idiom in a fashion that held more faithful to its original form, eventually producing grooves which rivaled those of Brown and company themselves. However, it may be argued that what made Brown's new style distinctly 'funky' in the first place was the result of a process of stylistic cross-fertilization of elements which were historically present in both jazz and popular musical traditions in the U.S. long before the 1960's. Therefore, when funk did arise as a new style, jazz artists could be said to already be actively utilizing some of its stylistic materials, albeit in different configurations, in the same ways as the pioneer funk artists themselves were simultaneously re-contextualizing musical markers of jazz practice.

1.4.1 Funk before Funk – Funky Hard Bop/Soul-Jazz (1950's -1960's)

Historically, the term 'funk' or 'funky' had already been utilized in various different musical contexts well before the emergence of funk as a distinct style. As early as the in the very beginning of the 20th century, the word itself connoted that of a strong offensive smell, and one of its earliest recorded uses in regards to music was in a song credited to New Orleans ragtime cornetist Buddy Bolden called 'Funky Butt', written at some indeterminate point before his death in 1907 (Welch 2007). Guitarist Danny Barker claims that in the song's lyrics: *I thought I heard Buddy Bolden say/ Funky Butt, Funky Butt take it away/ I thought I heard Buddy Bolden shout/ Open the windows and let it all out,* Bolden was alluding to the term to describe the ripe olfactory state of a dancehall after an invigorating dance

[2] Herbie Hancock's contributions, although considerable, occurred relatively late, starting in 1973 with the album *Head Hunters*. In Miles Davis' case, whilst catching onto Funk already in 1970 in *Bitches Brew,* and perhaps more significantly in 1971's *Live Evil!,* the incorporation of Funk elements occur in an thoroughly eclectic and iconoclastic fashion, alongside heavy use of stylistic signifiers from other contemporary popular styles such as Rock/Psychedelia, and would perhaps be more suitably labeled under 'Fusion'.

tune because “any crowd of people, black, white, green, gray will get funky when dancing close together and belly rubbing” (1998: 31). In the era where jazz was in its infancy in New Orleans, the term ‘funk’ was already connoted with the particular black musical traditions of the region, although also in a more general sense with music which was made to dance to, or to literally getting ‘funky’ to.

In the mid 1950’s however, the term ‘funk’ would become more concretely associated with a particular sub-style of the hard bop[3] school of jazz, namely that of ‘funky hard bop', also commonly referred to as ‘soul-jazz'. Most historians draw narratives which purport that the various hard bop branches evolved as a reaction to previous bebop's “avant-garde drifting and solo experimentation,” which was “presumably distancing jazz from its roots and from mass appeal” (Brown 1994:498), or as against cool jazz’s excessive austere dedication to “restraint and subtlety,” that had “reputedly drained the emotional content from jazz” (Rout B. Jr. 1968: 39). Regardless of which interpretation may have been a greater influencing factor, it is generally accepted that the funkier brand of hard bop took center stage in filling the commercial and aesthetic gap in the jazz world by embracing a “return to the pulsing rhythms and earthy emotions of jazz’s ‘roots’” (Rosenthal 1988:22). These purported ‘roots’ were namely that of the Blues tradition, as well as those derived from “Gospel-oriented black Baptist and Spiritualist Churches of the South and the urban ghettos of the North” (Rout Jr.: 49,n31). As David Rosenthal elucidates, in this period, ‘funk’ was therefore “upgraded from implying an unpleasant odor to denoting emotional authenticity…” (1988: 24-25), and together with the interrelated term of ‘soul’, was applied to express “earthy, natural [as opposed to] phony” qualities (Rout Jr. 1968: 49,n31). More technically, though, ‘funk’ was frequently used to describe the “extensive use of blues voicings on tunes that [were] not strictly speaking blues,” (Rosenthal 1988:22) or as pianist Horace Silver put it “funky means earthy and blues-based. It might not be blues itself, but it does have that ‘down-home’ feel to it” (in Du Noyer 2003: 140), whilst ‘soul’ alluded to the harmonic progressions and rhythmic fervor of music derived from Gospel.

Furthermore, historians DeVeaux and Giddins add that whilst most hard bop styles “employed a strong backbeat, an aggressive urban sound, and gospel-style chords”, the Funky branch “simplified the result – preferring basic harmonies, shorter solos and clearly defined dance rhythms” (2009:444). Indeed, pioneer hard boppers of the funky tinge forged a conscious attempt to take jazz away from the pedestal of the concert stage filled with reverently silent and still-seated listeners, which bebop had precipitated, back to the rowdy dance halls and clubs where avid fans and dancers convened. As drummer and bandleader Art Blakey relates: “when we’re on the stand and we see that there are people

[3] ‘Hard Bop’, Rosenthal (1992) explains, was an umbrella term devised in the mid 50’s by critics to denote Jazz trends developed in the East Coast of the U.S. in opposition to the contemporaneous ‘Cool Jazz’ school of the West Coast region. Asides from the ‘funky’ branch, he describes it as encompassing three other main sub-styles: an 'astringent' branch characterized by relatively more ‘sombre moods’ that favoured the minor mode; a gentler, 'lyrical' sub-style, less 'high-voltage' in comparison, and an 'experimentalist' branch which strove above all to expand jazz's structural and technical boundaries.

in the audience who aren't patting their feet and who aren't nodding their heads to our music, we know we're doing something wrong" (in Rosenthal 1992:37). Record producer Michael Cuscuna from the Blue Note label, which had an extensive soul-jazz artist repertoire, noted that the early hard boppers of the funky variety "knew that the only way to get the jazz audience back and make it bigger than ever was to really make music that was memorable and planned, where you consider the audience and keep everything short. They really liked digging into blues and gospel, things with universal appeal..." (in Dean 2010). Funky hard boppers, then, sought to bridge the gap between jazz and popular styles by tailoring the technical codes of their new style to appeal to wider audiences.

Rosenthal believes that what "chronologically separated bebop and hard bop in ghettos" of the North-East, was not simply negative reaction against either preceding bebop or parallel cool jazz styles, nor a mere retrograde revival of jazz's progenitor 'roots', but rather the positive influence and hybrid incorporation of elements from the "vigorously creative black popular music" of the time which "began the amalgam of blues and gospel that would later be dubbed 'soul music'," (1992:24). 'Soul' was indeed the label attached to the form of R&B which heavily adapted stylistic elements of the same purported 'roots' of jazz, that of gospel and blues, by artists such as Ray Charles, Little Richard and later also James Brown. This emerging form of popular R&B in the late 50's presented itself to both established and aspiring jazz musicians alike as a rich source of generic codes, ready to be adopted and transformed into their stylistic palette to their own likings, in much the same way funk would in the 60's. Plenty of hard bop musicians can be said to have 'paid their R&B dues' by actively performing with groups that covered a wider range of popular styles rather than just strictly 'jazz' - a quick glance at several funky hard bopper's biographies usually confirm this. In fact, such active cross-generic activity was common practice for a range of jazz musicians extending back to at least the Swing era if not beyond, partly due to economic necessity as it wasn't always viable for jazz musicians to only play jazz gigs at all times.

1.4.2 Funk as a Rhythmic Approach

As we saw in the previous section, from the mid 50's to 60's, musical 'funkiness' was connoted to a dance-oriented beat with backbeat emphasis, which was present in funkier brands of both popular R&B styles of Soul as well as jazz styles such as funky hard bop/soul-jazz. However, perhaps the most relevant meaning of 'funk' tied to the actual distinct style of funk as developed by James Brown in the late 60's, is that of a rhythmic sensibility or 'attitude' stemming from New Orleans percussive traditions. Stewart (2000) has outlined in detail how at least since the early 1950's, native musicians of the Crescent city regarded 'funkiness' as denotative of a local approach to rhythm derived in part from traditional percussion patterns of second-line marching as well as Mardi Gras Indian processions. Some of the main characteristics common to these drumming patterns were that they

were based on sixteenth-notes rather than swing/shuffle eighth-notes, and were "often highly syncopated and stressed the first beat of the measure, permitting deviations from the accented second and fourth beats (backbeats) and offbeat eighth notes found in jazz and R&B shuffles" (loc. cit. 309). Another characteristic associated to this funkiness, was the practice of blending of straight and swung subdivisions by the various instruments of ensembles, producing uniquely ambivalent funky rhythms that were a 'trademark' of local R&B artists (loc. cit.:297).

In the mid 60's, Stewart recounts how in popular music at large, a shift from 12/8 compound meter and shuffle- or swing-based to 4/4 meter based on straighter eighth-note rhythms had occurred in the majority of R&B styles in the rest of the United States. However, highly syncopated patterns largely based on further subdivisions of sixteenth-notes and featuring unusual syncopations such as the accenting of the 'four-and' beat by snare drum (instead of the regular second backbeat on the fourth quarter note) were practically unheard of except for in New Orleans, and might be ascribed to Afro-Cuban influence ('four-and' equaling the third stroke of the three-side of a rumba clave). In the late 60's, however, they begin to feature as a standard trait in the drum patterns of James Brown tracks, starting most notably in 1967 with *Cold Sweat*[4]*,* and signaled a decisive break for Brown in his transition from Soul to funk. According to Jim Payne (1996), this apparently occurred not long after one of Brown's key drummers in the early 60's, Clayton Filyau, learnt the highly syncopated drumming practice from travelling New Orleans musicians, and passed it on to John 'Jabo' Starks and Clyde Stubblefield, the latter who would eventually go on to craft the signature *Cold Sweat* pattern as well as several variations based upon it. As Brown's alto saxophonist, Maceo Parker said, funk became a new compositional tool for the band, it was "a way to play: funky as opposed to straight" as well as "a form, a style of music… [which] James made a craze," (Rose in Stewart 2000: 309).

Coincidentally, during the same period, a parallel, arguably more radical, shift to straighter rhythms took place in the jazz tradition which, for since its inception had been largely dominated and even defined to a considerable degree by swung eighth-note based rhythms (save perhaps for a few certain Latin-American influenced styles). This was brought about when the same type of sixteenth-note based syncopated patterns funk had adopted also became conspicuously present in the output of artists associated with soul-jazz. One of the earliest examples of this transition to straighter, funkier rhythm occurring can be found in tenor saxophonist Lou Donaldon's *Alligator Boogaloo*, which released in the very same year of 1967 and featured a drum figure almost identical to that of Stubblefield's in *Cold Sweat*. The common link in this case was drummer Idris Muhammed, who was himself a native of New Orleans and well versed in the practice of funky syncopated rhythms. The

[4] There are earlier examples to be found such as *I've Got Money* from 1963 as Stewart (2000) relates, as well as in several 'funkier' live versions of originally non-Funk James Brown tracks in the 1964 album *Pure Dynamite!,* however only after 1967 do they become commonplace in Brown's repertoire.

eventual popularity of *Alligator Boogaloo* precipitated a trend of funkier rhythms in jazz that paralleled the impact James Brown's *Cold Sweat* had in the popular realm, and both tracks can be seen as considered as marking a critical point where the distinct styles of funk and jazz-funk began to crystallize.

1.4.3 Funk and Jazz-Funk as Distinct Styles (1967 onwards)

With the release of *Cold Sweat*, James Brown had funk more or less set down as "a cohesive, rhythmically locked musical structure" (Stewart 2000:309), and a new standard was set for Brown and his musicians of which the majority of their musical output in the next few years would adhere to. One element which distinguished James Brown's new proto-typical funk from his previous Soul tracks of the 1960's was, as we saw in the previous section, the shift from simple eighth-note based rhythms to more syncopated funkier rhythms based on sixteenth-notes derived from New Orleans percussive traditions. Asides from this were mainly changes in the harmonic foundation and overall formal structure - long extended grooves with few formal divisions, usually only verse-bridge binary structures, based on simple single or two-chord vamps in modal harmony (usually dorian) would usurp the typical R&B foundations based on variations of the basic 12-bar blues format comprised of I7, IV7 and V7 chords. Thus the earlier conception of 'funk' as relating to Gospel and Blues-based chord progressions would be replaced by the rhythmic conception primarily, coupled with even simpler, more 'static' harmonic foundations.

The use of extended single or two chord vamps, as Stewart notes, was an element which Brown assimilated from jazz (Stewart: 309) as they were standard feature in the modal jazz of the late 50's. Alfred 'Pee Wee' Ellis, alto saxophonist in Brown's band who co-wrote and arranged the song, says that Miles Davis' seminal tune *So What* (1959), was a direct influence in the creation of *Cold Sweat* (Cohen 2007). Indeed, one can hear the clear parallels in that both songs are in the Dorian mode and feature main horn riffs which are based on simple two chord statements over a vamp centered on a tonic chord. Other jazz qualities appropriated in Brown's new funk was a general "[p]reference for chords including upper partials such as ninths" (loc. cit.) which give most funk tunes a distinctive jazzy feel. Another less frequent but significant jazz y quality in funk is the odd unorthodox harmonic modulation, such as in the transitional segments between verse to bridge *Cold Sweat*[5], which even in traditional jazz settings might sound rather odd or according to Ellis (2002: 80) in his autobiography, as almost "musically incorrect." However, they are somewhat in keeping with jazz's experimental and avant-garde tendencies of pushing boundaries and deconstructing accepted parameters.

[5] The verse moves from a Dorian tonic Dm vamp down a whole step to a new Mixolydian tonic chord C7, and alternates with a subdominant F7 until it finally and unexpectedly climbs to a dominant G9 via a rhythmically punctuated, melodically ascending horn break before returning to verse's Dm.

As for parallel funk developments in the jazz world – the purported hybrid style of 'jazz-funk', in this author's opinion, should be attributed to works by soul-jazz/funky hard bop artists which appropriated the salient funk qualities to at least a similar degree of Brown's first prototypical funk track, *Cold Sweat.* Therefore, inclusion of syncopated rhythmic patterns based on sixteenth-notes by accompaniment section instruments itself would not necessarily suffice if a 12-bar Blue format was still maintained. However, it seems that in the period between 1967 and 1971, whilst many soul-jazz artists incorporated funky rhythms in favor of swung uneven eighth-note based ones, they occasionally continued to prefer Blues formats. The first 'true' jazz-funk track which fulfilled all of the salient funk criteria set by *Cold Sweat*, was most probably, and perhaps not coincidentally, a cover of James Brown's song "*Say It Loud (I'm Black and I'm Proud)* by none other than Lou Donaldson, once again in the same year of the original's release (1968). Still, in the same way that there was probably no definite moment in which forms of Soul crystallized into funk, since the features which came to define funk were already present to varying degrees in proto-funk songs before *Cold Sweat* (Danielsen 2006:39-40), there was no parallel radical transition from soul-jazz to jazz-funk. However, by virtue of the paramount importance we may ascribe to funk's rhythmic properties in particular as style-defining, for the purposes of this thesis, soul-jazz tracks which clearly depart from overt swing-based grooves and incorporate funk rhythmic foundations, but not necessarily harmonic or overall structural ones, such as Donaldson's *Alligator Boogaloo*, will still be regarded stylistically as jazz-funk.

1.5 Overview of Salient Funk Rhythm Characteristics

In this segment, we will briefly review the most relevant criteria of funk rhythm which will be pertinent to our analytical micro- and macro-investigations in chapters 3 and 4 respectively. They are informed primarily by Danielsen's (2006) and Stewart's (2000) guidelines, who both ground their definitions of funk as a style with "an emphasis on technical features and [their] appropriability" (Moore 2001: 441). It should be made clear that the definition of style that is used in this thesis is based on what Alan Moore refers to as 'internal, musical features', which operate 'prototypically'. However, he warns that "one cannot devise an exhaustive list of features that all examples of a style have, and that will enable any listener to make the same labeling decision no matter what their background" (loc. cit.:119-120). Jazz historian Scott DeVeaux agrees, adding that "the more specific or comprehensive such a list attempts to be, the more likely it is that exceptions will overwhelm the rule" (1991: 529). If we limit the scope of the body of funk works to a more 'local' style level, however, or to a narrow period of time which closely bounds related works with similar basic features, 'proto-typical' members of the style, as Moore says, can serve as an immediate and quite effective

means of conveying style. Therefore, for our purposes, James Brown's *Cold Sweat*, for example, may serve as a track which exemplifies certain overarching common features of Funk as pertaining primarily to the parameters of rhythm.

1.5.1 Sixteenth-note density referent

A subtle but vital quality of funk rhythm is that, whilst on the surface their density referent[6] may be strongly perceived as based on the eighth-note level (since it is frequently constantly and clearly externally manifested by primary time keeping elements such as the hi-hat or ride cymbal), the sixteenth-note level is all-pervasive in funk. The faster subdivisions in funk impart a perception of "double time [within] regular time," as drummer and educator Jim Payne put its (in Milkowski 2012). This feature alone generally distinguishes funk from earlier typical rhythmic patterns used in Soul/R&B, which operated mainly on the straight eighth note level, and can be most readily heard in the patterns of drums which are rife with flurries of sixteenth-note snare drum ghost strokes, or in those of typical guitar 'chicken scratch' riffs (short, muted percussive attacks on the strings which produce little or no sustain and decay). More often than not, sixteenths are woven into the grooves of funk patterns in interspersed, rather than a continuous and insistent fashion, and "[e]ven when it is not played, in funk the sixteenth note is always felt or implied," (Stewart 2010:309). Therefore, funk tracks do not always establish an overt perception of a main sixteenth subdivision level, showing what Danielsen refers to as "highly developed ambivalence towards [the] smallest rhythmic unit" or a seeming "emerging non-fit of subdivision and phrasing", that is, "subdivision [on the eighth level] implying one density referent and phrasing [on the sixteenth level] another" (Danielsen 2006: 75). This usually occurs when notes coinciding with eighth-note beat locations are phrased in such a staccato manner as to imply the higher, smaller subdivision level of sixteenths.

1.5.2 Syncopation and Counter-rhythm

Strong accentuation of off-beat eighth-note locations in the patterns of instruments are ubiquitous in funk grooves. Systematic series of such off-beat accentuation may be considered as cases of isolated syncopations when considered in the context of singular eighth-note beats of the 4/4 meter. However, when viewed from a wider structural perspective such as within the span of a one or two bar repeated basic unit in a groove, they may also be seen as comprising extended 'counter-rhythmic' figures with a "tendency towards cross-rhythm" which hint at an alternative pulses (Danielsen 2006: 62). The main function of these figures is to seemingly add tension and disturb the main pulse, however, unlike pure cross-rhythms, they do not usually serve to make a track "the product of two different pulse schemes", and are alternatively woven into the fabric of the groove so that it appears as a 'single rhythm' where

[6] The smallest practical unit of subdivision in which a rhythm is organized (Danielsen 2006:44)

the main 4/4 still pulse rules (loc. cit.: 67). Typically, such counter-rhythmic patterns in funk and jazz-funk are composed of variations of the so-called duple meter version of the 'African Standard Pattern', which group the eights or sixteenths of a bar into asymmetrical figures of 3+3+2 or 3+3+3+3+2+2 (loc. cit..: 63).

1.5.3 Swing

The precise extent to which various instruments swing their sixteenth notes in funk is as of yet empirically unknown, and will be explored in depth in Part I of this thesis. However, in general, as Danielsen has observed, the sixteenth-level subdivision in the early funk of James Brown seems to "almost always be swung to a greater or lesser extent" (2006:224n4). Additionally, it is common to find separate instruments operating with various different degrees of swing ratio on "the borderland between duple and triple subdivision," which ultimately contribute to a reigning ambivalence within the total groove texture (loc. cit.:134). Such microrhythmic ambiguities are held to be so vital by Danielsen that when certain instruments, such as guitar in a later-era Disco-tinged funk Brown track *Funky President* (1974), play continuous sixteenths 'too evenly and accurately' in exceedingly insistent fashions, they run the risk of "straightening out the groove in a negative way" by not allowing enough "room for the ambivalence cultivated by the rest of the groove" (loc. cit.:229n9). Conversely then, we can assume that sixteenths swung too highly would likely disturb the balance of the groove in an opposite way.

It would seem then, that subtle, rather than radical blends of swung and straight sixteenth rhythmic patterns are preferred in a great deal of early funk. As for jazz-funk, since its rhythmic foundations were both derived from funky New Orleans rhythmic-compositional practices common to funk, as well as distinct funk rhythms themselves, it is likely to operate by similar aesthetic principles regarding swing. However, whereas the pioneering funk musicians had operated with straighter rhythms for a longer period of time, many jazz-funk artists came directly out of explicitly swung jazz styles such as soul-jazz and it is possible that they may have brought elements of these swing practices into their funk-based repertoire. To answer this, as well as several other questions pertaining to how swing is applied in funk and jazz-funk remains to be answered in the main body of this thesis.

1.6 Outline Summary of Thesis

Part I encompasses the microanalyses of funk and jazz-funk grooves. The main purpose will be to explore *to what extent* classic period funk and jazz-funk instrumentalists swing rhythmic events on the sixteenth-note level. In section 2.1 theoretical and methodological considerations concerning measurement of swing and microrhythm will be discussed, and then in section 2.2 the specific

materials and procedures utilized in the analysis of salient accompaniment instruments' rhythm in thirteen funk and jazz-funk audio recordings from 1967-1971 will be elaborated on. In Chapter 3, the results of the analyses will be presented in terms of: Global Mean Swing Ratio (overall swing ratio per measure) and its relationship between tempo, Absolute Duration of Sixteenth Pairs' Second Note (mean duration of off-beat) in relation to tempo, Global Mean Asynchrony (between drums and bass/guitar/keyboards) and Local Mean Swing Ratio (mean swing ratio per individual sixteenth-note pairs of a measure).

In Part II (Chapter 4), I will discuss the relationship between micro-features of the groove and rhythmic structure at the level of one to two measures (the 'basic unit' of the groove). In sections 4.1 to 4.2 a basic rhythmic framework which allows us distinguish between complete swung note-pairs and lone standing off-beat sixteenth pickup and syncopation within the scope of virtual reference structures will be established. Then in sections 4.3 - 4.6 structural-affective theories from research into both jazz and funk, form the starting point for exploring possible explanations for *why* funk and jazz-funk instrumentalists might swing their sixteenth-note gestures. Various ways in which swung sixteenth note pairs, pickups and syncopations may be perceived to interact with virtual referential metric structures and macro-rhythmic figures will be elucidated throughout the chapter using empirical observations from Part I.

In the last chapter I will summarize the main findings of the thesis and discuss its limitations, as well as outline some directions for future research.

Part I:

Microanalysis of Select Funk and Jazz-Funk Tracks (1967-1971)

2 Theory and Methods

In section 2.1 theoretical and methodological considerations concerning our measurement of swing and microrhythm will be discussed. In section 2.1.1 the basic theoretical framework of rhythm adopted in this thesis will be outlined, in **Error! Reference source not found.** relevant empirical research into swing microrhtyhms will be reviewed, in section 2.1.2 the metric frame of reference for analysis will be determined, in 2.1.3 certain issues pertaining to the measurement of sound event onsets will be discussed, 2.1.4 'just noticeable thresholds' (JND's) of swing will be established, 2.1.6 JNDs for onset asynchronies will be established and, in 2.1.7 the relationship between asynchrony and swing ratio will be elaborated upon, as well as the implications of both 'absolute' vs. 'relative' swing ratio calculation. In sections 2.2.1 to 2.2.8, the specific materials and procedures utilized in the analysis of rhythm instruments' microrhythm in thirteen funk and jazz-funk audio recordings from 1967-1971 will be elaborated on in detail.

2.1 Research into Microrhythm: Theoretical and Methodological Considerations

2.1.1 Sound and reference structures

For the purposes of a microanalysis focused on determining swing ratios and other microtiming relationships, the question of what is to be the fundamental referential scheme against which to measure rhythmic events becomes most pertinent. There are numerous approaches to this challenge belonging to different research traditions (see Honing 2012 for a comprehensive overview). However, most of them share the view that rhythm emerges in the meeting of external sound and internal schemes for structuring the sound that are activated in the listener.

In this thesis, I will mainly adopt the dual framework of virtual reference structures and actual gestures as proposed by Danielsen (2006, 2010), which are based in part on the so-called Uppsala school of rhythm research (Bengtsson and Gabrielsson 1983) as well as Clarke's (1985, 1987, 2000) conception of rhythm perception as fundamentally belonging to both a categorical and a non-categorical, or expressive component. In Danielsen's model, rhythm is similarly conceived as the interaction between "rhythmic structure and the sounding realizations of such structures" (2010:19). In *Presence and Pleasure* (2006), she draws upon Gilles Deleuze's metaphysical notion of 'virtuality' to devise an analytical framework for understanding the relationship between the interaction of the 'something sounding', or that which is played, together with the 'something not sounding', or the structures of reference which may serve as 'preliminary conditions for

performance'. According to Deleuze's model, the 'virtual is not the opposite of the 'real', but instead simply one part of a two-fold manifestation of reality, in which the 'virtual is the complement of the 'actual'. Danielsen therefore argues that in music, "even though the structures of reference at play in a rhythm are not actual sound, they should not be regarded as something abstract or external to the music," but rather as virtual structures – either in the form of referential beat and subdivision schemes or ideal forms of rhythmic figures (loc. cit.:47). These virtual figures and schemes should be seen as 'real but not actual, ideal but not abstract'; they "must be defined as a part of the real object, as though the object resides partly in a virtual domain" (loc. cit.) and as inextricably linked to actualized (externalized) sound events in a groove, together comprising a single gestalt, one total 'reality' of rhythm (loc. cit.:47).

Danielsen further explains the interdependence between opposite sets of actual objects (sound events) and virtual objects, (structures of reference) via an appropriation of linguistic concepts proposed by Ricoeur and Bakhtin amongst others. In short, actual sound manifestations in music are likened to concrete forms of linguistic speech, such as 'utterances' or 'gestures', which are deemed as the counterpart to virtual language 'schemes' or 'figures'. Importantly, neither gesture nor figure should be considered as 'primary' in determining the other, but instead as mutually interdependent concepts contingent upon one another: an "utterance is not to be regarded as an actualization of a structure existing independently of the utterance, either before or after," but instead, the "virtual sentence of linguistics comes into being as far as an actual utterance is spoken, and the other way around," (loc. cit:49). In the very same spirit then, rhythmic 'figures' "might be conceived of as a proposal or scheme for structuring and understanding the gesture", where neither necessarily prefigures the other (loc. cit.).

The implication of such a model for conceptualizing rhythm is that performers are assumed to operate with some sort of mental schema in order to orient themselves rhythmically, via a hierarchy of regular beat and subdivision reference structures on the virtual level. On the sixteenth-note level, where swing is purported to occur in funk rhythm, such a reference structure may or may not necessarily be isochronous. Rather than being considered as micro-deviations from an assumed, metronomic grid-like internal reference, actual gestures of swung notes should be viewed to provide clues as to the nature and shape of the virtual structures of which express and engender simultaneously. Observations of actual gestures of swung sixteenth-note pairs grouped into long-short patterns of varying ratios would therefore imply a swung sixteenth virtual subdivision comprised of 'virtual swing pairs'. As such, even when the first notes (off-beats) of such pairs are not actualized, it is entirely possible for performers to maintain operating on a virtually swing level, which however, may possibly fluctuate to varying degrees throughout the course of a performance, from straighter to more swung.

2.1.2 Empirical research into swing

A great deal of empirical studies conducted into micro timing of jazz swing styles have focused on measuring average ratios of eighth-note pairs in melodic solo instruments: Ellis' (1991) study of saxophone improvisations found swing ratios between 1.7:1 – 1:1, Collier and Collier's (2002) analysis of swing timing in two Louis Armstrong solos found swing ratios between 1.61:1 – 1:1 and 1.58 – 1 at fast tempos of 173 and 186 bpm, and Benadon (2006) also studied a variety of prominent jazz soloists and found swing ratios to range between 1.4:1 – 1 and 1.2:1 – 1. Rose (1989) additionally measured the timing of piano, bass, and drums in 'play-along' recordings and found all instruments to swing at approximately the same mean ratio of 2.4 in the 'swing' track at 132 bpm. In addition to measuring swing ratio, certain researchers have focused on additional factors affecting performance of swing rhythms, such as body movement (Waadeland 2006, 2011; Kilchenmann and Senn 2015). In the remained of this section, however, we will focus on reviewing three studies which have investigated relationships between swing ratio and global timing factors such as tempo in rhythm instruments in greater depth. As such, they are of particular interest for this thesis and will serve, in part as references for our own micro-analytical investigations. These are Friberg and Sundström's paper '*Swing Ratios and Ensemble Timing in Jazz Performance: Evidence for a Common Rhythmic Pattern'* (2002)*,* De Haas' master thesis, *The Role of Tempo in Groove and Swing Timing* (2007) as well as a paper subsequently produced from the results of the latter by Henkjan Honing and De Haas, *Swing Once More: Relating Timing and Tempo in Expert Jazz Drumming* (2008).

Friberg and Sundström measured the IOIs of four consecrated jazz drummers' ride cymbal in excerpts from 1960's recordings, and by plotting the mean calculated swing ratio of the ride cymbal as a function of tempo from the various excerpts, they found a tendency towards a linear relationship. More specifically, their results implied an inversely proportional relationship which dictated that as tempo increased towards 300 b.p.m. and beyond, the drummers' swing tended to gradually approach lighter ratios up to almost 1:1 (even eighths) and conversely, as tempo decreased towards 80 b.p.m. and below, mean swing ratios approached a 'hard' maximum of around 3.5:1 (longer than a dotted eighth note followed by a sixteenth). De Haas (2007) and Honing and De Haas (2008) on the other hand, conducted experiments in a laboratory setting with three contemporary professional jazz drummers from Holland, and their results showed no significant correlations between swing ratio and tempo: "swing timing did not scale proportionally with tempo," with "no evidence… found for a linear interpretation" (loc. cit. 2008:475). The drummers they studied did show a slight linear trend in the region of 250ms to ca. 375ms (from 160 – 240 b.p.m.). However, in medium to slow tempos, that is, from 375ms and upwards to 600ms (<160 b.p.m.) each individual drummers' swing ratio maintained itself rather stable at approximately 2.2 (near tied-triplet eighths).

Both teams also investigated the relationship between the mean absolute duration of the second note in a swing pair and tempo. Once again, Honing and De Haas and Friberg and Sundström came to contrary conclusions. Friberg and Sundström (2002:337-338) reported that the mean duration of the second note became approximately constant at 100ms at tempi above 150 b.p.m. (75 b.p.m. relative to funk). They speculated that such a value could be related either to the shortest IOI duration playable, or to the lower limit of human perception for duration of short physical stimuli (Efron 1970). This value was also significant for bolstering their assumed relative constant JND threshold value of 20% for swing ratio since, by both assuming a constant second note duration of 100ms as well as a constant IOI JND duration of 10ms, they calculated that in terms of swing ratio, JNDs would roughly be 10% at slower tempos and 20% at higher. Meanwhile, Honing and De Haas' (2008:475) study found no evidence for a constant second note duration in their drummer's ride swing in mid to fast tempos, in fact, their results indicated a strong linear correlation between absolute second note duration and tempo, where second note duration decreased proportionally with increasing tempo.

It is worth mentioning that De Haas (2007) also studied two additional rhythmic patterns asides from the straight-ahead jazz ride swing pattern focused on in further detail in Honing and De Haas (2008). These were the so-called 'funk shuffle', based on Jeff Porcaro's half time shuffle pattern in Toto's '*Roseanna*' where drummers in the experiment were instructed to swing the eighth[7] notes, and the other was based on Clyde Stubblefield's pattern from the James Brown track '*Funky Drummer*', where drummers were instructed to play 'straight'. De Haas found that in the funk pattern, much like the jazz ride Swing pattern mentioned before, no correlation or linear trend was found between tempo and swing ratio: "The swing ratio changes very little over tempo [from 120 to 200 bpm] and stays approximately constant at 1:1, which means that both eighth-notes have an equal duration," (loc. cit.:35). Curiously, on the funk Shuffle pattern, however, the ratio of the swung hi-hat cymbal, which averaged between 1:5 and 1.75:1, did in fact show an inverse proportional scaling with tempo (loc. cit.:34,38). We will later in the analysis section compare our results to all of these findings.

On one hand, both teams' studies provide at least partial support for what Honing and De Haas term as the '*tempo-specific timing hypothesis'* in jazz, which states that expressive timing in the form of swing performance is 'tempo-dependent', that is, "it cannot be transposed in tempo by multiplying all durations with a constant factor" (2008:475). This, they explain is in opposition to the claims of contrasting studies (MacKenzie & Van Eerd (1990); Repp (1994); etc.) which purport an invariant swing performance under tempo transposition' in jazz. However, significant differences between the two teams' studies arise not only in their results as we saw, but also in method.

[7] De Haas, in a highly atypical fashion, transcribes the two funk-based rhythmic patterns in 'half time', that is, with the continuous hi-hat pulse layer comprising the eighth subdivision level instead of the sixteenth level (as is exceedingly in more common in Funk literature). This was probably done in order to compare directly with the 'swing eighths' of the Jazz rhythm in the study, where quarter note beats would the equivalent of eighths in our Funk/Jazz-Funk patterns.

Honing and De Haas for one, deal with laboratory-based experiments with solo drummers in real time rather than analysing realistic, historical performances from ensemble recordings. De Haas (2007) explains that such an approach was chosen "to ensure that the deviations from [a] metrical grid were caused by expressive timing and not by tempo deviations", and therefore "drummers recorded for [his] thesis played along with a metronome [whilst] the drummers measured by Friberg and Sundström were not," (2007:41). A contention to be raised on the consequences of such a methodological choice, are the results' ecological validity - whilst De Haas' drummers were apparently instructed to play 'naturally', they performed only an extremely basic two bar swing pattern repeatedly without variation and without any interaction whatsoever with other instruments, only with an isochronous metronome. In other words, such a study could hardly be said to comprise any sort of 'natural' jazz' setting, and consequently, the results of such a study cannot invariably be considered 'typical' or immediately applicable to realistic situations. A major point of contention could be raised regarding whether Honing and de Haas' drummers would have swung their notes in the same manner had the added factor of a proper jazz combo ensemble been present in the experiment. Commenting on the starkly different results from Friberg and Sundström, De Haas suggests that the fact that former team's data was gathered from ensemble playing "might have biased the results of Friberg and Sundström in a different direction than the data presented in [his] thesis, because interplay with other musicians probably affected the timing of the drummers" (loc. cit.:43). Indeed, one could say that a most significant point in Friberg and Sundström's study was to promptly attempt to identify patterns of swing in realistic musical settings, where interplay with other musicians is 'naturally' of paramount importance, and treating such ensemble interaction as a convenient variable to be excluded from the investigative formula cannot be lightly dismissed. Another factor which somewhat increases the ecological validity Friberg and Sundström's study is the calibre of the individual drummers studied – historically significant individuals acknowledged as having been widely influential in the shaping of stylistic standards within their genres, versus Honing and De Haas' contemporary Dutch drummers, who are of considerably less acclaim and influence despite their unquestioned competency. To their credit, however Honing and De Haas' aim was to model swing patterns in modern jazz drumming, rather than older established forms.

Despite such drawbacks in terms of supposed ecological validity, there is no doubt that one strong advantage their methods have over Friberg and Sundström's is a significantly higher degree of accuracy of measurement and more data. De Haas is likely correct when he therefore claims that "*the data presented by Friberg and Sundström is not enough evidence for the conclusion that there exists an approximately* linear *trend of decreasing swing ratio with increasing tempo, which they clearly suggest,"* (2007:43, emphasis in the original). However, we might speculate that Friberg and Sundström might not necessarily be wrong regarding this linear trend, only that it might not be valid

for jazz drumming in general, and instead only for either jazz drumming of similar styles during the time period of the tracks recorded, or (at least) for the group of individual drummers they studied. Their implied assumption, however, is that those very drummers may serve as prototypical examples of swing timing in jazz drumming in general, just as much as Honing and De Haas assume their swing model for modern drumming of the general jazz populace may be served by the sample of three professional Dutch drummers. Both sets of studies, then, could – although relevant and important in different respects – be considered to have questionable external validity.

2.1.3 Determining Metric Frame of Reference for Analysis

The styles of music in the tracks examined in this thesis – funk and jazz-funk of the late 60's to early 70's – are ones in which performers did not adhere to a strict isochronous external metronome or click track during the recording process. In light of an ever changing wave of near-but-never-perfect isochronous human rhythm in such audio recordings, what is to serve as primary reference, or that which sets the first downbeat and subsequently the pulse and all of its subdivisions? A simple question, perhaps, yet the answer seems to be of a multifarious and relative nature rather than absolute. In order to establish what may be considered as constituting the beat, one should examine what the valid options are, and weigh the eventual advantages and implications of choosing one element over another, ultimately selecting one which will serve the practical purposes of an eventual microtiming analysis without sacrificing too much accuracy or considerably misrepresenting reality.

Even without the use of external metronomes, however, we might consider that individual musicians likely operate with an internal, or 'virtual' beat reference as we saw in section 2.1.1, which may or may not take precedence as primary over the actually manifested collective sounds events of other rhythm musicians during performance. In performance contexts then, such as the live-recording situations of the funk and jazz-funk tracks we will analyze, the various sounds of the drum-kit immediately present themselves as the most practical reference to which expressive timing of various instruments can eventually be measured against. The drum-kit, is after all, the one instrument in a typical funk and jazz ensemble which can produce the widest range of frequencies simultaneously at any given time, from the deepest bass drum hits and the sharpest of succinct mid-range snare strokes to the highest of airy cymbals. When combined with the fast, impulsive and percussive attack character of most of its elements, which is usually distinctly audible within the sonic landscape of an ensemble in a performance context, the drums can be argued to be the most capable instrument of setting and maintaining the standard for pulse and sub-division layers in the most immediate and frequent fashion at all times during performance. Considering the drum-kit's advantage in producing clear, attack-point sounds in light of its traditionally expected role in popular music bands as the main time-keeper and, no less importantly, the main determinant of the foundational feel of the groove –

the drum-kit seems indeed to be the ideal main candidate for 'beat' reference in a micro-analysis. Therefore, in this thesis, the drums' beat will be considered as the main referential structure to which other instrument's sounds (guitar, bass and keyboards) are measured against.

Problems that arise with utilizing the drums as main reference are that at the start of each groove's basic unit (usually comprising one or two measures), two drum elements may accent the first downbeat simultaneously – typically a cymbal such as a hi-hat or ride (sometimes a crash in transitions between formal segments) stroke and a bass drum hit. Not infrequently, these elements are struck at slightly different time locations and in varying succession by the drummer (whether voluntarily or as a result of human error/motoric limitation is unknown), and such cases may be referred to as 'asynchronies'. A choice must be made in determining which of the specific drums should count as the 'actual One', the main reference to which all micro-data from other instruments will be compared against and consequently considered 'late', 'on top, or 'behind' in relation to.

One argument for the hi-hat in particular to be considered primary in keeping the beat, is that its spectral signature, being higher in pitch and sharper/shorter in attack time than the bass drum, is likely to be more clearly heard by other members of the ensemble. Physiologically, according to Equal-Loudness curve studies, the human ear is most sensitive between 2 and 5 kHz. A hi-hat/ride hit produces higher levels of sound pressure (dB) in the 2-5kHz range than the average bass guitar sound, and will therefore likely be perceived as louder even if played at equal levels. In live situations, such as in the recording process of the tracks to be analysed, although certain bass drums may produce sharper attacks than others, none will arguably produce as clearly audible attack transients as the average hi-hat or ride cymbal. There are also pragmatic reasons for choosing the hi-hat strokes, namely that they are easier to identify in spectrograms of sound and also more frequent than bass drum strokes.

2.1.4 Perceptual Attack Time

Seeking to measure and relate temporal durations of instruments' sounds, begs the issue of how best to accurately measure so-called 'Inter-Onset Intervals' (IOI's), indeed it raises the particular question of what an individual sound's 'onset' is, and how we generally perceive sounds to 'start', or how they begin to occur in a temporal context. An 'attack transient' is defined by Antonio Belfiglio as the "portion of the waveform beginning at physical onset, the moment at which the waveform begins to rise, and continuing through amplitude peak" (2008:51). In between physical onset and amplitude peak we find the interval which is called the "acoustical rise time" (loc. cit.). 'Impulsive' or percussive instruments have much shorter rise times than other instruments, for example, ride cymbals transients tend to have rise times of "about 1 ms", therefore determining IOI's utilizing either physical onset or amplitude peak as references for such percussive sounds is unproblematic, since their rise times fall

between a “negligible amount of time in terms of human perception” (loc. cit.: 2008:52). Instruments with a slow attack character, however, such as plucked string bass transients, may have much longer and significant rise times. Belfiglio states that “in these transients, the perceptual attack time occurs at some hypothetical point between physical onset and signal peak, and the longer rise times result in a greater range at which individuals might perceive the attack,” therefore the rise time is a “critical component affecting the perception of attack…. [with] longer rise times mak[ing] it problematic to pinpoint [accurate] perceptual attack time.” (loc. cit.).

Now, most of the instrument sounds to be analysed in this thesis are percussive in nature – asides from the more obvious drum elements, both rhythm guitar and Hammond organ attacks tend to be quite sharp – their rise times often being rather short in duration, resulting in onset and peak times coinciding closely, just as in hi-hat and ride cymbal hits. In an amplitude graph, when several instruments’ frequencies are overlapped and enmeshed with each other, it is not often easy to discern an attack's onset, rather its peak is slightly more visible. In a spectrogram, if there is not too extreme an overlap between various sound sources, a better indication of individual onsets can be attained. Whilst sounds with a high frequency character, such as hi-hat and ride cymbals, are easy to locate with great temporal accuracy (Hanning window of 3 ms, accuracy ±1.5 ms), one is often forced to increase the time window in the FFT analysis in order to capture sounds with lower frequency, which invariably leads to decreased temporal resolution. For instruments with frequency signatures in the mid register, one often has to increase the window up to 6 ms for guitar/organ, which still is an acceptable margin of error in accuracy (±3 ms). However, for bass guitar and bass drum, one often has to increase the window to at least 12 ms, if not 24 ms, at which point the temporal accuracy becomes perhaps too low to reliably discern onset locations (±6 and ±12 ms respectively). In such cases, it may become wiser to consult waveform representations of the sound to identify the reference.

As Belfiglio elucidated (loc. cit.:52), the actual perception of an instrument's attack is located at some hypothetical point between physical onset and amplitude peak, and it is generally quite difficult to determine the peak of slow rise time attacks. To date, there seems to be limited amounts of experimental research dealing specifically with Perceptual Attack Time (PAT). However, Wright’s (2008) studies revealed that the perception of temporal location of sounds varies depending on their dynamic envelope (attack, peak, sustain, decay). In general, he found that only in cases of extremely short percussive sounds, such as the clicks of traditional metronomes, were subjects likely to locate the PAT closer to the onset, however for sounds with progressively slower rise times, there was a large variation in relation to when the sound was perceived to occur, ranging between onset and peak of amplitude. Considering that PAT research is still at an early stage and therefore does not lend conclusive proof on the matter, for the purposes of this essay *we shall choose to consider onset times*, in favour of peaks, as the primary temporal indicators for measuring IOI durations, since it is the

relationship between the IOI's of the various instruments we are seeking to examine, and therefore onset to onset measurements are likely to yield as satisfactory results as peak to peak in theory. However, we are to remind ourselves, that since the measurement accuracy for lower register instruments such as bass guitar and bass drums are lower than for impulsive, percussive instruments, results of the swing ratio and asynchrony calculations for bass guitar in particular (since in the case of drums, more accurate hi-hat strokes as used as primary reference) will include a greater amount of uncertainty.

2.1.5 Swing Ratio - Just Noticeable Difference ('JND') Thresholds

How can one tell if a rhythm is swinging? The typical technical definition of swing in the Jazz tradition is more or less based on the notion of 'uneven eighth-note pairs', however, since swung notes in funk operate more typically on the sixteenth-note subdivision level, we may establish a more inclusive working technical definition of swing to: *'any (systematic) pairing of consecutive subdivisions of the same level with a non-equal (or asymmetric), long-short ratio between duration of on-beat and off-beat notes'*. In quantitative terms then, any pair of notes with ratios higher than that of 1:1 would technically count as objectively 'swung'. However, in order for the human mind to perceive successive note pairings as subjectively swung to a significant degree, it is presumed that a ratio above a certain swing 'threshold' has to be passed, for ratios only incrementally above or below 1:1 are likely not categorically perceived as swung despite not being technically 'even' or 'straight'. In order to establish a swing threshold which isn't purely arbitrary, we may turn to cognitive studies and experimental psychology, and the concept of a 'difference threshold', often referred to as a 'Just Noticeable Difference' ('JND') is described as "the minimum amount by which stimulus intensity must be changed in order to produce a noticeable variation in sensory experience"[8]. In our case, a swing JND value would therefore denote the approximate minimum duration of time, expressed as either an absolute value or a constant relative to tempo, in which two consecutive notes must differ from a 1:1 ratio to be perceived as being 'different' enough to be actually swinging.

Within the last few decades, several researchers have conducted studies in order to attempt to ascertain empirically founded values for JNDs in relation to rhythmic displacements in both experimental settings of simple isolated isochronous sequences as well as in live musical performance settings. Within the context of Jazz rhythm, Friberg and Sundström have conducted several experiments and analyses which produced a suggested range of both constant absolute (non-tempo proportional) and relative (tempo-dependent) JND values. In a study which dealt with perception of

[8] USD Internet Sensation & Perception Laboratory: http://apps.usd.edu/coglab/WebersLaw.html [Accessed 02.05.2016]

swing ratios in jazz, they suggested that, in general, “a 20 % difference may be a good rule of thumb for a perceptible deviation in [the] tempo range [of 65 to 170 b.p.m]” (1997:23). These findings were based on experiments which used 'simple melodies played on a synthesizer' and where subjects found on average that the swing ratio of a sequence of even eighth notes had 'to change from 1 to 1.2 to be noticeable' - thus the 20% JND value (2002:346).

In their 1995 paper, *Time discrimination in a monotonic, isochronous sequence* (1995:2528), however, they alternatively explored the JNDs of rhythmic displacements in isochronous sequences in non-musically realistic, yet rhythmic, contexts. In one set of experiments dealing with 'single displacement' of a single fourth tone within a sequence of six, the JND was found to be a constant absolute value at as low as 6ms for tone inter-onset intervals shorter than about 240ms (equivalent to 250 bpm in straight ahead jazz) and the constant relative JND at 2.5% of the tone IOIs above 240ms (<250 bpm). However, in a more relevant set of experiments dealing with cyclical displacement, where “every other onset was delayed in repetitive sequences, thus, similar to a sequence of swing eight notes but with simple acoustic markers instead of musical tones” – they found that the JND in swing ratio was about 10% for tempi slower than 120 bpm and a constant of approximately 10ms for tempos from 120 to 300 bpm (2002:346). Findings by several other seminal contributors to the field of rhythm perception in cognitive studies were reviewed by Friberg and Sundström for comparison with their own findings. Amongst those which corroborated their results for cyclic displacement, were for example those reported by Van Noorden (1975) and Gert ten Hoopen et al. (1994), the latter whose findings suggested a constant absolute JND of around 10 ms for IOIs below about 240 ms (250 bpm), and a constant relative JND of swing ratio of about 4.5% for IOIs ranging from 240 to 720 ms (83–250 bpm).

From these results, we learn that the difference threshold values differ according to the length of duration of IOIs. In terms of swing perception, this means that the JND value differs depending on the tempo of a performance. This relationship between JND value and tempo (or IOI duration), as we have seen, can be measured in both 'absolute' duration terms (expressed in milliseconds) as well as relative terms (expressed as percentages of the relationship between IOI and subsequent JND duration). In experimental psychology theory, Weber's law states that the size of a JND is a constant proportion of the original stimulus value (in our case, the IOI). However, in reality, at least for both simple and cyclic displacement experiments, Friberg and Sundström’s study showed that several researchers report a combination of constant relative and absolute JND threshold values. In the short to medium IOI range, that of 100ms to 240ms (fast to medium tempi; 300 to 125 b.p.m. in Jazz eight notes, 150 to 75 b.p.m. in funk sixteenth notes), studies found that JNDs are perceived as an absolute constant value of ca. 10ms. A so-called breaking point occurs at around 250ms (tempos slower than 120 b.p.m in Jazz; 60 b.p.m in funk), where JND for IOIs being to adhere to Weber’s law and a

constant proportion presents itself, and therefore JND thresholds can be expressed as constant relative values rather than absolute durations. There is less consensus for JND threshold relative values for this region – suggestions range from 2.5 to 10 %, the large differences in results likely stemming from differences in methodology, according to Friberg and Sundström. Regardless, data for such large IOIs (slow tempos) are not relevant for our purposes since the duration of sixteenths notes in funk and jazz-funk tracks do not reach such an excessive range.

To summarize the most relevant figures for our purposes then, both Friberg and Sundström's and others' findings provide us with some empirically based swing ratio JND values which range from a highest relative constant of 20%, derived from rough musical experiments where subjects were presented real 'musical' examples, to a lowest absolute constant of 6ms based on more accurate, yet non-musical experiments, involving short isochronous sequences of monotonic sounds. Matthew Butterfield (2011), another scholar who has dealt extensively with microtiming rhythmic investigation of jazz, argues that under 'ideal listening conditions', competent listeners should be able to perceive a swing ratio differential of as little as ±.045 for tempos below 250 bpm, such calculations being based on Friberg and Sundström's absolute constant JND values of 6ms. However, he argues that in actual jazz contexts, listeners "probably require a larger differential," which he speculates to be between ±.10–.20 – that is, swing ratios of at least 1.10 to 1.20 – which are close to Friberg and Sundström experimentally founded 20% JND relative constant values.

Since the tracks we shall look at in this thesis are rhythmically multi-layered, and therefore not as easily discernible as monotonic sequences in isolation, as well as not being available for listening in any 'ideal condition' (such as isolated from one another), it seems we can disregard the lowest absolute constant JND of 6ms and instead utilize the 20% constant relative JND as a higher, more stringent threshold. Therefore, for the purposes of this thesis, *any successive note pairing that demonstrates a ratio of at least 1.20 may be considered to swing to a significantly perceptible extent.*

If we are to consider an even 'safer' or more unambiguously perceptible threshold of swing in addition to the 1.2 theoretical JND, it is prudent that we should establish an additional speculative threshold of 1.50. It is pertinent to remind ourselves that based on traditionally held notions of jazz swing, despite there being no wide-reaching consensus, a threshold of least a 2:1 ratio (66.6-33.3%), or actual tied-triplet eight notes (two tied eighth notes followed by a single eight note), has been long considered as a 'standard swing'. Gridley (2014) purports that typical average swing in jazz lies somewhere between 2:1 and 1:1, and de Haas (2007:9) rightfully points out the fact that many jazz drummers are taught how to swing by being told to practice eighth-note tied triplets. Honing and De Haas' experiments found that "at tempos over longer beat durations [than 350 ms, or ca. 170 b.p.m] the swing ratio seems to stabilize around a swing ratio close to 2.2:1," that is, essentially tied-triplet swing (2008:475). Friberg and Sundström (2002:334) on the other hand, found that only within a

particular tempo range of ca. 200 b.p.m. were the drummers likely to implement a swing ratio (on their ride cymbal) close to 2:1. In any case, it would seem that a swing ratio of 1.50:1, which we will use as our higher, speculative threshold, would likely be generally acknowledged as lying on the lower end of the swing spectrum, a rather 'light' swing ratio, yet still one which noticeably or distinguishably could be considered to veritably swing rather than not.

2.1.6 Asynchrony

A JND threshold must also be utilized for measuring significant, or perceptible, asynchrony (delay) between the reference of drums in relation to bass, guitar or organ respectively. In his experimentally based study of three contemporary Dutch drummers' swing in three basic rhythmic patterns ('straight ahead jazz', 'funk shuffle' and 'funk rhythm)', De Haas (2007) utilizes the minimum 6 ms constant absolute JND value suggested by Friberg and Sundström's (1995) isochronous sequence experiments as a reference for perceptible inconsistencies in the standard deviation of the drummers' mean swing ratios. We shall also consider this value as a valid threshold for the sake of cross-study comparison; however, since we are dealing with entire ensembles in polyrhythmic textures, it is prudent to establish a more stringent threshold. The reason for this is that, whilst theoretically it may be possible to perceive asynchronies of 6 ms between bass, guitar or organ and drums, if we consider the copious amount of rhythmic overlapping and clashing at the micro-level, not to mention frequency masking effects and noise present in every track, it is unlikely that the average listener will be to mentally sort through the several instruments and pulse layers and identify such small asynchronies, especially at higher tempi. Clarke (1989) suggested that in 'metronomic contexts', a 20 ms Therefore, a JND threshold at a relative 10% of the sixteenth notes' IOI duration may, for the purposes of this essay, serve as more 'unambiguous' perceptible asynchrony threshold. In terms of concrete numbers, in the fastest tempo studied in this thesis, 132 b.p.m., 10% of the average sixteenth-note IOI duration (ca. 116ms) is 11.6 ms. In other words, a relative 10% JND threshold would require at least approximately double the theoretical 6ms perceptible JND threshold suggested by Friberg and Sundström. At the slowest tempos, 10% of the average sixteenth-note IOI duration (ca. 167 ms) would be 16.7ms. As support for this approach, several studies (Danielsen 2010; Johansson 2010) claim that 'rhythmic tolerance', or the degree to which one is able to distinguish between discrete rhythmic events virtually coinciding with each other, tends to increase as tempo decreases.

2.1.7 'Absolute' vs. 'Relative' Swing Ratio

An interesting connection between consistent asynchrony and swing ratio arises when Butterfield (2011:1) reminds us that the term 'swing', asides from its technical definition discussed in the previous section, is also often utilized to describe the "lilting rhythmic groove emerging from the

interaction of bass and drums as they maintain the beat." This reference to the groove, or overall rhythmic texture arising from the core rhythm section instruments (the very foundation of jazz and funk alike), despite its facile formulation, is in fact quite pertinent to the perception of rhythm. Not only in the mere interaction of bass and drums however, but also that of bass and drums themselves in relation to the remaining accompaniment instruments, such as guitar and organ/keyboards. Such a seemingly non-technical definition of swing may actually be quite technical underneath its vague veneer – an instruments' eighth notes (in jazz) or sixteenth notes (in funk) which do not objectively swing (have a swing ratio either equal to/ approximately one, or lower than the perceptual JND of 1.20), may still be perceived as swinging if they are consistently located behind or ahead (asynchronous) of the drum's quarter or eighth note downbeats respectively. Instead of an 'absolute swing', calculated by utilizing measurements of an instruments own IOI attack/peak transient points, a 'relative swing' arises, with the on-beats of drums serving as a main reference (particularly hi-hat or ride) for the off-beats of the "laid-back" instrument in question. In such a case, a subjective perception of swing can therefore be caused even when no particular instrument is 'swinging' their note pairs, instead, a relative swing effect is created that only arises from the interaction of two or more instruments simultaneously playing.

The illustration below (see ***Fig. 2.1***) demonstrates how an instrument playing a pair of non-swung, even notes followed by a third on-beat note (D,E,F) which is consistently ahead or behind that of another instruments' pattern (A,B,C) may be perceived as swung if their off-beats (E) are heard as secondary in relation to the other instruments' on-beats (A and C). In funk or jazz-funk for example, should a guitar, organ or bass play a rhythmic pattern which is even in swing ratio itself (non-swung) yet located slightly ahead or behind the drum, depending on how strongly one perceives the drum hi-hat pulse as the primary beat reference, one could hear a 'relative' swing arising from the asynchrony between the two elements. This effect of relative swing perhaps may be produced more easily when the 'secondary' instrument plays patterns which omit the first downbeats of a straight sixteenth pair, only expressing the off-beats which may then be more clearly perceived in relation to the primary eighth downbeats pulse of drum hi-hat.

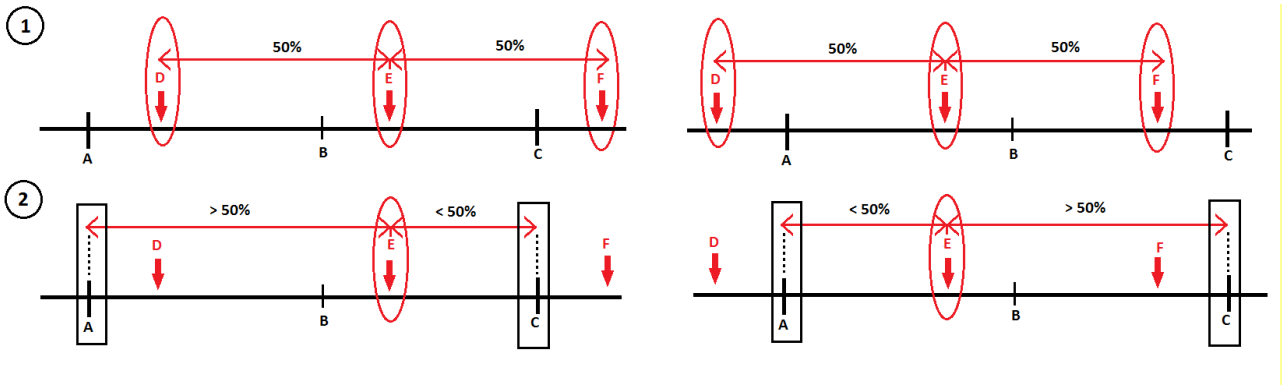

Fig. 2.1 *– Diagram representing how differences in 'Absolute' and 'Relative' swing ratios may arise depending on whether an instrument's even notes (D,E,F) are perceived in relation to itself (example 1) or to another 'primary' instrument's downbeats (A and C, example 2) as a main beat reference .*

Essentially then, there are at least two ways to calculate the swing ratio of the various instruments in the recordings of funk and jazz-funk ensembles: In an 'absolute' – that is, instruments in relation to themselves – or 'relative' fashion – that is, in relation to the drums. Since we shall be comparing the swing ratio of all instruments equally, it is prudent to devise as consistent a system as possible, and ideally the swing ratio of note pairs should be calculated in an 'absolute' fashion, in order to reveals pattern of swings of individual instruments, rather than mixing a relational instrument's data with another. In practice, this is not entirely possible, however, for various rhythmic patterns performed by guitar, bass and organ often incorporate lone standing off-beat notes which lack either preceding or following down beats to use as reference for note pair ratio calculation. In such cases, the drums will serve as primary reference in lieu of a superimposed isochronous grid, and consequently, swing ratio values will be calculated using a mix of absolute and relative data. Therefore, it must be acknowledged that what we will term as 'swing ratio' values will not be technically, perfectly absolute.

2.2 Material and Procedures

In order to gain insights into the extent to which swing occurs on the sixteenth-note level in the rhythm of early funk and jazz-funk section players, prototypical recordings were selected and spectrograms and waveforms of the selected excerpts analysed. Inter-onset-intervals (IOIs) for salient rhythm instruments were identified manually and mean swing ratio, durations of off-beats (second notes in swung pairs) and on-beat (first note) asynchronies were calculated. Consistency for each instrument's swing ratio was operationalised as standard deviation of the mean. Statistical tests (Pearson's correlation tests) were then conducted on selected pairs of data. In the following we will explain each of these procedures in more detail.

2.2.1 Selection of Musical Excerpts

The criteria for the sample funk and jazz-funk tracks from which excerpts were to be analyzed were based on a rough, basic set of aesthetic technical traits (see sections 1.4.3 and 1.5), that is:

- signature syncopated drum patterns derived from New Orleans rhythmic traditions (e.g. variations of either Clyde Stubblefield's *Cold Sweat* beat or Idris Muhammad's *Alligator Boogaloo*)
- presence of 3:2 and 4:3 'Standard Pattern' counter-rhythms
- sixteenth-note note density referent, and
- simple chord-vamps or blues based forms amongst others.

The tracks were also limited to being recorded in the period 1967 – 1971. In the end, excerpts from thirteen different tracks[9] – five early funk tracks by James Brown and eight funk-based tracks by various jazz artists – ranging from ca. 15-30 seconds or more in duration, at various key formal segments of each track (e.g. verse/bridge/solo sections) were chosen at ideal locations for the clearest measurement of instrument IOIs via spectrograms and waveforms graphs possible (see ***Table 2.1*** below for an overview.

[9] Refer to appendix section 7.2 for transcriptions of excerpts from each track.

Table 2.1 *Overview of excerpts from funk and jazz-funk tracks selected for analysis.*

Track/Artist/Album/Label No.	Year	Drums	Bass/Organ Pedals	Guitar/Organ	Section
FUNK EXCERPTS					
Cold Sweat pts. 1 and 2 James Brown Single King 6110	(1967)	Clyde Stubblefield	Bernard Odum (bass)	Alfonzo Kellum/or Jimmy Nolen (guitar)	Verse (A-section) + Drum break
There was a Time James Brown Single King 6144	(1967)	Clyde Stubblefield or John 'Jabo' Starks	Bernard Odum (bass)	Alfonzo Kellum/or Jimmy Nolen (guitar)	Verse (A-section)
Give it up or Turnit a Loose James Brown Single King 6213	(1968)	Nate Jones	Charles Sherrell (bass)	Jimmy Nolen (guitar)	Verse (A-section)
Super Bad pts. 1 and 2 James Brown Single King 6329	(1970)	John 'Jabo' Starks	William 'Bootsy' Collins (bass)	Phelps 'Catfish' Collins (guitar)	Verse and Bridge (A+ B sections)
Get Up (I Feel Like Being a Sex Machine) James Brown *Single* King 6318	(1970)	John 'Jabo' Starks	William 'Bootsy' Collins (bass)	Phelps 'Catfish' Collins (guitar)	Verse and Bridge (A+ B sections)
JAZZ-FUNK EXCERPTS					
Alligator Boogaloo Lou Donaldson *Alligator Boogaloo* Blue Note BST 84263	(1967)	Idris Muhammed	Lonnie Smith (organ Pedals)	George Benson (guitar)	12 bar Verse (A-section)
Son of Ice Bag Lonnie Smith *Think!* Blue Note BST 84290	(1968)	Idris Muhammed	Lonnie Smith (organ pedals)	Lonnie Smith (organ)	Verse (A-section)
Blue Juice Jimmy McGriff *The Worm* Solid State Records – SS 18045	(1968)	Grady Tate or Mel Lewis	Bob Bushnell (bass)	Thornell Shwartz (guitar)	12 bar Verse (A-section)
Orange Peel Reuben Wilson *Blue Mode* Blue Note BST 84343	(1969)	Tommy Derrick	Reuben Wilson (organ pedals)	Melvin Sparks (guitar)	Verse (A-section)
I Can't Stand it Lonnie Smith *Live at Club Mozambique* Blue Note B1-31880	(1970)	Joe Dukes	Lonnie Smith (organ pedals)	George Benson (guitar)	Theme (A-section)
Ain't it Funky Grant Green *Green is Beautiful* Blue Note BST 84342	(1970)	Idris Muhammed	Jimmy Lewis (bass)	Emmanuel Riggins (organ)	Theme (A-section)
The Emperor Donald Byrd *Ethiopian Knights* Blue Note BST 84380	(1971)	Ed Greene	Wilton Felder (bass)	Don Peake or Greg Poree (guitar)	Vibes solo section
Fire Eater Rusty Bryant *Fire Eater* Prestige PR 10014	(1971)	Idris Muhammed	Bill Mason (organ pedals)	Wilbert Longmire (guitar)	Sax solo section

In the period of 1961-71, in this author's opinion, no other artist or group defined the style of early funk as much as James Brown and the musicians in his various ensembles (the James Brown Orchestra prior to 1970 and the JB's from 1970-72), and it is for this reason why all the funk tracks were represented by just this group.[10] Certain key tracks were chosen for their historical significance, such as *Cold Sweat*, which was arguably the first true, prototypical funk track, and others for their perceived swing characteristics (both positive and negative). As for the jazz-funk sample group, the choice was narrowed down to artists of the independent Jazz labels based in New York (mainly Blue Note), who were amongst some of the earliest already established Jazz musicians to explicitly venture into funk territory, hybridizing jazz instrumental solo improvisation with funk harmonies and grooves. A random selection was made for tracks which qualified for the aforementioned funk criteria and time period.

2.2.2 Selection of Instruments

The instruments to be analyzed in each track will be a selection of the three most salient rhythm section instruments. In the James Brown funk tracks, these are typically drums, bass and guitar. In the jazz-funk tracks, whilst drums always comprise one element, the remaining two vary between: either bass guitar or organists' foot pedals/left-hand when the former is not present (hereby referred to simply as organ pedals) and in the last case, as both are usually present, either guitar or Hammond organ, depending on which plays a more salient rhythmic accompaniment role (right hand in the case of organ bass pedals also being present). Such a choice will be based on subjective criteria to an extent, however, objective factors such as which elements lend themselves to be located and measured in the recordings' mix by the analytical tools will be considered.

2.2.3 Software Tools

The location of individual measured instruments' IOIs (drums, bass or organ bass pedal, and guitar or organ) of all excerpts were plotted manually with markers in Steinberg's WaveLab 6 using a combination of Spectrogram (Frequency/Time) and Waveform (Amplitude/Time) graphs. Marker location data were then transferred manually to data tables in Microsoft Excel, where subsequent IOI durations for all sixteenth-note values were computed.

2.2.4 Tempo Determination

Since all the recorded tracks were originally played without a metronome, there is usually a slight

[10] Sly and the Family Stone were another salient influential funk group. However, their repertoire was stylistically broader and more hybrid than that of James Brown and bands, incorporating ample rock, folk and psychedelia elements. Their output of heavily funk-oriented tracks in the period of 1967 – 1971 was arguably relatively sparse and is therefore not included.

fluctuation in b.p.m. throughout any given track, and even between individual beats within a bar IOI durations of eighth and quarter notes vary in minute amounts. A mean tempo for each excerpt was calculated into b.p.m. using the IOI (inter-onset interval) duration of drum strokes of the eighth notes, for at least 32 beats (8 measures) of each sample. Standard deviation values were computed in order to gauge how much slower or faster from the norm the track tended to fluctuate.

2.2.5 IOI Measurement Accuracy

The excerpts were digitally sampled with 16-bit resolution and with a sample frequency of 44 kHz. A Hanning window of 3ms was used for percussive sounds (such as most drum elements, as well as some rhythm guitar and organ stabs) and markers were located at the onset of the sound (first zero crossing). Larger windows of 6 – 12ms were used for sounds in the lower registers. For sound with longer attack rise times, physical onsets were used in favour of peak location for all instruments.

In a spectrogram analysis, the accuracy of temporal measurement is indicated by a value of ± half of the Hanning window utilized in analysis. Therefore, the strokes of drum elements were measured with an estimated precision of ±1.5ms (3ms). In a few cases, there were two simultaneous hi-hat/ride strokes very close to each other (about 10-20ms apart), and in these cases, the loudest stroke was chosen. Friberg and Sundström have a possible explanation for these in that that the edge of a cymbal was possibly hit before the tip of the drumstick hit the cymbal, or that the drumstick was bouncing on the cymbal. For guitar and organ sounds without any significant masking sounds or noise occluding them, the smallest possible window of 3ms was used, however in opposite cases with a lot of noise, larger windows of up to 24ms were used – however, this does not necessarily translate into a very large margin of accuracy of ±12ms, for in such cases temporal information from the waveform graphs were consulted, which conversely allows for extreme accuracy (the recordings' sample-rates were 44 kHz – therefore each samples duration is ca. 0.2ms with an accuracy of ±0.1)

2.2.6 Swing Ratio Calculation

To calculate swing ratio, IOIs of two consecutive sixteenth notes (one on-beat + one off-beat) followed by a third on-beat stroke were used. Individual instruments' own onsets were used whenever possible; however, it is to be noted that in cases of sixteenth off-beat pickups or syncopations of guitar/bass/organ, corresponding drum hi-hat on-beats onsets are used the grid/reference for ratio calculation. Therefore, calculated swing ratio results will essentially be a combination of 'absolute' and 'relative' values. Mean durations of individual sixteenth pairs per measure (8 in total) were calculated, and the swing ratio of each combined pair was computed as the IOI duration of the first on-beat sixteenth-note divided by the IOI duration of the second off-beat sixteenth-note. In total, 956 sixteenth swing pair ratios were collected – average pairs per excerpt were 34 for drums, 29 for

guitar/organ and 17 for bass/organ pedals.

2.2.7 Asynchrony Measurement

Asynchrony between the reference drum onsets (primarily hi-hat, bass-drum if latter missing) and the on-beat sixteenth (or eighth-note) onsets of bass/organ bass and guitar/organ, respectively, were calculated and presented in ± milliseconds. This was done in order to identify any systematic asynchronies between drums and the remaining salient comping instruments – whether they were consistently behind or ahead of a particular beat on average throughout a measure, especially whether there was any correlation between tempo and asynchrony.

2.2.8 Statistical Analyses (Consistency and Correlation)

Consistency of the various instruments' swing ratio is reported as the standard deviation (SD) of the mean for each respective data set. Correlations were computed via the 'Regression Analysis' tool in Microsoft Excel 2016, and results for the Pearson's Correlation test (r^2 and p values) were reported.[11] If not otherwise indicated, results are reported significant at $p<0.05$.

[11] The r^2 in Pearson's correlation tests can be conceived of most simply as a measure of the strength of the correlation, and represents the fraction of the total variance of Y (ex. Swing ratio) that is "explained" by variation in X (ex. tempo). For example, in a Pearson's correlation test between swing ratio and tempo for drum results, $r^2 = 0.083$ would mean that only 8.3% of the variability of factor Y (swing ratio) can be explained by factor X (tempo) – i.e. there is a weak correlation between the two variables, and other variable(s) not considered are highly likely to affect the variability in swing ratio.

3 Microrhythm in Funk and Jazz-Funk: Results

In this chapter, results from the microanalysis of three salient rhythm instruments from each of the thirteen tracks' excerpts outlined in section 2.2.1 will be presented. In section 3.1 we will examine Global Mean Swing Ratio (GMSR) for all tracks and in 3.1.1 see the relation between GMSR and tempo, in 3.1.2 we will look into the relationship between the various instruments' GMSR, in 3.2 the focus is mean Absolute Duration ('AD') of sixteenth pair second notes (off-beats) in relation to tempo, in 3.3 we will examine mean Asynchrony of instruments, and in 3.4 we will look more closely at patterns of fluctuation in Local Mean Swing Ratio (LSMR), that is of mean SR per sixteenth pair per measure.

A technical note: Throughout this chapter Swing Ratios may be displayed in either ratio (e.g. 1.5:1) or decimal form value (e.g. 1.5), and will frequently be displayed in a number of graphs where on the x-axis, tempo (b.p.m.) is placed and on the y-axis the swing ratio is displayed. Reference lines will be placed at 1:1 swing ratio, that is, when both notes of a sixteenth-note pair are equal in duration, at 1.2:1 denoting the theoretical 20% JND threshold for perceptible swing, and at 1.5:1 denoting a more or less unambiguous 'light' swing.

It is also important to remember that in this chapter, due to the fact that swing is necessarily calculated as the ratio between on-beat and off-beat note durations in sixteenth-note pairs, when lone standing off-beat pickups or syncopated sixteenths occur, whilst not technically comprising complete 'actual' pairs, they are assumed to form part of 'virtual' swing pairs in which their on-beat components are simply left unstated. In such cases the drum beat is used as reference for the on-beat component, standing in as the closest approximation of the virtual location. (Later, that is, in Chapter 4, we will consider the distinction between swung note-pairs and off-beat pickups/syncopations in more depth.)

3.1 Global Mean Swing Ratio

An overview of the global mean swing ratio results for all instruments in all excerpts (both funk and jazz-funk) can be found in ***Table 3.1***. In total, nine out of thirteen excerpts were found to display at least one instrument with mean global swing ratios of at least a perceptible degree (= or > 1.2:1 JND swing threshold): four out of five funk excerpts and five out of eight jazz-funk. Within the total tempo range from 90 to 132 b.p.m., the highest SR value found was 2.01 in the bass of *Blue Juice* (akin to triplet swing) and the lowest value 0.93[12] (virtually straight/even) was in the guitar of *Son of Ice Bag*.

[12] Negative global mean SR values in organ pedals and guitar of *Son of Ice Bag* and bass of *Superbad* do not necessarily imply a short-long durational relationship between sixteenths so much as slightly anticipated off-beat positions. As can be seen in the transcriptions of their basic unit in Appendix section 7.2, their sixteenths are all pickups and syncopations, and as a result were measured against drum on-beats, yielding slightly more skewed 'relative' swing values.

Only in two out of the total thirteen tracks' excerpts does at least one instrument present SRs equal to or higher than 1.5 (clearly perceptible 'light' swing): *Blue Juice at 90* b.p.m. and *Get Up (I feel like a Sex Machine)* at 109 b.p.m. In seven out of thirteen tracks, SR values between 1.2 (lowest theoretically perceptible swing) and 1.5 were observed: *Give it Up or Turnit A Loose* at 110 b.p.m., *Cold Sweat* at 114 b.p.m., *I Can't Stand it* at 115 b.p.m. *and Orange Peel* at 121 b.p.m. Asides from the obvious outlier SR values of instruments in the two tracks *Get Up (I feel like a Sex Machine)* and *Blue Juice*, all other tracks present SR values between ca. 1 to 1.5 in general.

Table 3.1 – *Global Mean Swing Ratios for instruments in All Excerpts. SR values = or > 1.2:1 (10% Swing JND Threshold) are highlighted in yellow, SR = or >1.5:1 ('Light Swing') are highlighted in green. Empty fields indicate instruments without sixteenth notes events within their respective groove's basic unit.*

		Drums		Bass/Pedals		Guitar/Organ	
Track/Artist	**Tempo (b.p.m.)**	**GMSR**	**S.D. (±)**	**GMSR**	**S.D. (±)**	**GMSR**	**S.D. (±)**
Blue Juice	90 ±4	1.33	0.39	2.01	0.92	1.64	0.46
Fire Eater	94 ±2	1.10	0.10	1.13	0.24	1.15	0.24
The Emperor	97 ±2	1.09	0.10	1.13	0.26	1.25	0.22
Ain't it Funky	101 ±2	1.09	0.12	1.10	0.11	1.26	0.20
Get Up (...Sex Machine)	109±3	1.60	0.09	1.52	0.40	1.86	0.28
Give it Up or Turnit…	110 ±4	1.16	0.23	1.23	0.18	1.43	0.31
Cold Sweat	114 ±3	1.07	0.31	-		1.24	0.25
I Can't Stand It	115 ±3	1.30	0.45	1.12	0.32	1.11	0.23
Orange Peel	121 ±3	1.24	0.31	1.14	0.61	1.00	0.22
Superbad	125 ±3	1.13	0.11	0.93	0.20	1.22	0.23
There was a Time	127 ±4	1.03	0.21	-	-	1.12	0.20
Alligator Boogaloo	128 ±4	1.10	0.21	-	-	-	-
Son of Ice Bag	132 ±3	1.04	0.03	0.93	0.17	0.93	0.09

Variation in the mean SR of instruments was rather considerable overall – the mean standard deviation for the various instruments of all excerpts combined in SR units was ±0.20 for drums, ±0.35 for bass and ±0.24 for guitar. This means that, within an excerpt's basic unit, it is normal for each instrument to fluctuate in SR such that certain sixteenth notes may either swing higher or lower than the global mean, at times crossing thresholds (1.2 or 1.5), dipping below them, or approaching 1.0 (not swinging). In section 3.4 we will look at the local mean swing ratio of each sixteenth-note pair per measure in greater depth so that we may eventually ascertain what role these large deviations may play in the context of the grooves.

3.1.1 Global Mean Swing Ratio vs. Tempo

In this section we will examine the various funk and jazz-funk excerpts' global mean swing ratio – that is, the mean swing ratios of all sixteenth-note pairs per measure – in relation to tempo. We will examine what trends may be present, particularly as to whether the styles adhere to the tempo-specific

hypothesis or not, and in similar or different fashions to that of straight-ahead jazz as reported by Friberg and Sundström (2002) and jazz and funk as reported by De Haas (2007) and Honing and De Haas (2007). It should be outlined that such data does not take into account systematic fluctuations of mean swing ratio per beat which may be present, caused by the fact that individual instruments may often implement higher or lower swing on particular sixteenth-note pairs rather than apply a single consistent swing ratio to all pairs throughout a measure. Such 'local' mean swing ratio data will be further examined in section 3.4. Here, however, despite the fact that global mean values obfuscate information regarding inter-measure swing fluctuations, they are most practically suited for examining and comparing the overall relationship of instruments' swing ratios to tempo. Descriptive statistics of global mean swing ratio vs. tempo is provided in ***Table 7.2*** in the Appendix.

3.1.1.1 All Excerpts

The global mean swing ratio (SR) for all instruments sixteenth-note pairs in the thirteen tracks' excerpts can be seen plotted against tempo in ***Fig. 3.1.*** Overall, no clear trends present themselves when considering all thirteen excerpts' as a single overarching combined category (funk + jazz-funk) in relation to tempo. Submitting each individual instruments' data series to a Pearson's correlation test confirms that there are no significant correlations between swing and tempo in any of the instruments' case (Drums: $r^2 = 0.083$ p=0.338[2], Bass/Org. Pedals: $r^2 = 0.368$ p =0.063, Guitar/Organ: $r^2 = 0.263$ p =0.088). Such low correlation values suggest that other variables not considered are significantly responsible for the determination of swing ratio in performance. However, in order to further confirm the lack of significant correlation, it is important to remember that we are dealing with two assumed different genre categories, with likely different ideal swing ratio patterns and it therefore becomes prudent to separate the data as such and see if stronger trends arise, as we shall do so in the next few sections.

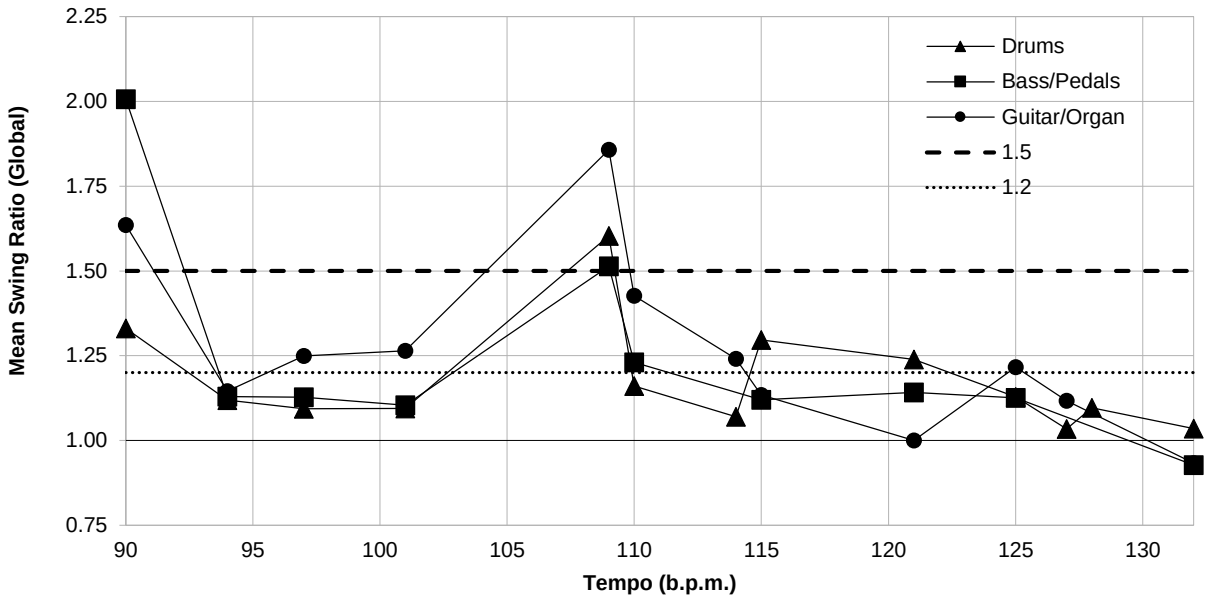

Fig. 3.1 *- Mean Swing Ratio (Global) as a function of tempo for all 13 excerpts (both Funk and Jazz-Funk).*

3.1.1.2 Funk excerpts

When plotted separately, most instruments in the funk excerpts, particularly guitar, seem to hint at a slight inverse proportional correlation between tempo and swing ratio (see ***Fig. 3.2***), as they both show high and low peaks at the slowest and fastest tracks respectively, as well as subsequent initial decrease before plateauing. However, Pearson's correlation tests show no significant correlations, or no simple linear relationship between swing ratio and tempo in any of the individual instrument groups (drums: $r^2 = 0.374$ p=0.272, bass: $r^2 = 0.808$ p =0.289, guitar: $r^2 = 0.595$ p =0.126).

Only in the slowest track, *Get Up (I Feel Like being a Sex Machine)* at 109 b.p.m. do guitar, bass and drum SRs unambiguously by exceeding the 1.5 threshold. In the range of tracks from *Cold Sweat* at 114 b.p.m. and faster, bass and drums remain well below the 1.2 threshold, ceasing to swing perceptibly, whilst guitar SR on the other hand remains consistently higher relative to the other two instruments throughout all five tracks. It is the instrument which swings the most overall, beginning above the 1.5 threshold with a significant 1.86 (near tied-triplet) average on the slowest track, *Sex Machine*, and remaining above the 1.2 threshold in all but the very fastest track of *There was a Time,* at 127 b.p.m, where it falls to its lowest of 1.12.

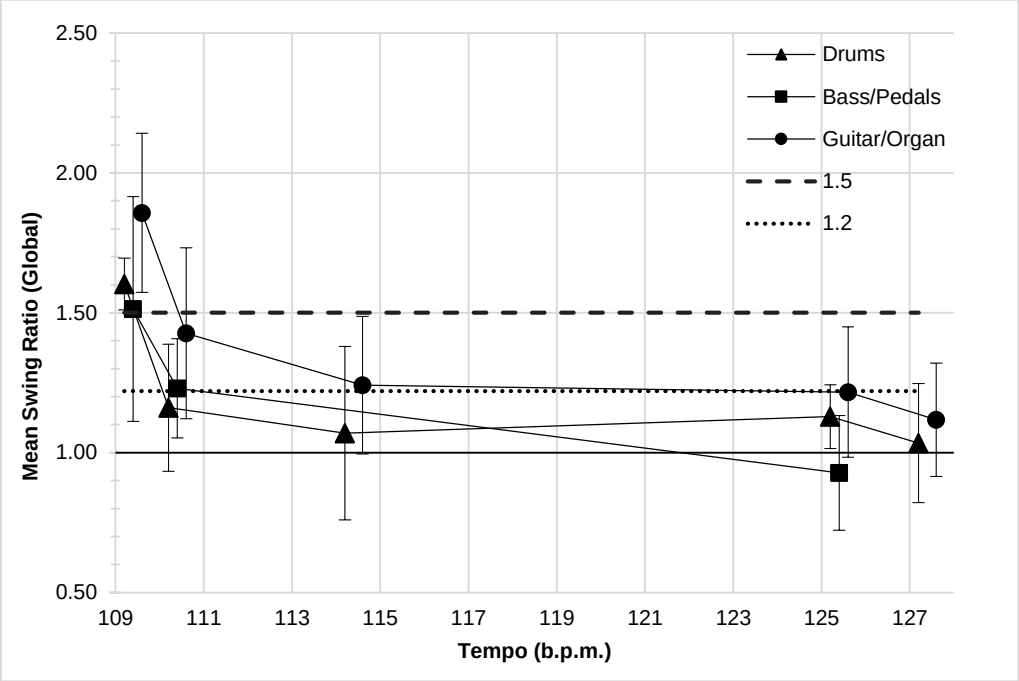

Fig. 3.2 *- Mean Swing Ratio (Global) as a function of tempo in Funk tracks. Error bars show standard deviation.*

In the total range from 109 to 127 b.p.m. then, significant mean SRs equal to or above 1.2 are observed in 4 out of 5 tracks (80%), however in terms of instruments, only in 6 out of 13 cases (46%). This means that there is on average at least one instrument per track with noticeable mean SRs, with the only exception of the fastest track 127 b.p.m., *There was a Time,* where there is no perceptible swing present at all. This may suggest that in at faster tempos in funk, swing becomes unfavourable as an aesthetic choice, or alternatively, becomes technically more difficult to implement as the duration of the second note approaches motoric limitations. For bass and drum rhythms in particular however, swing perhaps becomes unfavourable already at lower tempi from approximately 110 b.p.m. and onwards.

Mean standard deviation for the various instruments in the funk excerpts SR units was ±0.19 for drums, ±0.27 for bass and ±0.25 for guitar - rather significant values to consider for those tracks in particular with mean SRs hovering just above or below the various swing thresholds. Either each musician was unconsciously inconsistent or 'loose' with regard to their swing ratios, or such discrepancy might be intentionally applied in order to emphasize certain beats or larger macro-structural patterns within a measure (a possibility which will be explored in chapter 4).

3.1.1.3 Jazz-Funk excerpts

In the jazz-funk excerpts alone (see ***Fig. 3.3***), for drums and bass, no correlation between swing ratio and tempo was found (drums: $r^2 = 0.085$ p=0.484, bass/org. pedals: $r^2 = 0.353$ p =0.160), however, for the guitar/organ pair, the correlation was significant ($r^2 = 0.663$ p =0.026), indicating that at least

for the guitarists and organists in our sample the faster the tempo in a track, the lower the swing ratio they tend to implement in their sixteenths. We notice a somewhat similar pattern to that of the funk tracks; only in the slowest track of the sample group, *Blue Juice* at 90 ±4 b.p.m. do instruments (bass and guitar) swing unambiguously and exceed the 1.5 threshold. After this point, with only a slight increase in tempo (4 b.p.m.) the mean SRs for all instruments drop to center around the 1.2 threshold until only to drop slightly further at the very fastest tempo range over 121 b.p.m. where no swing perceptibly presents itself in any of the instruments. In total, significant SRs (above 1.2) are observed in 5 out of 8 tracks (64%), however, more specifically only 7 out of 23 (30%) instruments show any such perceptible swinging in their sixteenth-note rhythm – far fewer cases than in the funk example.

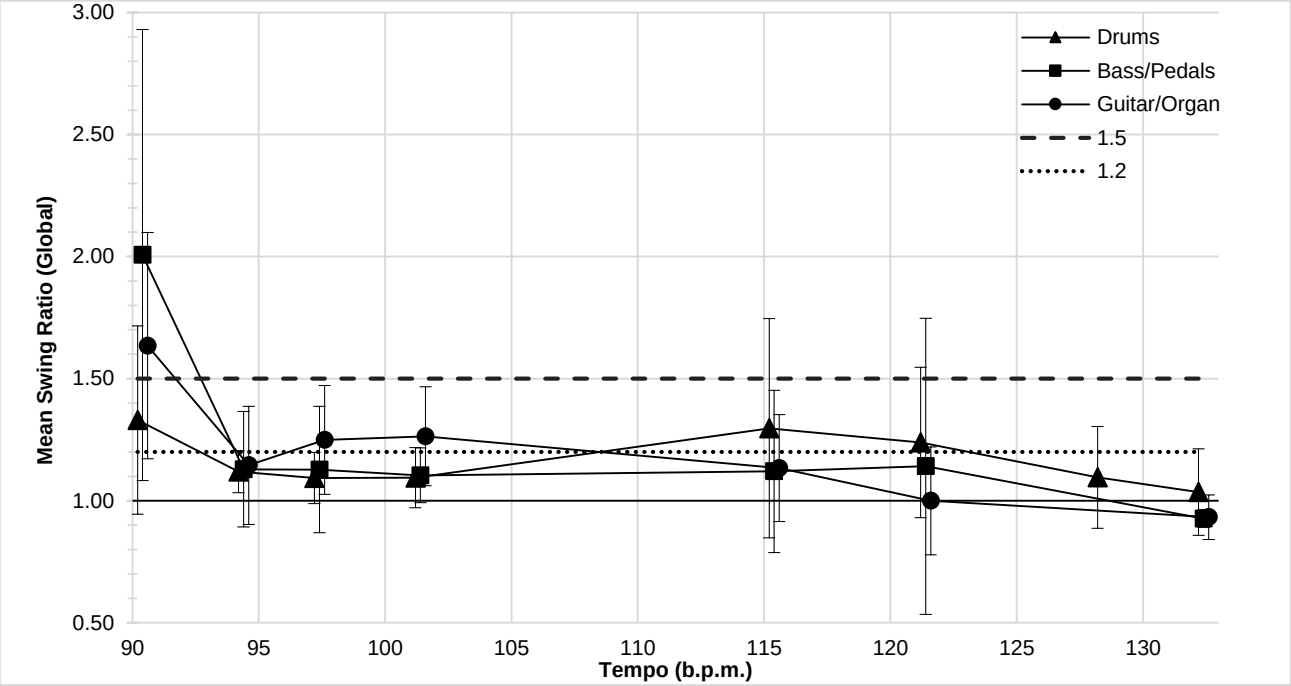

Fig. 3.3 *– Mean Global SR as a function of tempo (b.p.m.) for Jazz-funk tracks (right). Error bars show standard deviation.*

In the first half of the tracks (90 -101 b.p.m.), guitar/organ generally swing higher on average than bass or drums, however in the faster half of the tracks (115 to 132 b.p.m.), it is drums that either swing at a higher mean SR than the other instruments, and in fact are the only instrument to swing perceptibly at all at that range. Just as in the case of the funk tracks, higher overall mean swing ratios can be generally found in guitar/organ and drums, and less so in bass – in fact, there is no bass ratio above either the 1.2 JND threshold except for in the very slowest track *Blue Juice* (which present a curious outlier case, in that all instruments show extremely high swing ratio values compared to the rest of the sample, just like *Get Up (I Feel Like Being a Sex Machine)* in the funk case). Overall, the discrepancy in SRs between the various instruments seems to be lower than in the funk examples.

Mean standard deviation for each instrument in the jazz-funk excerpts in SR units was ±0.21

for drums, ±0.38 for bass and ±0.22 for guitar. Particularly high SD in SR can be observed for by both bass and drums on certain tracks such as *Blue Juice* (94 b.p.m.), as well as *I Can't Stand It* (115 b.p.m.) and *Orange Peel* at (121 b.p.m.). In the first case, the slow tempo is a possibly causing factor since performers have a much longer span of time in which to elongate or shorten the IOI durations and alter the ratio of the swung sixteenth notes, allowing for greater variation (or deviation) in swing ratio. Also, just as in the latter two cases, it seems high SD deviation values are caused by the fact that SR values higher than the global mean seem to consistently occur on particular beats and potential reasons for this so will be examined in chapter 4 along with similar cases from the funk excerpt.

3.1.1.4 Summary

Whilst Global Mean Swing Ratio does tend to decrease with increasing tempo, no simple linear relationship between tempo and mean swing ratio was found for any of the instruments, with the exception of guitar/organ in jazz-funk category.

3.1.2 Inter-Instrument Global Mean Swing Ratio

Patterns observed in both funk and jazz-funk global mean SR plots (where instruments' swing ratios seem to curve in approximately parallel fashions) suggest that the swing ratio of instruments may be inter-correlated or co-dependent. To test the solidity of this observation, Pearson's correlation tests of relationships between instruments' SR ratio were conducted for pairs of instruments for all excerpts and each style, separately. In the following we will examine only the significant results for funk and jazz-funk, respectively (the tests for all excerpts combined yielded no significant results). Complete correlation results are reported in **Table 7.3** in the Appendix).

3.1.2.1 Funk excerpts

In the funk excerpts, strong positive correlations were found between all instruments' SRs: in guitar vs. drums ($r^2 = 0.946$ p=<0.01), guitar vs. bass ($r^2 = 0.946$ p=<0.01) and bass vs. drums ($r^2 = 0.876$ p=<0.05). This means that the instruments' SRs scale proportionally with each other – as one instrument's SR increases so does that of the other and *vice versa*. Guitar SRs are consistently higher than drums on average (+0.17 ±0.09) and bass (+0.27 ±0.07) in all tracks. Drums and bass SRs on the other hand are at the same level and come close to scaling proportionally (1:1), that is, their SRs are more closely synchronized in each track, that is, within 0.07 ±0.13 SR units of each other.

3.1.2.2 Jazz-Funk excerpts

In the jazz-funk excerpts, only guitar/organ to bass/organ pedals SRs were found to correlate strongly with each other ($r^2 = 0.806$ p=<0.001). This may indicate that in jazz-funk, these instruments are more

attuned to each other's' swing ratios (they are on average within 0.03 ±0.18 SR units of each other). Drums on the other hand seem to maintain a mean SR that is largely independent of the other instruments.

3.1.2.3 Summary

In the funk excerpts, all three rhythm section instruments' global swing ratio were found to scale proportionally, whilst in the jazz-funk sample only guitar/organ to bass/organ pedals global swing ratios were found to correlate strongly with each other.

3.2 Absolute Duration of Sixteenth-Pairs' Second Note

In this section we will examine the mean absolute duration of the sixteenth-note pair's second (off-beat) notes of as a function of tempo, in order to compare whether the rhythm instruments in our funk and jazz-funk excerpts demonstrate a constant lower limit of second note duration in mid to fast tempos (>75 b.p.m.[13]) as reported by Friberg and Sundström (2002) or conversely, whether a linear relationship presents itself where absolute second note duration decreases proportionately with increasing tempo as reported by Honing and de Haas (2008). Descriptive statistics of all durations for second notes of pairs of sixteenth are provided *in* ***Table 7.4*** *(*including outliers) and ***Table 7.5*** (excluding outliers) in the Appendix.

3.2.1 Absolute Duration of Sixteenth-Pairs' Second Note vs. Tempo

3.2.1.1 All Excerpts

The results of all thirteen excerpts' sixteenth-note pairs' second note durations are plotted against tempo above in ***Fig. 3.4***. If we disregard the most obvious outlier values of *Blue Juice* (90 b.p.m) and *Get Up (I Feel Like Being a Sex Machine)* (109 b.p.m.), similar patterns seem to emerge for most instruments – that of a slight linear trend of decreasing second note duration with increasing tempo. If we consider all the data points for each instrument, outliers included, only in the case of drums is a strong correlation to be found between second note duration and tempo (r^2=0.727, p=<0.001). However, if we exclude these outlier values[14] – we see that in fact strong correlations are to be found for all instruments; drums (r^2=0.942, p=<0.001), bass/organ pedals (r^2=0.837, p=0.001) and guitar/organ (r^2=0.791, p=0.001), and therefore a linear relationship between decreasing second note

[13] Originally >150 b.p.m. in Friberg and Sundström (2002) relative to eighth-notes in straight ahead Jazz, however 75 b.p.m. is half this value which is relative to the sixteenth-note level where swing may occur in Funk and Jazz-Funk.
[14] Once again, those pertaining to *Blue Juice* and *Get Up (I Feel Like Being a Sex Machine*), which, whilst both seem to be atypical members of their respective Funk and Jazz-Funk categories, they share the common characteristic of being the slowest tracks of each.

duration and increasing tempo does indeed presents itself in the combined categories of funk and jazz-funk together.

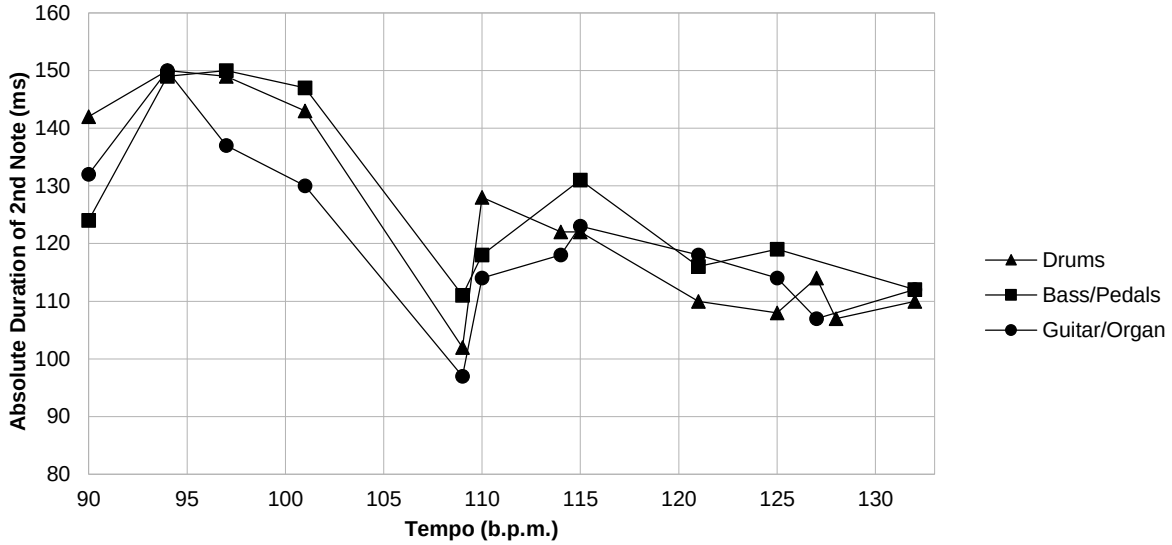

Fig. 3.4 *- Mean Absolute Duration of Sixteenth Pairs' Second Note (ms) as a function of tempo (b.p.m.) in All Excerpts*

3.2.1.2 Funk excerpts

Considering the results of the funk excerpts alone (see ***Fig. 3.5***), even including outlier values, no correlations between absolute second note duration and tempo was found for any of the instruments. However, if we exclude the outlier data values of the slowest track, *Get Up (I Feel Like Being a Sex Machine),* a correlation with a trend towards significance is found for drums (r^2=0.854, p=0.076). For guitar there are no significant correlations (outlier included and excluded), and for bass, there are too few data samples to do statistical tests.

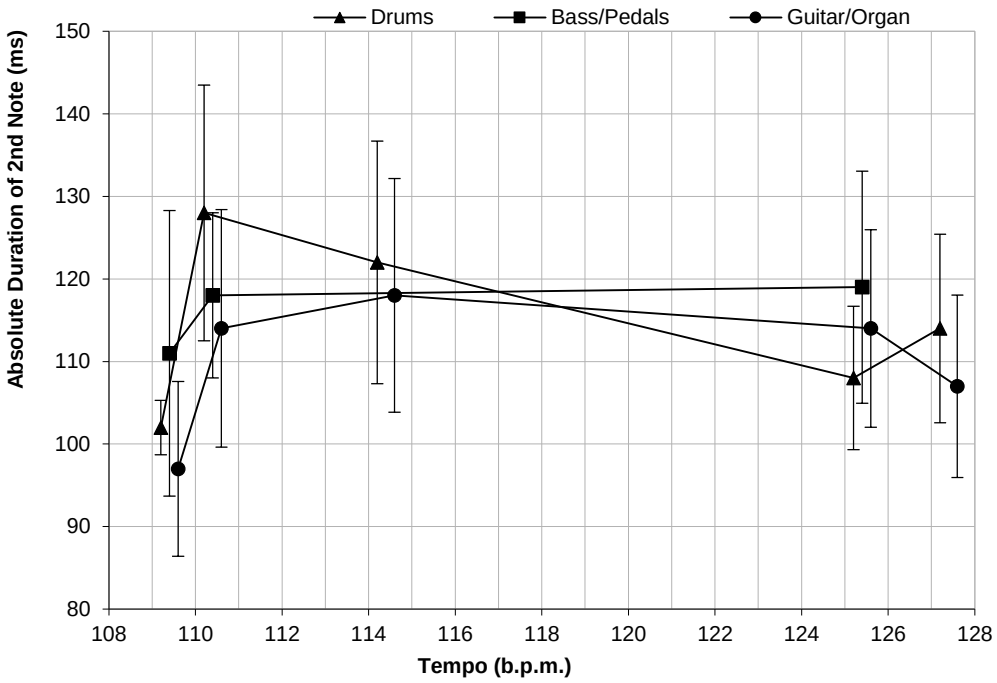

Fig. 3.5 *Mean Absolute Duration of Sixteenth Pairs' Second Note (ms) as a function of tempo (b.p.m.) in Funk excerpts.*

3.2.1.3 Jazz-Funk excerpts

In the jazz-funk excerpts (***Fig. 3.6***), a general linear trend of decreasing second duration as tempo increases can be observed for most instruments from the second slowest track at 94 b.p.m and above. Including the outlier data from *Blue Juice* at 90 b.p.m., strong correlations for both drums (r^2=0.909, p=<0.0001) and guitar/organ (r^2=0.757, p=<0.05) were found, whilst only a weak correlation with merely a tendency towards significance was observed for bass/organ pedals (r^2=0.514, p=0.070). Excluding the outlier values, bass/organ pedals consequently show strong correlations (r^2=0.956, p=0.001) and guitar/organ correlation values are strengthened (r^2=0.880, p=<0.05).

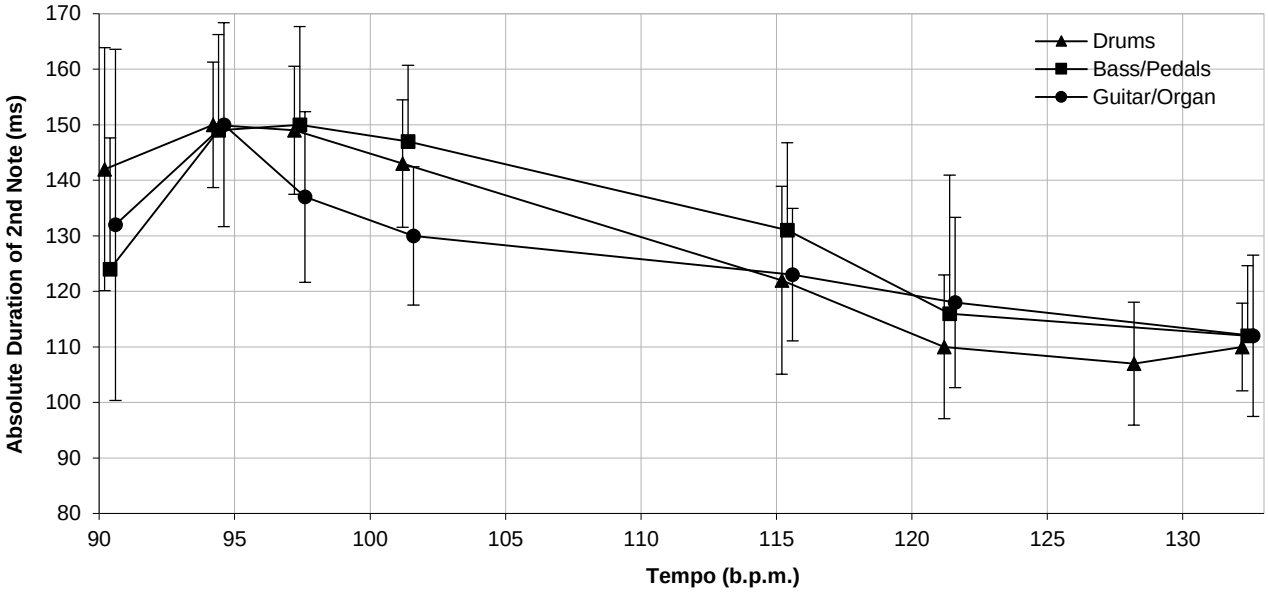

Fig. 3.6 *- Mean Absolute Duration of 2nd Note as a function of tempo (b.p.m.) for Jazz-Funk excerpts.*

3.2.1.4 Summary

Excluding outlier values, absolute duration of second note (off-beats) in sixteenth pairs and tempo was found to scale proportionally for all instruments in the combined category of All Excerpts, as well as the jazz-funk excerpts. In the funk excerpt category, however, only a trend towards significance was found regarding drums

3.3 Global Mean Asynchrony

In this segment we will focus on on-beat sixteenth notes, testing the global mean asynchrony between bass/organ pedals and drums as well as guitar/organ and drums, both in relation to tempo and independently of tempo for each instrument category. This is done in order to see whether patterns of consistent 'behind', 'on-top', or 'ahead of' placement in relation to the drum's downbeats emerge, with the purpose of uncovering possible differences and similarities between the styles of funk and jazz-funk. ***Table* 3.2** presents an overview of the results of this section in relation to the significant thresholds of perceptible asynchrony established in section 2.1.6, that of the more stringent relative 10% JND threshold and the lesser 6 ms absolute constant JND threshold.

Table 3.2 *– Summary of Mean Asynchrony analysis results for Bass/Organ Pedals and Guitar/Organ in All Excerpts.*

		Bass/Organ Pedals		Guitar/Organ				
Track/Artist	**Tempo (b.p.m.)**	**Asynchrony (ms)**	**S.D. (±ms)**	**Asynchrony (ms)**	**S.D. (±ms)**	**Difference (ms)**	**±10% Relative JND (ms)**	**±6 (ms) Constant JND**
Blue Juice	90 ±4	31	27	30	15	1	16.7	6.0
Fire Eater	94 ±2	-1	30	5	23	-6	16.0	6.0
The Emperor	97 ±2	13	16	4	17	9	15.5	6.0
Ain't it Funky	101 ±2	3	31	10	17	7	14.9	6.0
Get Up (...Sex Machine)	109±3	-13	22	7	27	20	13.8	6.0
Give it Up or Turnit…	110 ±4	17	15	5	16	12	13.6	6.0
Cold Sweat	114 ±3	13	31	27	10	14	13.2	6.0
I Can't Stand It	115 ±3	-22	12	4	29	26	13.0	6.0
Orange Peel	121 ±3	2	34	25	11	23	12.4	6.0
Superbad	125 ±3	0	13	-12	18	12	12.0	6.0
There was a Time	127 ±4	n/a	n/a	5	17	5	11.8	6.0
Alligator Boogaloo	128 ±4	9	18	8	15	1	11.7	6.0
Son of Ice Bag	132 ±3	15	13	0	24	15	11.4	6.0

3.3.1 Global Mean Asynchrony vs. Tempo

3.3.1.1 All excerpts

Visual inspection of plots of data for all the instruments' sixteenth-note on-beat asynchrony tracks in relation to tempo (see ***Fig. 3.7***) revealed no proportional relationship between mean asynchrony and tempo for either style category and no further tests on this were done. The total range of asynchrony for both instrument categories was a maximum of +31ms behind the (drums') beat and a minimum of -21ms ahead of the beat. The mean difference in placement between bass/organ pedals and guitar/organ for all the tracks was 11±8ms, with a maximum difference of 26ms in *I Can't Stand It*. This means that the largest asynchronies found are most likely perceptible in the given musical context in relation to our 10% JND threshold. No clear patterns between bass/organ pedals and guitar/organ seem to be present, in the sense that when one is behind the beat, the other doesn't show a tendency to be neither systematically ahead, on beat or behind (see also ***Fig. 3.8***).

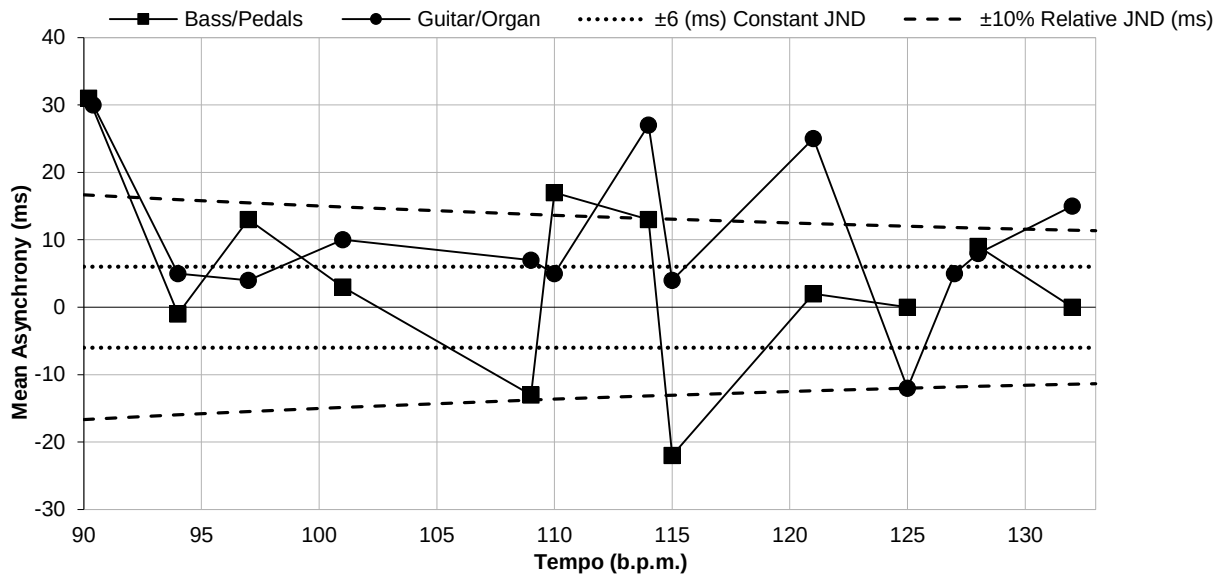

Fig. 3.7 *– Global Mean Asynchrony (ms) of bass/organ pedals and guitar/organ as a function of tempo (b.p.m) for All Excerpts. Relative JND and Absolute constant JND thresholds indicated by dotted and dashed lines.*

3.3.1.2 Funk excerpts

Looking more closely into each style, in the funk tracks, on average bass showed a tendency to be asynchronous with drums in three out of four tracks[15]: it was on the beat (aligned with the drums) in one track (*Superbad),* ahead of the beat in one track (*Get Up (I Feel Like Being a Sex Machine)),* and behind the beat in two tracks (*Cold Sweat, Give it Up or Turnit a Loose)*. Neither regarding guitar was there a clear pattern. Out of a total of five tracks, the guitar was on the beat in two (*Give it Up or Turnit a Loose, There Was a Time),* ahead of the beat in one (*Superbad),* and behind the beat in two (*Get Up (I Feel Like Being a Sex Machine), Cold Sweat)*.

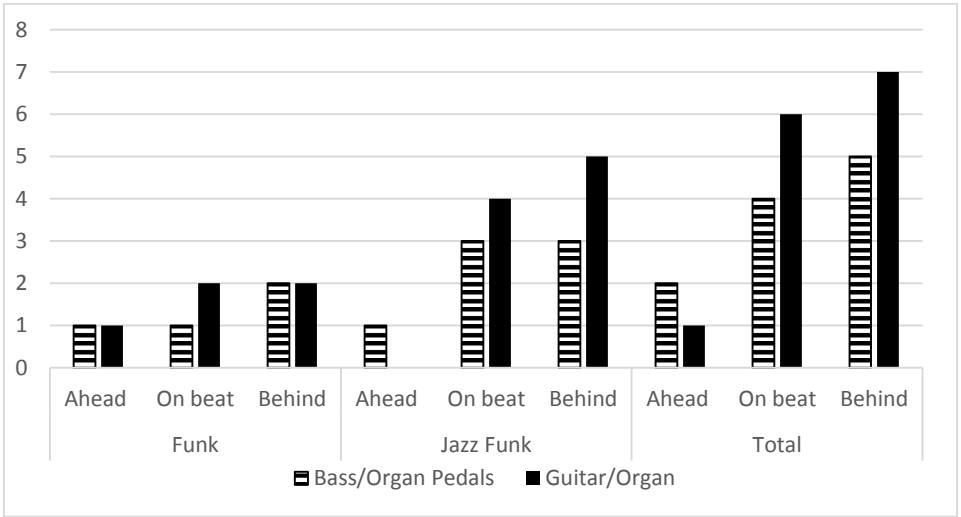

Fig. 3.8 *– Bar chart presenting a summary of mean bass/organ pedals and guitar/organ downbeat locations relative to the drums' downbeat locations in Funk (left), Jazz-Funk (middle) and All excerpts (right).*

[15] No data for There Was a Time (impossible to extract from recording).

3.3.1.3 *Jazz-funk excerpts*

In the jazz-funk tracks, bass/organ pedals generally tended to be either behind the beat (4/8 *Alligator Boogaloo, The Emperor, Blue Juice, Son of Ice Bag)* or on the beat (3/8 tracks: *Fire Eater*, *Ain't it Funky, Orange Peel)*, with only one case in which they were ahead of the beat (1/8: *I Can't Stand It).* Guitar/organ tended to be consistently behind the beat in four tracks (*Alligator Boogaloo, Ain't it Funky, Orange Peel, Blue Juice*) and on the beat in the remaining four (*Fire Eater*, *The Emperor, I Can't Stand It, Son of Ice Bag*), being ahead of the beat in none of the tracks.

3.3.1.4 Summary

No systematic relationship regarding mean asynchrony was found for guitar/organ and drums, and bass/organ pedals and drums, respectively, on on-beat sixteenths (or alternatively, eighth-notes) in either the funk or jazz-funk excerpts. In both funk and jazz-funk however, on average bass/organ pedals and guitar/organ were found to place their on-beats mostly either behind or on top of the drums' beat, rarely expressing microrhythmic placement ahead of its beat.

It is likely that, rather than tempo, players' individual styles as well as technical abilities may be a more significant variables affecting mean asynchrony from drums, as well as more diffuse variables such as ideal/desired aesthetic rhythmic 'feel' to be achieved which may be heavily dependent on the context of the groove in question – all of which factors unsuited for measurement and quantification and therefore beyond the scope of this type of microanalysis.

3.4 Local Mean Swing Ratio

Results from segment 3.1 dealt with global mean swing ratio values, which did not reveal how swing ratio in instruments may in fact fluctuate from beat to beat within a track's basic groove unit (usually comprised of one or two repeated measures). In this section, we will therefore examine the results of the various instruments' 'local' mean swing ratios, that is, the mean swing ratio of each individual sixteenth-note pair per measure (eight pairs per measure in total). We will also separate the results into two categories – excerpts showing either: a) relatively 'Stable' pattern of mean SR within a measure – i.e. low fluctuating mean SR values throughout a measure, or conversely, b) more 'Irregular' mean SR values patterns – those which demonstrate significant deviation of SR from global mean values in individual sixteenth-note pairs of at least ca. +0.20 SR units.[16] Singular instances of sixteenth pairs that do not fit this criterion but still cross either 1.2 or 1.5 JND thresholds (as well as

[16] Minimum perceptible value of swing ratio difference based on our established 10% JND threshold, where the difference between straight note pairs (1:1) and swing note pairs (1.2:1) becomes perceptible.

a higher 2.0 tied-triplet swing threshold) may be also be considered as 'significantly deviating' in certain cases. (A complete overview of all local mean SR results can be found in ***Table 7.1*** in the Appendix)

3.4.1 'Stable' Local SR Patterns

In slightly less than half of all excerpts from both styles combined (five out of thirteen, or 38%), none of the instruments were found to demonstrate any significant local SR deviation from the global SR mean (see ***Fig. 3.9***) (jazz-funk excerpts *Fire Eater* and *Alligator Boogaloo* and funk excerpts *Cold Sweat*, *There was a Time* and *Superbad*). Some instruments in these tracks do display slight fluctuation rather than uniform or 'stable' SRs within a measure. However, none of these deviations meet the criteria stated above, and as such we will assume that in these excerpts the average listener will likely not perceive any particular sixteenth-note as perceptibly swinging more or less than any other.

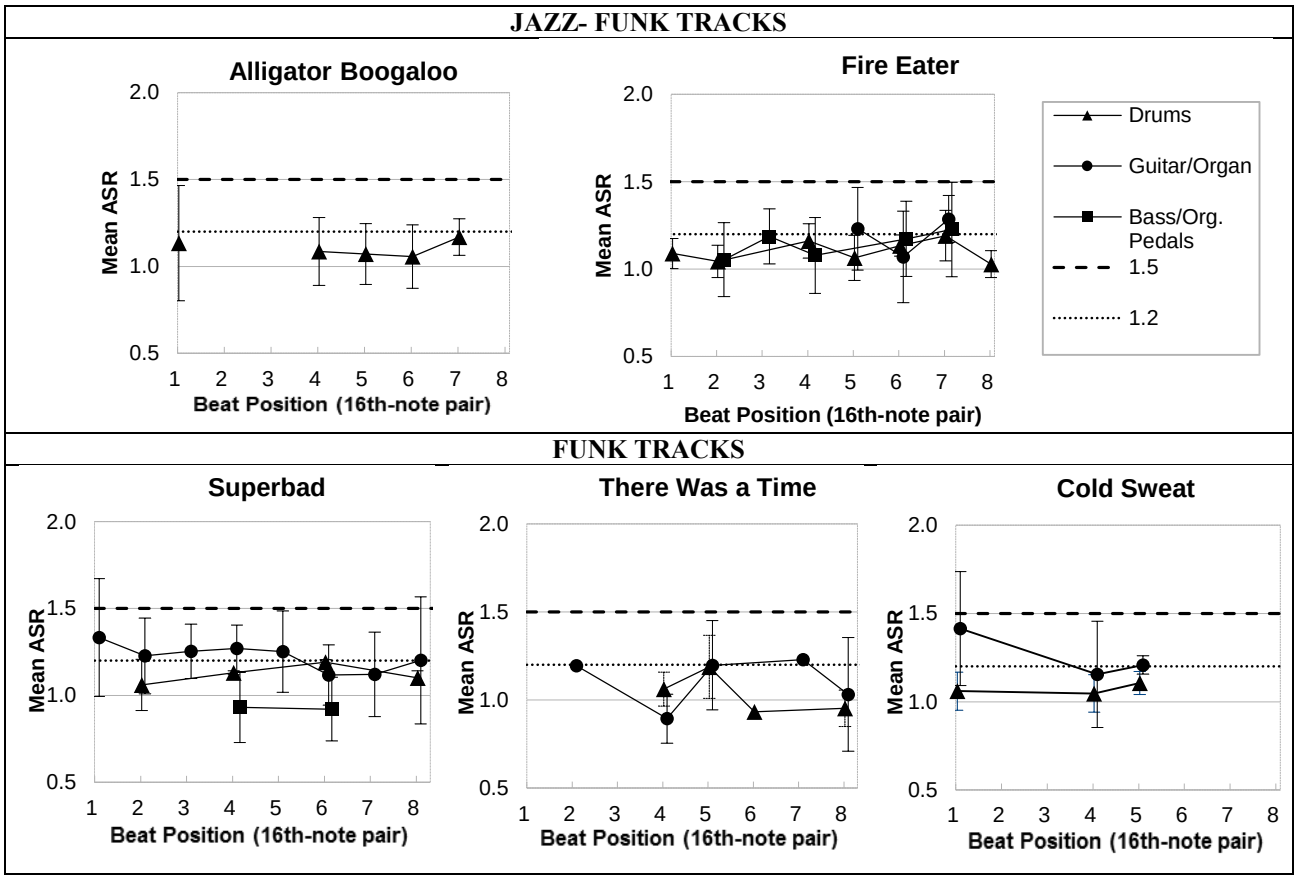

Fig. 3.9 *– Tracks displaying 'Stable' patterns for individual sixteenth pairs' mean SR per measure. The x-axis labels 1 – 8 denote eighth note beats within a measure, where each beat contains a sixteenth-note pair (8 pairs in total). Error bars show Standard Deviation.*

3.4.2 'Irregular' Local SR Patterns

In eight out of thirteen (62%) of all excerpts, at least one instrument was found to demonstrate a mean

local SR in particular sixteenth pairs which deviated significantly from the overall mean global SR (see ***Fig. 3.10***). In jazz-funk, irregular patterns formed a clear majority, that is, six out of eight excerpts (*Orange Peel, Blue Juice, I Can't Stand it, Son of Ice Bag, Ain't it Funky, The Emperor)*, whilst in funk two out of five were irregular *(Give it Up or Turnit a Loose, Get Up (I Feel Like Being a Sex Machine))*.

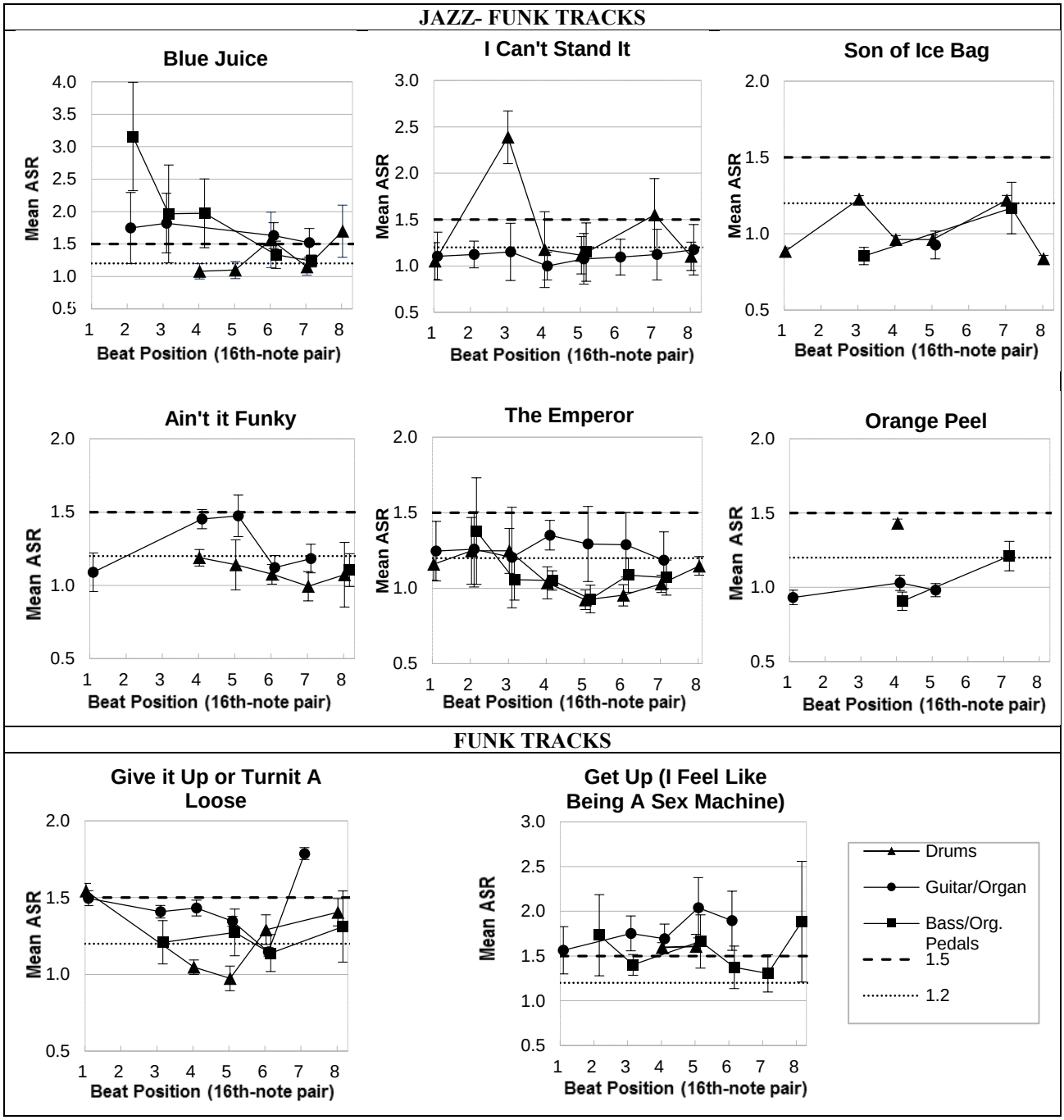

Fig. 3.10 *– Tracks displaying 'Irregular' patterns in local mean SRs for various Funk and Jazz-Funk tracks' excerpts. The x-axis labels 1 – 8 denote eighth note beats within a measure, where each beat contains a sixteenth-note pair (8 pairs in total). Error bars show Standard Deviation.*

Overall, in all eight excerpts from both styles which displayed Irregular local SR patterns in at least one instrument, extra swing emphasis occurred most frequently on the 7th sixteenth-note pair (5 instances), followed by the 2nd pair (4 instances), and 3rd, 6th and 8th pairs combined (3 instances) (see ***Fig. 3.11***). Extra swing emphasis on the 1st, 4th and 5th pairs occurred least frequently, with only 1 instance each. The instrument which demonstrated the most extra swung pairs was the drums (11/21 instances) followed by bass/organ pedals (6/21) and guitar/organ (4/21). Such local swing ratio data, which pinpoints where particular swing pairs (or swung off-beat pickups or syncopations) with extra swing emphasis occur will be essential in examining the relationship between microrhythmic expression on the sixteenth-note subdivision level and macro-structural rhythmic patterns in chapter 4, where we will attempt to answer why certain sixteenths are swung more than others and what role they may serve in the context of funk-oriented grooves.

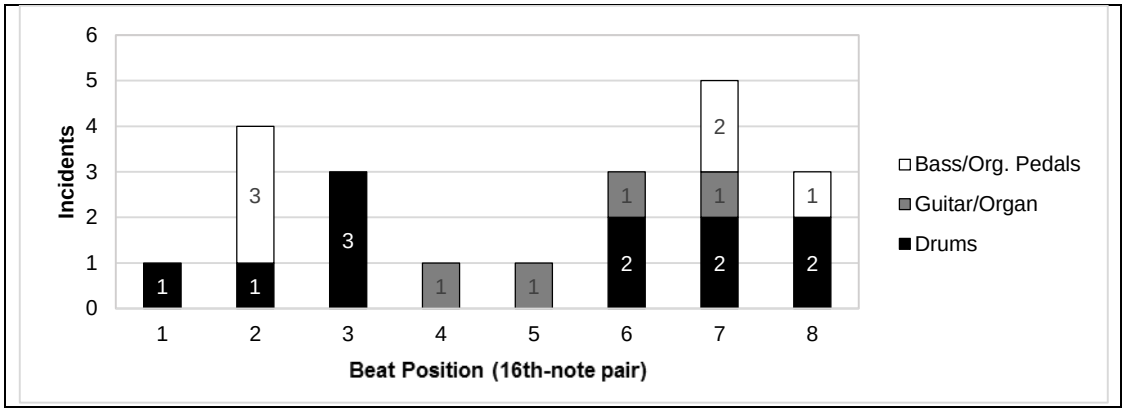

Fig. 3.11 *– Bar chart summarizing all instruments' instances of local sixteenth-note pairs w/ extra swing emphasis according to beat position (16th note pair) in excerpts with Irregular Local mean SR patterns.*

3.4.3 Comparison of Local and Global Mean Swing Ratios for All Excerpts

In ***Table 3.3*** (see below) we have an overview which compares results of global mean SR from section 3.1.1 with the local mean SR results of this section for all instruments from all excerpts. In terms of global mean SR only, nine out of thirteen excepts in total (69%) were found to display at least one instrument which swung the majority of its sixteenth-notes to at least a perceptible degree of mean SR (= or > 1.2:1): four out of five funk excerpts (80%) and five out of eight jazz-funk (63%) excerpts. However, when considering Local Mean SR results in addition, the total number of all excerpts with at least one instrument show consistent swing on a particular sixteenth pair rises to twelve out of thirteen (92%) – i.e. a vast majority. Such a result suggests that swing may likely be a salient element of funk rhythm more generally.

		Drums		Bass/Org. Pedals		Guitar/Organ	
	Track/Artist	**Global Mean Swing**	**Local Extra Swung Pair(s)**	**Global Mean Swing**	**Local Extra Swung Pair(s)**	**Global Mean Swing**	**Local Extra Swung Pair(s)**
JAZZ-FUNK	Blue Juice	Yes (>1.2)	Yes (>1.5)	Yes (>2.0)	Yes (>3.0)	Yes (>1.5)	No
	Fire Eater	No	No	No	Yes (>1.2)	No	Yes (>1.2)
	The Emperor	No	Yes (>1.2)	No	Yes (>1.2)	Yes (>1.2)	No
	Ain't it Funky	No	No	No	No	Yes (>1.2)	Yes (>1.2)
	I Can't Stand It	Yes (>1.2)	Yes (>1.5)	No	No	No	No
	Orange Peel	Yes (>1.2)	No	No	Yes (>1.2)	No	No
	Alligator Boogaloo	No	No	-	-	-	-
	Son of Ice Bag	No	Yes (>1.2)	No	No	No	No
FUNK	Get Up (…Sex Machine)	Yes (>1.5)	No	Yes (>1.5)	Yes (>1.5)	Yes (>1.5)	Yes (>2.0)
	Give it Up or Turnit…	No	Yes (>1.2)	Yes (>1.2)	No	Yes (>1.2)	Yes (>1.5)
	Cold Sweat	No	No	-	-	Yes (>1.2)	No
	Superbad	No	No	No	No	Yes (>1.2)	No
	There was a Time	No	No	-	-	No	Yes (>1.2)

Table 3.3 *- Presence of Global Mean Swing (consistent swing on majority of sixteenth-notes) vs Local Mean Swing (significant extra swing emphasis on individual sixteenth pair(s)) in all instruments from all excerpts. Excerpts containing SRs = or < 1.2:1 are highlighted in yellow, and those with SRs = or <1.5:1 are highlighted in green.*

3.4.4 Summary

Overall, most of the instruments that were found to swing perceptibly at the global level (mean swing ratios values equal to or above 1.2:1) also tended to show patterns of swinging particular 'local' sixteenth-note swing pairs to a significantly greater extent, demonstrating 'Irregular' SR patterns, rather than swinging all sixteenths at a constant uniform rate ('Stable SR pattern). However, whilst the majority jazz-funk excerpts showed Irregular local swing patterns (5/8), most funk excerpts showed Stable patterns instead (3/5). Also, when considering both Global and Local SR results combined, a vast majority of tracks – twelve out of thirteen (92%) – can be said show at least one instrument which swings above 1.2:1 on either the global or local level.

3.5 Discussion

Our overall findings serve to confirm the frequent presence of swing on the sixteenth-note level to various degrees in funk -based rhythm as reported by Danielsen (2006), Stewart (2000) and Butterfield (2006). Before we discuss the most relevant results of the previous sections in greater depth, however, it is to be noted that a much larger data set of both funk and jazz-funk excerpts from recordings of the early period (1967-71) would be needed to substantiate the validity of the findings as representative for both styles in general. We can only affirm that any trends or correlations found are reliable only in relation to our relatively small sample. Let us now discuss the results from each subsection in their own right as well as in the context of relevant research.

3.5.1 Global Mean Swing Ratio

Interestingly, global swing equal to or higher than the theoretical JND threshold for swing (1.2:1) was found in nine out of thirteen excerpts. This is in contrast to De Haas, one of the few researchers to my knowledge to have conducted comprehensive swing analysis of funk rhythm. In his study, De Haas assumed that the highest subdivision level in funk rhythm is "meant to be played straight", at least by the drums (2007: 20), and consequently did not find any swinging in his basic 4/4 funk pattern experiment (modelled on the figure of James Brown's *Funky Drummer*) – only in the overtly 'funky-shuffle' pattern, based on 12/8 compound meter, did his experiment results produce any perceptible swing. However, the fact that we have found ample empirical evidence to the contrary not only in the drums, but in all rhythm section instruments of historically classic grooves firmly rooted in 4/4 meter, and not just in the jazz-funk excerpts, but also in the funk excerpts, suggests that swing on the sixteenth level may be another salient element amongst the wider aesthetic stylistic traits of funk-oriented rhythm.

It should be mentioned that the degree to which individual instruments maintain a stable global mean swing ratio (their consistency in terms of mean standard deviation) in both funk and jazz-funk excerpts was similar to those found in straight-ahead jazz drummers analysed by Friberg and Sundström (2002), which in turn was not nearly as consistent as the range of values reported by the more tightly controlled experiment-based drummers in De Haas' (2007) study. This might be explained by four possibilities, firstly, measurement inaccuracy – a considerable amount of overlapping and noise in the waveform and spectrogram graphs do not allow our methods to be as precise as those of De Haas, and our results may show exaggerated SD values. Secondly, if our values are assumed more or less correct, then the fact that none of the performers in our sample were playing to any external metronome and overall tempo naturally fluctuated slightly, resulting in a larger range of IOIs between total calculated swung sixteenth-note pairs which skews the standard deviation values positively. Thirdly, unlike in De Haas' study, the musicians in our excerpts did not play in an isolated solo fashion for scientific purposes but rather in realistic recording situations together with an ensemble, which probably affected their ability to play as consistently as possible (and was undoubtedly not as vital a priority). Fourth and lastly, the most likely reason why the consistency of global mean swing ratios was not particularly low, is because musicians apply various degrees of swing ratio at different points in a groove (to particular sixteenth-note pairs or off-beats) in a more or less determined manner in order to produce a particular effect. (In section 3.5.4, we will discuss the results of these local mean swing ratios of individual sixteenth pairs per measure.)

3.5.1.1 Global Mean Swing Ratio vs. Tempo

In section 3.1.1, no significant correlation between tempo and mean swing ratio was found in any of

the excerpts for any the instruments, with the exception of guitar/organ in our jazz-funk sample. Therefore, whilst our findings generally lend further evidence to the hypothesis purported by both Friberg and Sundström (2002) and Honing and De Haas (2008) that swing ratio is not tempo-invariant (not readily transposed in tempo by a constant factor), they align more with those of Honing and De Haas (2008) who also found no evidence of a simple linear relationship between swing ratio and tempo in jazz styles, as opposed to Friberg and Sundström (2002) who, on the other hand, did. The exception in the case of our guitar/organ results indicates that tempo may have a greater determining role in setting the swing ratio for these instruments in our sample; however, as mentioned our data set is not large enough to guarantee external validity to the style of early jazz-funk as a whole. De Haas (2007) did in fact find proportional scaling in his 12/8 compound meter 'Funk Shuffle' drum pattern experiment, and although not directly comparable in terms of style, does lend further evidence to possibility of tempo being a primary determinant of swing ratio in particular funk-related rhythmic contexts.

Still, whilst tempo cannot be said to affect swing ratio in any simple linear fashion, results from the remaining majority of instruments do show that there is a tendency to swing less at higher tempos in both styles. Only in the two slowest excerpts of each separate style, *Get Up (I Feel Like Being a Sex Machine)* at 109 b.p.m. in funk and *Blue Juice* at 90 b.p.m. in jazz-funk, do instruments swing most clearly and unambiguously over the 1.5:1 JND threshold. As Stewart (2000:299) noted, "a slight swing feel" is commonly found in the funk grooves of "medium temp[i], around 100 beats per minute", and our findings further the veracity of such a claim. At higher tempi, however, global mean swing ratio tends to decrease considerably for both styles overall; singular individual instruments may still globally swing over the JND 1.2:1 threshold, but never over the clearly noticeable 1.5:1 degree to which they reach in the tracks of the very slowest tempos. In the relative mid-high tempo range of our sample (over 110 b.p.m), only guitar can be found to swing perceptibly up to tempos of around 120 b.p.m in the funk excerpts, and in jazz-funk, it is conversely drums which occasionally swing around and above the 1.2 JND threshold in the same tempo region. At tempos faster than 120 b.p.m however, most instruments do not to swing to any perceptible degree at all.

A possible reason for this may be that, as tempo increases, it becomes increasingly more challenging for performers to technically execute precise durational inequality, or swing, on the sixteenth-note level, as well as the fact that the durations between first (on-beat) and second (off-beat) notes in a swing pair gradually decrease until they approach the very limit of being considered perceptibly swung at all. For example, in the tempo of our very fastest excerpt at 132 b.p.m, in a hypothetical pair of sixteenths swung at the JND swing ratio threshold of 1.2:1, the difference in duration between on- and off-beat would be just 21ms – an extremely short amount of time for both instrumentalists to separate their sixteenth pairs by in a consistent fashion, as well as for listeners to

hear as swung rather than virtually straight (despite being within theoretical JND boundaries). Still, the fact that it might be increasingly difficult to control swing ratio at fast tempos does not explain the sharp, rather than gradual, decrease in mean global swing ratio that occurs for all instruments from the very slowest tracks to the next slowest in both the funk and jazz-funk excerpts.

In the funk sample, for example, *Give It Up or Turnit A Loose* is played at only ca. 1 b.p.m faster (110 b.p.m.) than *Get Up (I Feel Like Being a Sex Machine,* yet the global mean swing ratio of all instruments decreases considerably – bass and drums drop down from the 1.5:1 'light' swing threshold to hover just slightly above and below the 1.2 JND threshold respectively, and the guitar also falls a parallel distance to just slightly below the 1.5 threshold. In the jazz-funk excerpts, the difference from the two slowest tracks is 4 b.p.m. and a similar drop in global mean SR occurs as in the funk case. The difference, of course, between *Get Up (I Feel Like Being a Sex Machine* and *Give It Up or Turnit A Loose* in funk and *Blue Juice* and *Fire Eater* in jazz-funk, is comprised of a myriad other factors rather than just tempo, such as the types of rhythmic patterns (syncopated to greater or lesser extents) and harmonies (whether in major or minor modes) which vary greatly. Still, such radical divergences in mean SRs despite minute increments in tempo between these sets of tracks suggest that tempo might not be a prime determinant factor for swing ratio in the rhythm section, at least in the slower tempo range.

Similarly, the fact that the funk players swing comparatively higher at 109 b.p.m than jazz-funk players do at a slower tempo of 94 b.p.m. is probably not so much indicative of funk players being more technically adept at swinging than the jazz-funk players, the majority of which were proficient in much faster swing-based styles of jazz such as the funky branch of hard-bop. Instead, it is more likely that other objective factors such as inter-instrument swing ratio, (which we will look at next in section 3.5.1.2), as well as other musical contextual factors mentioned above, are greater factors determining swing ratio in a track. Aesthetic preference, although less amenable to quantification, cannot be discounted as a key principle guiding the use of swung notes in these styles, as funk or jazz-funk instrumentalists may choose to swing perceptibly or not depending on the 'feel' they wish to engender within the overall texture of the groove in question. What kinds of affective qualities may be conveyed when swung sixteenths are applied to the rhythm of Funk-based grooves, we shall explore in greater detail in chapter 4.

3.5.1.2 Inter-Instrument Global Mean Swing Ratio

In section 3.1.2 perhaps some of the most significant differences between the funk and jazz-funk excerpts regarding use of swing on the sixteenth-note level were found. Firstly, in the funk tracks, all three rhythm section instruments' global mean swing ratios were found to scale proportionally with each other. Also, a clear pattern of guitar swinging systematically higher than drums and bass at

all tempos was observed, whilst drums and bass swing ratios were closely synchronized. In the jazz-funk excerpts on the other hand, only guitar/organ to bass/organ pedals showed strong inter-instrument swing ratio correlations (excluding outliers), with drums maintaining a swing ratio largely independent of the other instruments.

These findings, together with the global swing results in general, suggest that in the classic funk rhythm mould of James Brown, foundational rhythmic instruments of bass and drums commonly maintain closely synchronized groove with usually relatively straight sixteenths (except in slower tempos) whilst guitar tends to swing its sixteenths noticeably higher in comparison. In jazz-funk, whilst guitar/organ and drums generally swing higher than bass/organ pedals on average, neither shows a pattern of being the most swung instrument at all times – guitar/organ swing highest in the slowest three tracks, whilst drums curiously swing highest in the fastest four excerpts. Therefore, whilst guitar was commonly found to be the main (or most notably) swinging instrument in funk, various instruments may assume such a role in jazz-funk. That drums should often take the role of highest swinging instrument at the faster tempo range in jazz-funk may be related to the fact that in more straight-ahead forms of jazz, drums are commonly found to swing higher (or more overtly) than other ensemble instruments (Butterfield 2011; Friberg and Sundström 2002). Therefore, it is a possibility that jazz-funk drummers adapting to funk likely may have retained some elements of that swing practice in their transition to funkier rhythms, albeit to a more subtle degree, whilst their funk drummer counterparts were assumedly were more accustomed to playing straighter R&B rhythms on a more regular basis an consequently do not swing globally at faster tempos.

More generally though, based on our sample's results, we may speculate that a possible general stylistic difference between funk and jazz-funk in regard to swing may be that in funk, a greater degree of juxtaposition of both straight and (lightly) swung sixteenth subdivision levels is preferred in comparison to jazz-funk, where instruments tend to swing at a slightly more synchronized, common ratio. Reasons for this may be in part due, again, to differences in historical aesthetic practice regarding swing in Jazz as opposed to popular styles. As we saw in section 1.4, before the emergence of jazz-funk in the late 60's, swing and shuffle based rhythm had dominated in Jazz since its earliest incarnations in the early 20th century. Asides from perhaps a minority of Latin influenced styles which incorporated rhythmic foundations from mambo, samba, bossa nova, etc., more explicitly duple based rhythms were rare in the jazz tradition repertoire. It follows that the majority of musicians playing in our jazz-funk excerpts, who were largely proficient in heavily swing based Hard Bop styles, were likely highly influenced by the older Jazz tradition which placed great emphasis on all rhythm instruments swinging overtly, and preferably swinging at somewhat uniform rates together – that is, not too disparately, or not in such a manner which explicitly blended straight and swung subdivisions.

The core rhythm section members of James Brown's bands on the other hand, whilst likely educated in jazz styles to a certain degree, more readily performed in styles rooted in the (black) popular music tradition, particularly the rhythm and blues of the era, which in turn was greatly based on traditional gospel, country blues as well as Latin Caribbean styles – all of which tended to encompass more forms based on straight rhythms in comparison to Jazz. Stewart reminds us, though, that whilst American popular music in general, like jazz, had also been dominated by triple based and shuffle rhythms in the pre-war era, by the 1960's "a general trend occurred in a rhythmic shift from triplet or shuffle feel, to even rhythm… [with] the occurrence of 12/8 metre relatively scarce" (2000:293). In the early to mid-1960's, the particular influence of New Orleans derived R&B styles, where the blend of straight and swinging was commonplace, had a major impact on the early funk of James Brown, particularly in the rhythm of the bands' drummers such as Clyde Stubblefield and John 'Jabo' Starks (Payne 1996). Consequentially, the remainder of the rhythm section was also influenced by such practices, and the element of rhythmic ambiguity inherent in the New Orleans derived styles inspired a new aesthetic ideal for a new distinct style of funk. As the results of our global swing analysis show, in the funk excerpts, it would seem that bass and drums tend to maintain the straighter (but not completely straight) rhythm whilst the more noticeably swinging role is most avidly taken up by guitar, but usually to subtle extents (mostly between 1.2 to 1.5) which do not necessarily produce an explicitly lilting swing feeling.

Differences between the use of swing in funk and jazz-funk rhythm must not be too exaggerated however, for early jazz-funk artists were similarly inspired by the New Oreleans funky rhythmic tradition. In addition, they were heavily influenced by the modernized funk of James Brown. Therefore, it is natural that the jazz-funk excerpt show similar patterns of global swing. For example, in the three excerpts of the jazz-funk category which display the highest disparity in mean global swing ratio between all instruments (excluding the outlier *Blue Juice*), namely those of *Orange Peel, I Can't Stand It* and *Ain't It Funky,* a pattern of two non-swinging instruments combined with one perceptibly swinging instrument can be found – just like the one found in the funk tracks. This is likely no coincidence considering that these very three jazz-funk tracks are either direct interpretations of, or closely based on James Brown's Funk songs – Grant Green's *Ain't It Funky* is based on the original of the same title, the riffs on Lonnie Smith's *I Can't Stand It* are derived almost ad verbatim from the original *I Can't Stand It (When You Touch Me)* and the riffs in Reuben Wilson's *Orange Peel* are also virtually the same as *Cold Sweat*'s. Such similarities serve to blur the distinction between early funk and jazz-funk, reminding us that they may not be so vastly different in regards to rhythmic approach on the micro-level. In section 3.5.4, we shall continue the discussing swing ratio, in light of results from the analysis of local mean swing ratio of individual sixteenth pairs per measure.

3.5.2 Global Mean Absolute Duration of Sixteenth-Pairs' Second Note vs. Tempo

The relationship between absolute duration of sixteenth pairs' second note and tempo was examined primarily in order to examine whether Friberg and Sundström's report of a practical lower limit of of ca. 100 ms in the off-beats eighth-notes of straight-ahead jazz drummers might also be present in the sixteenth off-beats of funk and jazz-funk musicians in general. Excluding outliers, in the Jazz-funk excerpts, strong correlations were indeed found between absolute duration of second note and tempo for all instruments, whilst in the funk category, a tendency towards significance was found for drums only. Considering the results of both styles categories combined, however (also excluding outlier values), all instruments were found to show linear scaling between second note duration and tempo. This does not mean, though, that the opposite of the tempo-specific hypothesis – that global mean swing ratio is proportional to tempo – is true, for as we saw in section 3.1.1, the relationship *ratio* of on-beat to off-beat notes of sixteenth-note pairs and tempo was not found to decrease linearly with increasing tempo. What such results tell us is that there is no evidence for a lower limit of absolute second note duration of sixteenth pairs in our sample. Our results therefore align themselves with those of De Haas (2007) who also found an inversely proportional linear relationship between absolute second note duration and tempo in his Jazz and funk drumming experiments, and no evidence for a constant second note duration irrespective of tempo.

3.5.3 Global Mean Asynchrony

Results from the instruments' global mean asynchrony analysis gave us some insight into timing relations between the sixteenth-note on-beats of bass/organ pedals and guitar/organ in relation to that of the drums' – whether they were placed significantly ahead, behind or synchronous with its beat. Friberg and Sundström (2000: 343) reported that in swing based jazz, relative to the drums' ride cymbal, bass tends to play "slightly delayed [and]… [t]here may be a tendency for longer delays at slower tempi,". In both our jazz-funk and funk excerpts, however, we observed an equal tendency for bass/organ pedals and guitar/organ to position their on-beats either behind or on the beat (using drums as reference for the beat), whilst rarely playing ahead of the beat. No substantial difference between the funk and jazz-funk styles was therefore observed, and no further relationship between tempo and asynchrony whatsoever was found either.

A personal assumption before conducting this micro-analysis, was that bass/organ pedals would be found to play either more or less tightly synchronized with the drums or slightly behind the beat since, just as in jazz, the notion of bass 'laying' back, or behind the drums' beat seems to generally be the norm in funk performance. Indeed, this was found to be so in our sample, for only in just two tracks out thirteen in total did bass/organ pedals conversely play ahead of the drums – in the funk track *Get Up (I Feel Like Being a Sex Machine)* at -13ms, and in the jazz-funk *I Can't Stand It* at -

22ms. Guitar and Hammond organ, however, had been contrarily somewhat expected to be ahead of the beat more often, since on close hearing, they often seem to engender a pushing feeling in both styles, and such an effect was assumed to be caused by placement of on-beats slightly ahead amongst other things. However, only a single case out of thirteen was found, that of guitar in *Superbad*, which showed a global mean asynchrony of -12 ms. In such an instance, despite the fact that it just barely crossed the relative 10% JND threshold (12 ms) for being considered perceptibly asynchronous, because of its rather large standard deviation value (±18 ms) its objective quality of being ahead of the beat is likely diminished. It would seem that the feeling of 'drive' or 'pushing' is more likely caused on the micro-level by significantly swung, or late off-beat sixteenths in swing pairs (or pickups and syncopations), which may at times be perceived as anticipated, virtual early on-beat locations (a possibility which we will examine later in chapter 4).

3.5.4 Local Mean Swing Ratio

Perhaps some the most interesting results of from our microanalysis were those pertaining to patterns of systematic fluctuation of mean swing ratio per measure found in the excerpts. It seems in funk-based rhythm in general, not only does the juxtaposition of straight and swung sixteenths occur by way of different instruments applying varying degrees of global mean swing ratio as we discussed in section 3.5.1, but additionally, it would seem that individual instruments themselves may simultaneously flirt with varying degrees of swing ratio at different points in a groove. We found that in the majority of all excerpts (8 out of 13) at least one instrument per excerpt was found to swing certain sixteenths significantly higher than the global mean, showing what we termed 'Irregular' local (swing ratio patterns. In the remained of tracks, instruments were found to swing more uniformly on all sixteenth pairs in comparison, and deemed as showing relatively 'Stable' patterns of swing in comparison (5 out of 13).

A very slight difference did present itself between the two styles in this regard – in the funk excerpts, most tracks showed a 'Stable' local mean SR pattern (3 out of 5 total) whilst in the jazz-funk excerpts a majority conversely showed 'Irregular' local mean SR patterns (6 out of 8 total). Ultimately, however, I do not believe this constitutes grounds for a possible general aesthetic difference between the two styles, mostly due to the fact that, in general, local swing emphasis within a measure tends to be of the same nature in both funk and jazz-funk – that is, they usually occur mostly on singular, rather than multiple beats. A typical example is in the drums of jazz-funk excerpt *I Can't Stand It,* where it swings to a radical degree on just the third swing pair of the measure, whilst in the rest of the basic groove unit, its swings more uniformly. In the same manner, the guitar of funk excerpt *Give It Up or Turnit A Loose,* swings more or less uniformly throughout the measure but emphasizes just the seventh swing pair. What effect these singular local extra

swung sixteenths may have on the groove whether in funk or jazz-funk are therefore likely the same – that of engendering a feeling of forward motion or drive, as well as producing subtle micro tension in the groove.

Finally, the comparison of results between the global and local mean swing ratio analyses was most revealing. It showed that, in almost every single excerpt (twelve out of thirteen) at least one instrument can be found to show some form of noticeable swing on the sixteenth level, whether global or local. In fact, the single track which did not show any global or local swing at all, *Alligator Boogaloo,* was only measured for drums (since the basic comping pattern of the other rhythm instruments did not contain sixteenth gestures), and it would not be unreasonable to assume that some swing on the sixteenths of the various melodic solos (which we have not measured) throughout the track is probably present. Even so, despite the relatively small size of our sample relative to the extended body of works which are encompassed by the styles of both funk and jazz-funk, our results strongly suggest that swing on the sixteenth-level is a salient element of Funk-based grooves. If anything, however, it is clearly and abundantly present in some shape or form in virtually all the tracks we have analysed.

Part II:

Microrhythm and Macro-Structures

4 Interaction between Microtiming and Macro-Structures of Rhythm

In chapter 3 we were primarily concerned with *how* or *to what extent* funk and jazz-funk rhythm section musicians swing their smallest practical subdivision units – their sixteenths – both on the global (average per total measure) and local (average per individual swing pair) level, as well as if they tend to position the on-beat sixteenths either asynchronously ('ahead'/'on top' or 'behind' the beat) or synchronously ('on the beat') with the main drum reference. We found that there were few significant differences pertaining to swing ratio applied on the sixteenth-note level between both styles, which is in retrospect perhaps not particularly surprising, considering that rhythm in early jazz-funk seems to be closely modelled on that of early funk groups' such as James Brown's band, as well as older black popular R&B styles which were common to both funk and the wider jazz tradition. What we did find, was that swing on the sixteenth level was pervasive in both styles, whether manifested on the local (particular sixteenths) or as global level (overall).

In this chapter, we will examine the quantitative findings from the last chapter, particularly that of the local mean swing ratio results from section 3.4, in a more interpretative manner, viewing them from a wider structural context so as to be able to try and explain *why* performers of both funk-based styles might be swinging their notes of the sixteenth-note level. If 'actual' rhythmic sound events are assumed to be conditioned by 'virtual' reference schemes and figures, then when a swing factor is applied to the sixteenth-note subdivision level, what affective purpose might this serve when played by funk-oriented musicians? Are swung sixteenths to be seen as possible devices of 'anacrusis' which impart motional energy and downbeat closure towards heavy beat locations of the main pulse, as Butterfield (2006) theorizes, and what might be their relationship to the typical rhythmic patterns they comprise, such as the 'ride swing pattern' or the various variations of the counter-rhythmic 'standard patterns'? To try and answer these questions, we must look beyond the micro or sub-syntactical level towards the macro-structural, syntactical level, or to the rhythmic figures which form the basic unit of grooves. Before we delve into concrete analyses of some select examples from our track sample, we will, in sections 4.1 to 4.3, review some rhythmic theories pertaining to virtual reference structures which allow us to distinguish the particular role of off-beat pickups and syncopations in swing contexts.

4.1 Strictly Swinging 'Pairs'?

In chapter 3 we explored to what extent sixteenth notes in a select representative sample of early funk and jazz-funk excerpts could be considered to 'swing' or not. One crucial assumption, with vital implications for measurement of IOIs and subsequent swing ratio calculation, was that even

when complete sixteenth-note 'pairs' were not expressed (both on-beat and off-beat sixteenths, or first and second notes of the pair), we still interpreted lone sixteenth off-beat notes as part of a 'pair' which were subsequently swung or not. If we recall our working definition of swing notes – that of 'pairings of consecutive subdivisions of the same level, with non-equal duration' – then indeed, the implication is that two notes must be consecutively expressed (sounded) in order to be considered 'swung' as such or not. Single off-beat sixteenths IOIs were still measured, however, and expressed as a ratio in relation to corresponding drum (hi-hat/ride) onset locations. As already stated in the theory and method (section 2.1.7), in such instances calculated swing ratios do not yield 'absolute' swing ratio values for an individual instrument (related to itself) at all times, but instead 'relative' swing ratios – that is, relative to the drum reference. Therefore, only by extending our working definition of swing to encompass 'relative' swung note pairs which may be comprised of more than one single individual instrument, could we justify lone standing off-beat sixteenths expressed by one instrument in relation to on-beat sixteenths expressed instead by another, such as drums, as instances of a more specific 'relative' swing. This would ultimately guarantee overall consistency in our usage of the term 'swing'.

As we saw in section 2.1.1, however, it is entirely possible to conceive that, even when performers do not externalize on-beat sixteenths, they may yet operate with some sort of mental schema in order to orient themselves rhythmically, via a hierarchy of regular reference structures on a virtual level. As Polak and London note, "non-isochronous subdivision can be metric in the sense of an internal pulse underlying the timing of notes in relation to even *unsounded* beats," (Polak and London 2014:[104], emphasis in original). In funk-oriented grooves, as with perhaps most music, the most vital of the virtual reference structures is likely the fundament of the main quarter note level, often termed the 'pulse' or 'basic beat'. In all of the excerpts we saw in chapter 3, the location of all of the quarter note beats, as well as their immediately higher duple subdivision of the eighth-note level, are nearly always externally manifested by sound events from at least one or more instruments (particularly drums), thereby easily providing easily observable evidence of virtual reference structures being 'actualized' in action. Data gathered from the onset locations of these quarter note and eighth-note level, derived especially from bass drum, snare and hi-hat cymbal patterns, indicate that their inter-onset interval durations are exceedingly consistent, as well as 'straight' (equal) rather than swung. The purported sixteenth-note level – which is at the heart of this thesis' analytical focus – is, however, one in which all of its beat locations are rarely expressed continuously by any instrument in particular.[17] As such is it comparatively problematic to utilize observed, objective data

[17] In fact, the clear-cut and obvious expression of constant sixteenths is, according to Danielsen (2006), somewhat antithetical to the aesthetic rules (and appeal) of funk styles. Constant sixteenths are rather a salient stylistic trait in later off-shoot styles derived from Funk rhythms, such as disco from the mid 70's.

as a means to establish the nature of the virtual, idealized subdivision structure, whether it is straight or swung. If it is indeed swung, is it swung at all times or only on particular pairs/off-beats?

It becomes prudent therefore to attempt to distinguish between the virtual structures which might be at play when instrumentalists display global swing on the sixteenth level from those which might engender greater local swing on particular sixteenth pairs or off-beats within a basic unit. In the former case, when an instrumentalist consistently phrases all (or the majority) of their sixteenths in an unequal fashion (long-short) – i.e. displays a global mean swing – regardless of whether they do so consciously or subliminally, we may more readily assume that they are intentionally 'operating' with a steadily swung virtual subdivision reference structure. Evidence for this was found in in chapter 3.1, where in more than half our thirteen analyzed excerpts, at least one instrument displayed patterns with global mean swing ratios over 1.2:1 (just perceptible swing) in all of their sixteenths. In section 3.4 , however, we also saw how in more than half of all excerpts, certain instruments swung particular local sixteenths to a significantly greater extent than the average global swing ratio, regardless of whether mean global swing was present or not in the first place.

Just the fact that certain instruments swing certain local pairs in a systematic and consistent fashion leads us to suspect that such instances may not be the result of mere random deviations, but instead may indicate that virtual reference structures or figures altogether different from a regularly swinging sixteenth subdivision level may be at play. The added fact that in several of the local swing cases, the 'swung' sixteenths are not comprised of complete 'pairs', but instead of single off-beat sixteenths occasionally followed by ensuing on-beat sixteenths, further complicates the matter, and leads us to back to the vital question: can we really consider instances of such off-beat sixteenths as either virtually, absolutely swung (in relation to an idealized beat) or actually, relatively swung (in relation to the drums' beat)? It is possible to consider these cases of disparately swung pairs or lone off-beats within a basic unit from a different, yet related perspective – as sixteenths positioned microrhythmically 'late' in relation to the ideal midpoint between drums' eighth-note reference. In this sense, they do not strictly 'swing' as such, but can alternatively be viewed as instances of 'pickups' or 'syncopations' which anticipate strong beat locations of the main quarter note pulse and its off-beats.

4.2 Pickups and Syncopations – Anticipating the Heavy Beats

'Pick-up' notes and 'syncopations' are intrinsically defined in terms their function in regard to metric accentuation schemes. Pickup notes, also traditionally called 'anacruses', are most simply defined in classical theory terms as single notes or a sequence of notes which precede the 'downbeat' (first quarter note beat) of a measure. Danielsen, however, describes pickups more generally "as the overarching movement from upbeat to a more or less heavy beat" (2006:80), therefore broadening its

scope to encompass any note immediately preceding an accented/heavy note. The *New Grove Dictionary of Music and Musicians'* definition of anacrusis agrees in that it too, describes pickups in a wider sense as 'an initiation on a non-accent,' and goes further on to state that: "as such[,] it is rhythmically unstable… [and] its most fundamental characteristic is the forward rhythmic impulse it generates towards the accent" (Doğantan 2001 in Butterfield 2011:10). Therefore, in a metrical scheme characterized by strong (accented) and weak (non-accented) beats, pick up notes are understood as preceding/preparatory off-beat notes to either virtual beat locations or actual notes of a lower, more fundamental subdivision level. Furthermore, pickups are seen to generate the effect of 'forward' rhythmic motion by heightening the expectation of the ensuing strong, or 'accented', virtual/actual on-beats which they are seen as leading into. Off-beat 'syncopations', on the other hand, are essentially pickups without their ensuing 'picked up' notes. According to Olly Wilson (in Danielsen 2006:62), syncopations are considered to "momentary displace the regular accent implied by the metric framework", and consequentially are similar to pickups in that they are also seen as accenting 'weak' beats in a metric scheme rather than 'strong/heavy' ones.

Now, considering that the identity of both pickups and syncopations are heavily dependent on metric accentuation or heavy beat schemes within basic units, it is vital to take heed to Danielsen reminder that in the black popular music of the 1960's - 70's, "the time signature 4/4 does not imply a beat sequence of strong-weak-strong-weak, as is so often the rule in classical music. How the beats are weighted [or 'accented'] varies from genre to genre," (loc. cit.:45). For example, in tracks with a typical 'back beat' accentuation of snare hits on the second and fourth quarter note beats (found in ample pre-Funk R&B styles), the heavy beat scheme implied "might well be quite the opposite: weak-strong-weak-strong," (loc. cit.). Whilst funk tracks also commonly contain a snare drum backbeat pattern, Danielsen contends that in a great deal of funk the heavy beat is often just the first quarter note downbeat, colloquially referred to as 'the One'. James Brown himself is quoted as having said that that funk's innovative rhythmic qualities emerged when he encouraged his band from changing the strong accent "…from the upbeat to the downbeat ... Simple as that, really" (Pareles 2006).

However, which beat locations in fact could be truly said to constitute 'heavy' or 'strong' beats in the metric schemes of basic groove units in funk may in actuality be a rather more complex and essentially relative matter, one largely contingent upon both the perspective of the listener and the specificities of the rhythmic particularities of groove in question. As mentioned, frequently only the first 'downbeat' ('the One') is considered a true heavy beat in funk, however, if expressed regularly and saliently enough, a backbeat snare pattern on the '2' and '4' may also be considered as additional relatively 'strong' beat locations as well. Most curiously though, even the off-beats (the 'ands') of the main quarter note pulse (or alternatively viewed, the eighth-note subdivision level) may in fact at times be perceived as comprising strong beat locations themselves, such as the '4-and' beat

(equivalent to the 7th eighth note beat) which is most prominently accented by several coinciding rhythm instruments in tracks such as 'Cold Sweat', 'Alligator Boogaloo', 'Orange Peel' and many other funk-oriented grooves of the era not explored in this thesis. Occasionally, these main pulse off-beat strong accents coincide with what Danielsen terms 'counter-rhythmic' figures, or stylistically typical patterns of systematic syncopations from the main pulse which demonstrate a 'tendency towards cross-rhythm', which we will look at in greater detail in section 4.6.

Returning to pick-ups and syncopations however, let us summarize how they differ from complete swung 'pairs' in terms of structure. In ***Fig. 4.1*** we can see all the possible locations where these various rhythmic units may occur in relation to a 4/4 meter and its main quarter note pulse (a) as well as eighth-note subdivision (b). All eight sixteenth pairs (c) are notated in typical jazz fashion as 'straight', however the ratio between their on-beats and off-beat components is in fact unequal to varying extents (at least > 1.2:1 based on our established JND of perceptible swing). Now, in this thesis, the term 'pickup' will be applied only to instances of off-beat notes which are unpreceded by a previous on-beat sixteenth but are followed by an ensuing on-beat note (which may last in duration up until the next pick-up) and lead into either a main quarter note on-beat (d) or off-beat (e) location. Lastly, single sixteenth off-beat notes which may be preceded but *not ensued* by on-beat notes lasting up until the next off-beat sixteenth-note will be termed off-beat 'syncopations'. These may likewise anticipate either the on- or off-beats of the main 4/4 pulse (f). Once again, when either pickups or syncopations occur significantly 'later' than an ideal, equidistant virtual off-beat location, they will be considered to 'swing' in relation to a virtual sixteenth subdivision structure, however will still be notated as 'straight' sixteenths for facilitated legibility purposes.

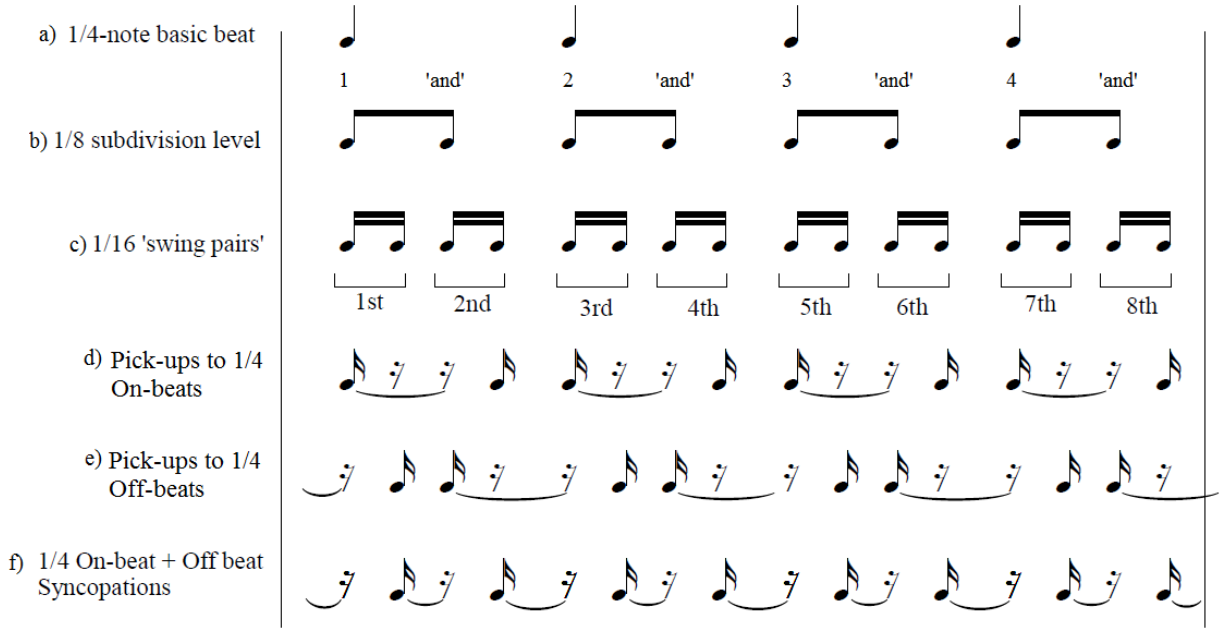

Fig. 4.1 *- Distinction between sixteenth 'swing pairs' (c), and 'pickups' (d),(e) and 'syncopations' (f), both in relation to the main ¼ note basic beat (a) and 8th note subdivision level (b). Slur lines indicate that the duration*

of the pickups and lone syncopations may last either approximately a sixteenth-note duration or shorter/longer until the next note onset.

It is important to note that swing pairs, late pickups and off-beat syncopations, despite their technical differences, may be viewed to overlap in definition, especially *vis-a-vis* their functional capacities regarding the basic beat and its off-beats when considered from the dual perspective of actual vs. virtual reference structures. For example, pickups could also technically qualify as syncopations since they too could be seen as accenting purported 'weak beats'. Conversely, one could argue that lone standing off-beat syncopations, although not leading into any actualized on-beat note coinciding with a heavy beat, might qualify as pickups if we imagine them leading into either a virtual heavy beat, or another instrument's actualized heavy on-beat. Lastly, and most importantly, the off-beat components of swing sixteenth pairs can also be perceived as fulfilling the criteria of a 'pickup', and as such we will occasionally refer to the second note of a sixteenth swung pair as a 'swing pair off-beat pickup'.

Despite the multifarious nature of off-beat sixteenths in relation to their neighbouring on-beats, what seems to unite swung sixteenth pairs off-beats, pickups and syncopations alike is their capacity for 'anticipating' an ensuing strong beat location on the quarter or eighth-note level. As Danielsen puts it, pickup gestures and syncopations essentially serve to "keep the groove in motion through the positions where musical forces are pulling 'downward'," by "pointing out the *significant beats* of the pulse *without accentuating them*" (2006:80). Where articulation of heavy beats alone might otherwise halt such a perception of forward push or movement, by rhythmically anticipating the quarter note pulse and their off-beats, sixteenth swing pair off-beats, pickups and syncopations emphasize and focus attention towards the heavy beat locations and increasing the feeling of 'motion'. It is precisely the seemingly motion-inducing quality of off-beats in swing pairs, pickups and syncopations which is at the crux of Mark Butterfield's (2006; 2011) concept of 'anacrusis', and which will serve as the basis for an analysis of excerpts with observed extra local swing emphasis throughout the next sections.

4.3 Anacrusis as 'Motional Energy'

Building upon Hasty's theory of metric projection in *Meter as Rhythm* (1997), Mark Butterfield maintains that "it is primarily the operation of anacrusis across multiple levels of rhythmic structure that generates the forward drive of much groove-based music," (2006: [par. 5]). What is meant by anacrusis here, however, is qualitatively different than the definitions we have seen up until now. For Hasty, Butterflied explains, off-beat "anacrusis represents considerably more than upbeat or pickup; it is rather a special kind of continuation oriented toward a new beginning…", (loc. cit.: [par. 10]). Hasty's projection theory itself is based on the assumption that relative durations of continuous sound

events in rhythmic contexts play a vital role in shaping and maintaining virtual metric reference schemes via a process of ongoing 'projection of durations'. In his model, Butterfield explains that when a sound event is actualized, the time interval before the onset of a new second event creates in listeners a 'projective potential', or a "potential to serve, upon its completion, as a measure for a new duration that will potentially be 'projected'" via the onset of the second event. For example, the initial onset of, say, a hi-hat cymbal stroke, opens up a durational 'projective potential' which, when struck for a second time ca. 150 ms later, leads to it being thus 'projected' – or in concrete terms, an expected virtual reference location 150 ms in the future is established and a sixteenth subdivision level at 100 b.p.m. would be established.

Now, according to Butterfield, various sound events are differentiated in terms of how there are seen to function in terms of projection. A main distinction is established between events interpreted as 'beginnings' and those as 'continuations'. In a metric context, 'beginnings' are said to "open up the potential for the becoming of duration" whilst 'continuations' serve "to continue durations begun earlier, as opposed to initiating new ones" (loc. cit.: [par.7]). Even more vitally, though, Hasty's model proposes that there are two main sub-types of continuative events – 'simple continuation' and 'anacrustic continuation' (or just 'anacrusis'). Simple continuation is described as "keep[ing] the becoming of the earlier event open and alive, yet also draw[ing] it toward a conclusion" in a manner which "points backward as a denial of ending for a prior beginning," - whilst anacrusis, by contrast "is a special kind of continuation oriented toward a new beginning… [it] 'points forward; it is anticipatory, directed toward a future event," (Hasty in Butterfield 2011:48).

As Butterfield (2011:10) puts it, relative to continuative events, anacrusis "prompts a more aggressive cognitive strategy from the listener, one directed toward the emergence of a new event, rather than the completion of a present duration". He further elaborates on Hasty's model by arguing that anacrusis functionally enhances the 'expectation for a new beginning' to a greater extent than simple continuation, by conferring what he terms as 'motional energy' upon such anacrustic events. Motional energy is used as an analogy to describe "the force of momentum with which some musical events are directed toward others", which may "exhibit varying degrees of velocity or intensity, as does motion we perceive in physical space" (loc. cit.:4). The higher the subdivision level an event lies upon, the greater motional energy it is felt to impart, such that "a series of sixteenth notes imparts more motional energy than a series of eighth notes… [in the way that] a strong dissonance is drawn toward its resolution with greater force than a weak one" (loc. cit:). In addition, Butterfield argues that 'durational inequality, or movement from longer durations to shorter ones, such as in swung eighth-notes in jazz, is also a key factor which imparts motional energy to off-beats, where the greater the swing ratio (or the 'beat-upbeat ratio', 'BUR', as Butterfield terms it) the greater the affective perception of forward motion and overall feeling of 'drive' or 'push' in a groove.

Durational inequality (swung notes), however, is only one of a few other conditions which may generate motional energy on off-beats, others are: shorter off-beat durations (snappy phrasing), 'accentuation' of off-beats relative to on-beats (louder dynamic) and slurred offbeat articulation (legato). Due to the fact that offbeat swing eighth notes in jazz often frequently exhibit several of these qualities at the same time, they are said to tend 'strongly' toward anacrusis. Despite so, Butterfield stresses that offbeat anacrusis should "be understood in terms of quality, not quantity – in terms of their effect (the feeling they engender) [rather than] their measurable appearance" (2006: [par. 19]), for as he rightly points out, Friberg and Sundström (2002) found that at fast tempos of up to 300 b.p.m. even when jazz drummers' swing ratio approaches an even 1:1, even so Butterfield perceives no "corresponding attenuation of the swing quality." This ultimately leads him to believe that "other factors must be involved in producing the effect of swing at the eighth-note level" – such as the other aforementioned qualities of which durational inequality in note pairs is key.

4.4 Anacrusis in Swing Pairs and Pickups

Let us focus now on Butterfield's model for how anacrusis operates in straight and swung notes, and how they affect perception of virtual subdivision beat schemes. For our purposes, we shall temporally transpose his model (Butterfield 2006: example 5) and its implications regarding eighth-note swung to notes to the sixteenth-note level, with the justification that a straight sixteenth-note duration in a Funk track at 100 b.p.m. is the same as the duration of an eighth note in an up-tempo in upbeat jazz - tracks at 200 b.p.m. – 150ms[18] and would therefore function in virtually the same manner. ***Fig. 4.2*** shows the difference in metric projection which straight, continuative sixteenth notes and swung, anacrustic sixteenth notes tend to engender. In the case of straight notes (***Fig. 4.2a***), each offbeat sixteenth-note first realizes projective potential (indicated by ⌒) and therefore functions as a 'continuation' (indicated by a \ slash) directed toward the fulfillment of a projected duration (indicated by ˙ . . ˙) of an equally long sixteenth note. Here, a virtual sixteenth subdivision reference structure is both engendered and maintained by continuous, ongoing notes of equal duration. In the case of anacrustic unequal swung notes (***Fig. 4.2b***), however, the variable timing of the offbeat swing sixteenth-note prevents the steady realization of projections at the sixteenth-note level – instead, the forwardly displaced offbeat sixteenth notes keep projective potential open and alive, and direct attentional energy toward the ensuing larger regular interval of the eighth-note level.

[18] In a sixteenth tied triplet (2:1) swung note pair at 100 b.p.m. the shorter note would be 100ms, that is, still discernable as a separate, perceivable sixteenth rather than an early instance of an ensuing off-beat

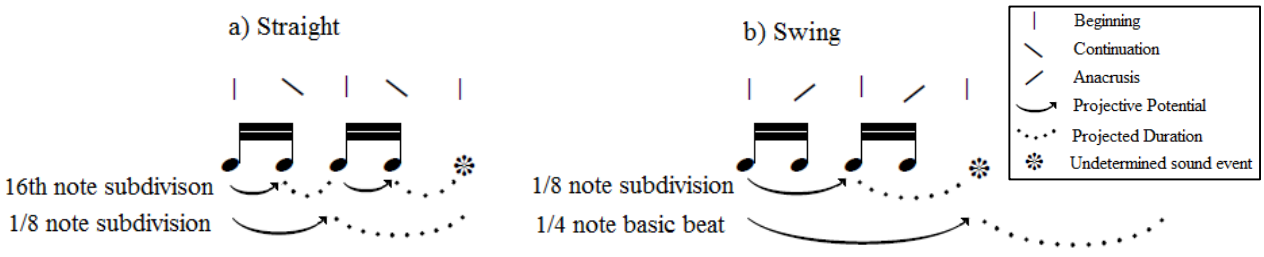

Fig. 4.2 *– Butterfield's adapted model for role of anacrusis and metric projection in sixteenth straight* ***(a)*** *and* ***(b)*** *swung notes.*

Compared to straight sixteenths of equal duration then, swung off-beats in sixteenth pairs (and pickups) may facilitate the perception of the eighth-note level (alternatively viewed as the main 4/4 pulse and its off-beats) to a greater extent than straight sixteenths, and as we have seen, it is upon this level where heavy accents are usually found in funk-oriented grooves. Butterfield contends, however, that this is would-be auxiliary effect of anacrusis, and that the main reason jazz musicians swing their eighth notes is to "perpetually generate a forward propulsive energy toward [heavy] beat[s]" (2006: [par. 20]), and may be a vital reason for why musicians may swing their sixteenths in funk-oriented grooves. As for the relationship between swing ratio and motional energy engendered by anacrusis, as expected, Butterfield states that the higher the swing ratio of swing note pairs, the higher the motional energy conveyed by off-beat notes, and the greater the anacrustic effects: "low [swing ratio] values produce minimal anacrusis, and only weak motional energy directed toward the ensuing downbeat," whilst "as [swing ratio] values increase, offbeat anacrusis acquires progressively greater strength, and a concomitant increase in motional energy directed toward the ensuing downbeat." (2011:10). However, very high swing ratios do not always necessarily lead to greater 'forward propulsion', rather "a series of highly uneven swing eighth notes tends to feel halting and choppy—it lacks continuity, for there is simply too much starting and stopping" (loc. cit.:11). In short, Butterfield argues that the longer the on-beat note of a swung pair, the closer it becomes to an ensuing pairs' long note as well, and the greater the effect of 'closure' resulting on the on-beats. Swing pairs with increasing motional energy, or anacrusis, conversely produce increasing amounts of 'closure' - too extreme a swing ratio leads to concomitantly extreme 'closure' on the on-beats, and as a result, very strong anacrusis fails to provide 'forward' propulsive feel to grooves and instead counteracts 'forward momentum' leading to a conveyance of 'choppy' or 'halting' rhythms.

As for the threshold point for when anacrustic swung notes theoretically stop 'swinging' and instead start 'chugging', based on related values from Eugene Narmour's theory of 'melodic closure', Butterfield hypothesizes that swing note pairs with more than 50% 'durational cumulation' from off-beat to on-beat – that is, where on-beats last more than half the length of preceding off-beats – tend to negate motional energy provided by the off-beats via excessive downbeat (on-beat) closure. More

concretely, the threshold where notes may begin to chug slightly by virtue of great 'downbeat (on-beat) closure is usually presented by Butterfield in terms of 'upbeat-beat ratio' ('UBR') of 1:1.5, which more or less corresponds with its inverse 'beat-upbeat ratio' ('BUR') – or in our terms, simply 'swing ratio'– of 1.5:1 (loc. cit.: 12)[19]. In other words, as swing ratios increase above 1.5:1, their increasing anacrusis strength and motional energy begins to be counteracted by the proportionally increasing 'force' of on-beat closure. To summarize, note pairs with swing ratios around 1:1 are weakly anacrustic (produce minimal motional energy) as well as weakly closural, whilst swing ratios approaching 1.5:1 are considered moderately anacrustic and moderately closural, and finally swing ratios around 2:1 or higher are considered both strongly anacrustic and closural.

Butterfield elaborates, though, that there are ways in which the halting closure-inducing effect of high swing ratios may be mitigated by melodic solo instruments by: "[o]ffbeat slurs, crescendos, and accents… [which] all serve to enhance the power of anacrusis and to strengthen motional energy without increasing durational cumulation on the downbeats" (loc. cit.). Examples of such performance strategies could be snare rolls for drums, or hammer-on and pull-off techniques for guitar and bass and so on. Regarding rhythmic instruments, however, he only specifies how jazz drummers, who generally implement significantly higher average swing ratios than their soloist counterparts (as evidenced by Friberg and Sundström (2002)), manage to offset strong closure produced by the constantly swung ride cymbal pairs on the on-beats of the eighth-note level by applying strong motional energy on a higher subdivision level, such as the quarter-note pulse. He argues that durational inequality, or a long – short pattern on the quarter note level, emerging between the ride strokes on the main quarter note beats 1 and 3 and the short, snappy hi-hat foot pedal 'chinks' on the backbeats 2 and 4, produces a 'robust anacrusis' with high motional energy that offsets the firm closure otherwise emerging on the downbeats 1 and 3 caused by the swinging eighth-note off-beats. Butterfield thus concludes that high swing ratios on swung eighth-note pairs do not necessarily attenuate forward propulsion in drum parts as they do in a soloist's melody line, "rather, they facilitate perception of the quarter-note pulse without compromising the motional energy of the groove" (2011:16).

Let us look at some examples from our analyzed excerpts of swung sixteenth pairs with a ratio greater than 1.5:1 which would theoretically engender a choppy feeling but may be mitigated by closure-offsetting means. In *I Can't Stand It* by Lonnie Smith, at two points in the two-bar basic

[19] Technically, Butterfield says that whilst "BUR [beat-upbeat ratios] and UBR [upbeat-beat ratio] values may appear to be mathematical inverses of one another," they are not since "the UBR is calculated from the ensuing, not the preceding, downbeat eighth note. Thus, a BUR of 2.0 does not necessarily entail a subsequent UBR of 0.5 because in actual performance the downbeat eighth note from which the UBR is calculated may be longer or shorter than the one used in calculating the preceding BUR. In general, however, as BUR values increase in a melodic line consisting of a sequence of swing eighth notes, UBR values tend to decrease." (2011:12)

groove unit, the hi-hat plays an instance of the typical jazz 'ride swing pattern'[20], once with the sixteenth off-beat preceding the '2-and' of the main pulse and a hard swing ratio of 2.39, and the other instance with the off-beat preceding the '4-and' beat with a light swing ratio of 1.55 (see ***Fig. 4.3***). As swing pair off-beats are essentially 'pickups' to the actualized ensuing on-beat strokes, they will be labelled in our transcriptions from this point onward as Swing Pair-Pickups ('SP-PU').

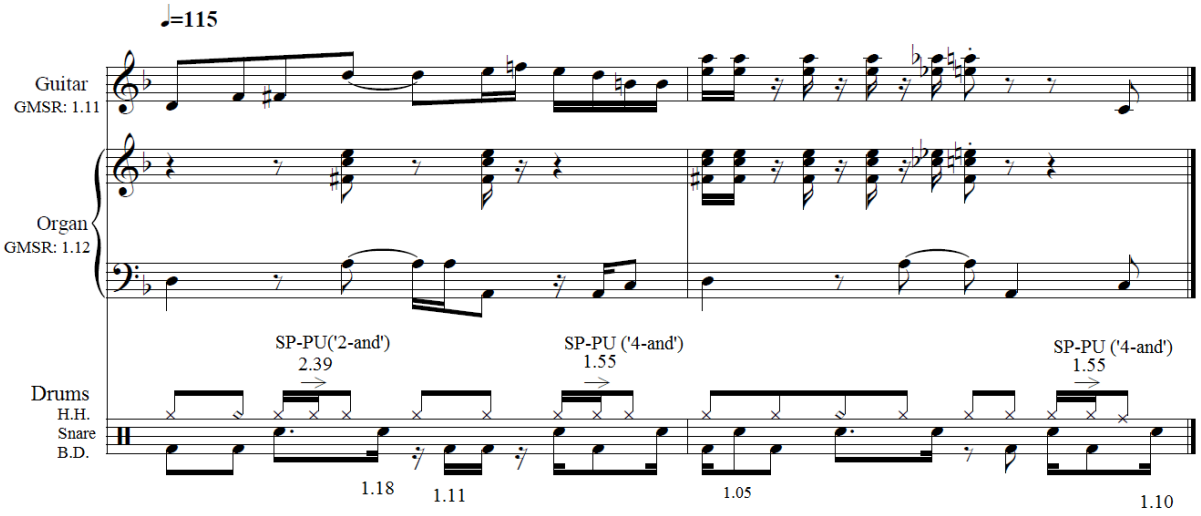

Fig. 4.3 *– Basic Unit in Lonnie Smith's 'I Can't Stand It'. Numerical values over sixteenth off-beats indicate swing ratio values of the corresponding sixteenth pair (whether virtual or actual). '→' indicate off-beats with significantly higher swing ratio than global mean (local beat swing emphasis). SP-PU(...)=Swing Pair-Pickup('beat'). GMSR = Global Mean Swing Ratio..*

Now, according to Butterfield's theory, the first hi-hat pickup (swung at over a 2:1 tied triplet ratio) would be considered highly anacrustic, imparting great motional energy towards the ensuing '2-and' on-beats well as high downbeat closure in such a manner as to induce a choppy feeling. Indeed, upon very close hearing, it does seem to impart a slight limping effect when it arrives with each repetition of the basic unit. However, if one doesn't focus too intently on it, it doesn't truly seem to interrupt the smoothness of the groove quite as much as highly anacrustic swung off-beat eights might do so in more straight ahead jazz styles, especially when they are constantly stated every second eight pair in a pronounced fashion.[21] It seems instead, that in this style of early jazz-funk, it is uncharacteristic for drummers to play constant swing pairs and if they do so, especially at high ratios, they tend to nestle them within the close proximity of other anacrustic events on the sixteenth level which invariably seem to help offset downbeat closure produced by highly swung pairs. For example, both the hi-hat swing pairs in *I Can't Stand It* are woven in between two snare hits; the first snare hit

[20] The Jazz 'ride swing pattern' (typically played by the ride cymbal) when translated from its original eighth-note level into sixteenths involves a complete sixteenth swing pair followed by an eighth note stroke. Here, it has been 'inverted', or displaced by an eighth note from the original '  'to '  '.

[21] Although, hypothetically, even in Jazz tracks with parallel double time tempo to *I Can't Stand It*, or 230 b.p.m., highly swung, constantly stated eighth-note pairs in a ride swing pattern might not produce as choppy a feeling as in slower tracks due

coincides with the hi-hat on-beat and is louder than it, masking the hi-hat and redirecting considerable attention away from it to such a degree that the following hi-hat off-beat is almost heard as a pickup rather than as part of a pair, a fact that ultimately serves to diminish its quality 'ride swing pattern' quality; and the second snare hit, which forms a sixteenth off-beat syncopation itself, offsets the downbeat closure produced by the hi-hat off-beat by imparting additional anacrustic motional energy of its own to the groove (which, as we will shortly see in the next segment, is conversely not translated into further downbeat closure by virtue of being a syncopation). Both these factors – dynamic redirection of attention from the sixteenth to the eighth-note level by the louder snare hits on beat 2 and 4, and further motional energy imparted by the snare syncopations preceding beats 3 and 1, offset the high downbeat closure and potential choppy effect produced by the highly swung 'ride swing pattern' sixteenth pairs.

Another track in which sixteenth-note pairs with mean swing ratios at around the threshold of 1.5 which might supposedly induce a slight choppy effect via downbeat closure is *Get Up (I Feel Like Being a Sex Machine).* In its verse segment, the fourth swung sixteenth pair of the measure by the hi-hat (see ***Fig. 4.4***) swings at a mean swing ratio of ca. 1.6:1. Danielsen has observed that drummer Clyde Stubblefield's use of these "few slightly swung sixteenth notes is not the scarce, shortened type that chop up the groove. Rather, he continuously pushes forward" (2006:77), and indeed, it feels that despite their moderately high swing ratio, they still produce a forwardly pushing feel rather than a choppy one. It would seem that, despite the fact that its 'ride swing pattern' character is more starkly evident (not diminished by any louder masking sounds such a snare hit) than in *I Can't Stand* it, since its hi-hat swing pair also occurs so infrequently throughout the basic unit (only once) and is similarly immediately followed by an equally anacrustic off-beat syncopation of the snare drum anticipating the '3-and' beat, overall downbeat closure is offset sufficiently as to avoid any resultant significant choppy effect. The additional anacrusis of the ghosted snare syncopation sufficiently provides equal amounts of moderate motional energy which keeps the main quarter note pulse from being accentuated too heavily, and the groove pushing forward in a flowing rather than halting manner.

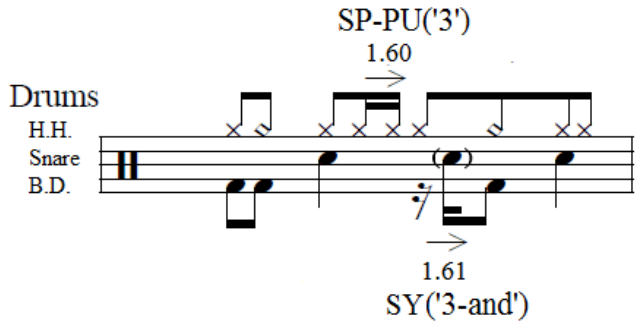

Fig. 4.4 *– Drum basic unit in verse segment ('A part') of 'Sex Machine' (James Brown). Numerical values over off-beats = local mean swing ratio. '→'= local beat swing emphasis. SP-PU= Swing Pair-Pickup, PU = Pickup, SY = Syncopation, (...)=beat, GMSR = Global Mean Swing Ratio.*

Just as with the case of off-beats in swing pairs, in 'lone standing' pickups (which are ensued but not preceded by sixteenth notes), the higher the swing ratio the stronger the anacrusis, which means the greater the motional energy imparted towards ensuing on-beats as well as concomitant downbeat closure. Very highly swung pickups may also hypothetically produce a choppy, momentum arresting effect in a groove unless downbeat closure is offset by additional anacrustic motional energy from adjacent sixteenths off-beat pickups (or manifested at a higher subdivision level. In *Give it Up or Turnit a Loose* highly swung sixteenths are sparsely distributed in the basic unit and occur both as pickups of complete swing pairs like we saw in the previous tracks, as well as a few simple lone standing pickups (see ***Fig. 4.5***). We find examples of the latter at the end of each bar of the basic unit in the guitar pattern, where lone pickups lead into the '4-and beat', swung to a rather high 1.79:1 ratio. Here, once again, had such a type of pickup been stated either continuously throughout the bar (in which case they would form continuous swing pairs) or every second sixteenth pair, it might have imparted a certain choppiness to the groove, however, in the first bar it merely seems to emphasize the heavy '4-and' beat location (which is prominently accentuated in tandem by all instruments, particular snare) and in the second bar it does the same, except in this case the additional bass drum's and bass' swing pair pickups prevent the '4-and' from comprising a heavy beat location here, and off-set any strong downbeat closure imparted by the guitar's highly swung pickup by redirecting attention towards 'the One' of the new basic unit period with additional motional energy and displacing the downbeat closure towards it.

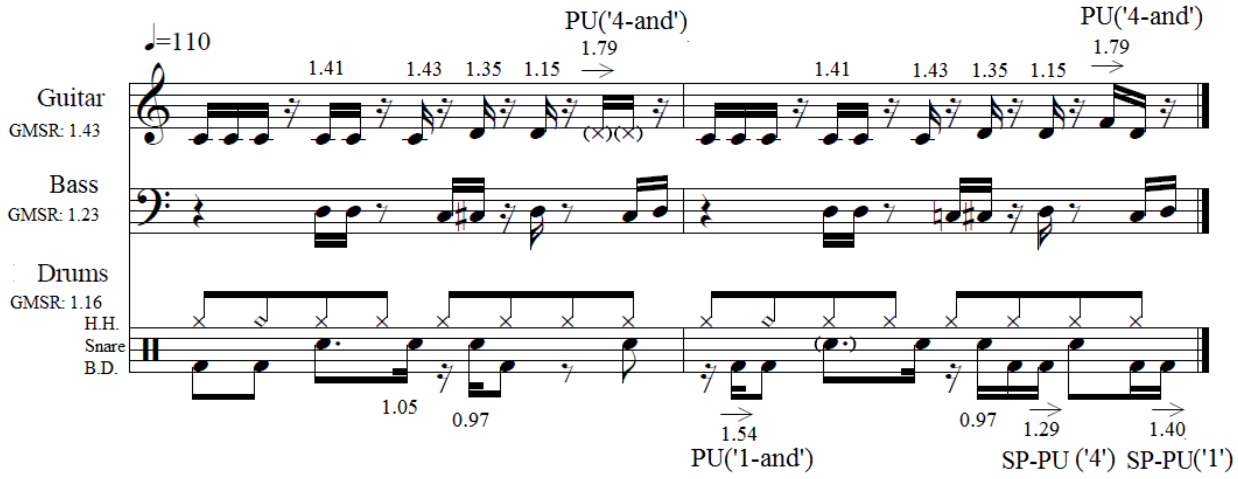

Fig. 4.5 *– Basic unit of 'Give It Up or Turnit A Loose' (James Brown) – Numerical values over off-beats = local mean swing ratio. '→'= local beat swing emphasis. SP-PU= Swing Pair-Pickup, PU = Pickup. (...)=beat. GMSR = Global Mean Swing Ratio.*

We have seen, then, how in both jazz-funk and funk tracks which display highly swung sixteenth swing pair pickups or lone standing pickups, despite their inherent potential to fragment and disturb the flow of a groove via strong downbeat closure, due to their relatively scarce and spread out occurrence within a basic unit measure, and their tendency to be located in the immediate vicinity of other off-beat pickups or syncopation which compensate with further motional energy, rarely are they felt as chugging. In fact, most of the time, despite the fact that they are technically swung to significant and perceptible extents, they do not readily convey the sensation of 'obviously swinging' – certain beat locations may swing heavily in funk-oriented grooves, but a key aesthetic principle in both early 'pure' funk and 'hybrid' jazz-funk seems to be that, unlike in straight ahead or Harp Bop Jazz, the groove should not 'swing' too overtly, but should in fact, 'groove' along most of the time, in the sense of feeling mostly straight rather than swung, or perhaps, simply swinging very subtly (on the micro-level). Swinging notes may very well be implemented, however continuous statement of complete swing pairs should be generally eschewed in favour of few and interspersed ones, combined with more frequent lone standing pickups and syncopations which, when swung to perceptible degrees, generally tend to convey less of a 'jazz swing'-like character, especially when implemented in counter-rhythmic figures. Before we examine these in section 4.6, let us first review how anacrusis functions in a slightly different manner in syncopation rather than swing pair and lone pickups.

4.5 Anacrusis in Syncopations

As we have seen, anacrusis in off-beat pickups function essentially in the same way as in those of off-beats in swing pairs (which are technically pickups as well), since they both involve actualized off-beats and on-beats whilst syncopations on the other hand involve only actualized off-beats. Anacrusis in off-beat syncopations then function slightly differently by virtue of not involving actual on-beats and present some unique and interesting possibilities for avoiding closure at high swing ratios. It is to be noted, though, that despite not actualizing on-beats, as mentioned previously, it may be argued that syncopations still induce the perception of a virtual articulation of an ensuing heavy beat, or as Butterfield puts it, they could be seen to function "protectively for the ensuing downbeat… even in the absence of a sounding event," – a valid point, for, as he says: "if they did not, they could not be experienced as syncopations" in the first place (Butterfield 2006:[par. 25]). However, a crucial difference between swung pickups/complete pairs and syncopations is elucidated by Danielsen when she states that an off-beat syncopation "…never completes its own movement. The closing, which is as significant for its shaping as the beginning, never occurs: the anticipation never ends on an

alternative strong beat. It only overshadows the beat that is supposed to be there – or, alternatively, it stretches out the beat in time" (2006:85).

Two salient points are to be noted here: first, since syncopations do not 'close' a virtual ensuing on-beat by actualization, they could theoretically be swung to a high extent and impart great amounts of motional energy, thus being strongly anacrustic whilst at the same time avoiding the extreme 'closural effects' on ensuing downbeats by virtue of these never actually materializing. Secondly, Danielsen argues that syncopations in general, yet especially those which are 'swung' or microrhythmically expressed relatively 'late', can be viewed as stretching or 'extending' the attack of strong on-beat locations, and viewed alternatively as instances of a particular funky phrasing approach which she terms as 'downbeat in anticipation'.[22] Viewed as such, she explains that a strong beat (on the main 4/4 pulse or its off-beats) no longer becomes "simply a [point] position but a rhythmic gesture in and of itself, unfolding in time and space"; instead of an attack point with a narrow 'correct location', "the core of the beat… becomes more a centre of gravity or concentration of energy than a fixed point in a metrical framework" (2006:79).

Before we begin to examine instances of syncopations (and eventually pickups) as 'stretching/extending' heavy beat locations from our own analyzed samples, let us roughly establish at what point swung, or 'late' off-beat sixteenth syncopations may begin to be practically perceived alternatively as 'early' instances of extended virtual on-beats – or as Danielsen might once again call them, as 'downbeats in anticipation'.

4.5.1 'Late' Syncopations vs. 'Early' Virtual Downbeats

Butterfield argues that whilst we tend to perceive rhythmic sounds in categories which we term as eighth notes, triplets, sixteenth notes etc., "the extent of subdivision is limited, however: some units are simply too short in duration to be meaningful *as* subdivisions… [i]nstead, we will likely assimilate [them] to a durational category of a higher order, which we then interpret as being played either early ("on top") or late ("behind the beat") in terms of expressive timing" (2006: [par. 24]). He hypothesizes that the threshold of duration for perceiving a note as categorical subdivision rather than as a late or early microtiming deviation is approximately 50ms. That is to say, notes lasting less than 50ms (such as thirty-seconds and shorter notes in our excerpts) will tend to be subsumed under a higher categorical subdivision, as either a late or early instances of other actual or virtual notes preceding or ensuing them respectively. To visualize the implications of this in terms of sixteenths, let us look at

[22] The term 'Downbeat' is used by Danielsen in a looser sense, not strictly signifying only either the first quarter note beat of the main 4/4 pulse or even synonymously with the 'on-beats' of a beat scheme, but more generally to signify any beat that may be perceived as a 'strong beat' (which occasionally may additionally fall on the off-beats to the quarter note level – i.e. eighth-note subdivision level)

syncopations of this subdivision level at 100 b.p.m. (which corresponds to the lower tempo range in our funk / jazz-funk track sample).

Equally spaced (straight) sixteenth notes ideally last 150ms each ***(Fig. 4.6(a)***, left) and an eighth lasts double this value, or 300ms. According to Butterfield's threshold, all off-beat syncopations located equal to or less than ca. 50ms ahead or behind the ideal virtual straight location will be likely heard as either 'early' or 'late' instances of the off-beat sixteenth itself, respectively. In terms of swing ratio, all off-beat syncopations swung from at least 1.2:1 (JND swing threshold) up to a ratio of ca. 2:1 (tied-triplet swing) (***Fig. 4.6*(c)**, left) would be likely heard as 'late' (or essentially, 'swung') syncopations. Interestingly, at this point we can see how Efron's (1970) theorized value of the lower limit of human perception of short durations at 100ms corroborates Butterfield's threshold value of 50ms – for a syncopation swung at a 2:1 ratio is both 50ms late in relation to its ideal straight (equally durational) location and located at least ca. 100ms or more away from an ensuing virtual or actual on-beat location. As such, syncopations swung less than 2:1 are more likely to be perceived as categorically distinct from ensuing virtual or actual on-beats.

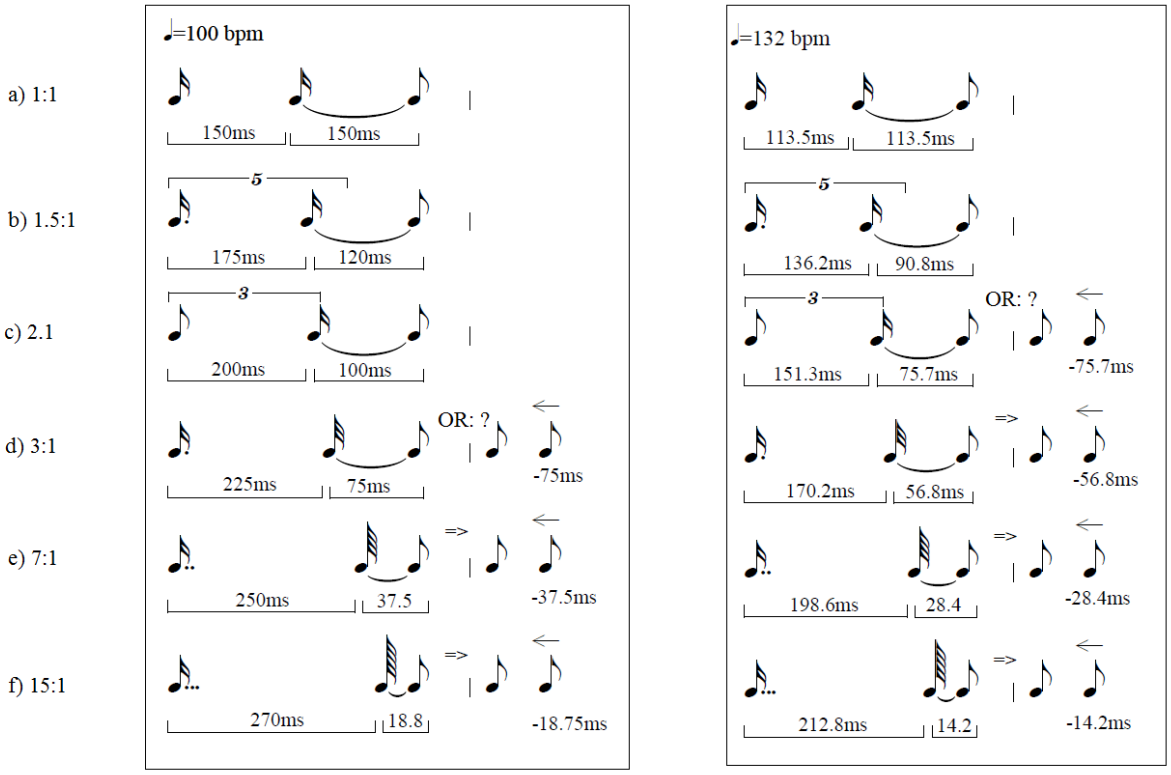

Fig. 4.6 – *Microtiming deviations at various swing ratios (a – f) in sixteenth-note syncopations at 100 b.p.m. (left column) and 132 b.p.m. (right column)*

Syncopations located at the midpoint between off-beat and off-beat, ca. 75ms or swung to ratio of 3:1 ratio (equivalent to a 'hard swing' – dotted sixteenth + thirty second tied to sixteenth, see ***Fig. 4.6(d)*** left) – are considered borderline cases in theory by Butterfield, who suggests that they may be heard

in two possible ways: as either as very late syncopations, or instead as 'early' virtual instances of a higher perceptual category, of the eight-note level. At the tempo rate of 100 b.p.m., Butterflied personally finds the former option more likely, adding that rather than comprising an intentionally hard swung syncopation however, that "we might be inclined to hear it as a timing error rather than as an expressive deviation" (2006:[par. 26]). Now, syncopations expressed equal to or later than 100ms from an off-beat location, or alternatively located within 50ms of an on-beat note of a higher subdivision level, it seems then would be unlikely to be heard as 'late' or swung syncopations, or even as errors, but instead as early instances of ensuing virtual on-beats eighth-notes. Indeed, it is probable that rather than be heard as swung equivalent to extremely hard ratios of ca. 7:1 or above (***Fig. 4.6(e)***) and ***(f),*** left), as Butterfield notes, such syncopations will probably be absorbed into 'the beat range' of an ensuing eighth note, where it will be most likely experienced as 'on top of the beat within the range of expressive microtiming' in much the same way that Danielsen would describe very late sixteenth syncopations as 'extending the (virtual) beat' of ensuing heavy beats of a higher subdivision (as 'downbeats in anticipation').

It is to be noted that in our sample of tracks, the fastest was *Son of Ice Bag* at 132 b.p.m, and therefore in the right column of ***Fig. 4.6*** we can see parallel durations of sixteenth syncopations virtually swung to increasing degrees and how they might be perceived at such a tempo. Here, syncopations swung already at the 3:1 ratio (see ***Fig. 4.6(d)*** right), would be located 56.8ms before a virtual on-beat eighth – only slightly above Butterfields threshold – and therefore possibly be heard as an extremely early, or ahead of the beat instance of the virtual on-beat rather than an extremely late, or behind the beat off-beat sixteenth syncopation. There is no objective way to establish which is more likely for it seems to be a matter of perspective contingent on how closely one is able distinguish such micro-deviations in the sound mix of a track in question. Even so, results from chapter 3's analysis shows that in fast tracks such as *Son of Ice Bag* itself, no instrument swings more than 1.2:1 (only drums), and in fact, in all tracks above 120 b.p.m, neither in the funk and jazz-funk excerpts do instrumentalists tend to swing their sixteenths any more than ca. 1.5:1 (where at 132 b.p.m. off-beats would last at least 90.8ms), nor position their on-beats asynchronously with the drums more than 30ms ahead of the beat. It is probable though, that if a note within the faster tempo range of our excerpts were located in the midpoint between virtual straight on-beat and off-beat locations, they would perhaps be heard, as Butterfield might suggest, as 'errors' – either exceedingly late syncopations or early on-beat anticipations.

4.5.2 Syncopations as 'Downbeats in Anticipation'

Now that we have established a general rule of thumb pertaining to how microrhythmically 'late', or swung an off-beat syncopation need be in order to be perceived as a virtual early on-beat (at least ca.

50ms, or equal to and above ca. 2:1 swing ratio), let us finally examine how syncopations swung to varying degrees may be seen as functioning to 'extend' the location of heavy beats in a groove, as instances of what Danielsen refers to as 'downbeats in anticipation'. As we saw previously, off-beat syncopations may emphasize heavy beats without actually accentuating them by focusing motional anacrustic attention towards them, and the more they are swung, the closer they come to virtually coinciding with the on-beats. Danielsen uses the case of the fourth stroke of the basic guitar verse pattern in *Get Up (I Feel Like Being a Sex Machine)* as a prime example of late syncopations seen as 'stretching' the heavy beat location. The stroke is located on the off-beat sixteenth prior to the fourth quarter note snare beat, and is swung at a hard ratio of ca. 2:1 (tied-triplet), or located ca. 46ms ahead of the snare, according to our measurements in chapter 3 (see ***Fig. 4.7***). This places it just within the 50ms threshold Butterfield hypothesizes for being considered a virtual early on-beat, and is corroborated by Danielsen when she observes that the syncopation is positioned "so late that the off-stroke virtually coincides with the beat on the snare drum that is intended to anticipate," and as such can be perceived as stretching the "limit of how early an attack can be without losing contact with the heavy beat" (Danielsen 2006:78).

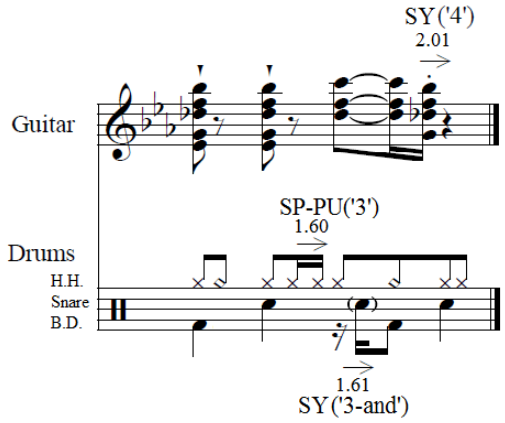

Fig. 4.7 *– Off-beat sixteenth syncopations and pickups in Guitar and Drums of the basic unit of the verse ('A section') of 'Get Up (I Feel Like Being a Sex Machine)' (James Brown). '→' = local beat swing emphasis. SP-PU= Swing Pair-Pickup, SY = Syncopation, (...)=beat*

Late off-beat sixteenth syncopations of a single instrument, such as guitar as seen above, may not only anticipate and extend a virtual eighth-note (or off-beat quarter-note) location of its own referential scheme, but in the wider scope of the multi-layered groove could also be viewed as extending the actualized beats of another instrument, such as a snare drum accenting a backbeat on the 2 or 4. In a similar fashion, off-beat sixteenth pickups may also be seen as serving to extend either virtual heavy on-beats or those actualized by other instruments (or both), such as the several instances of bass pickups preceding heavy quarter note beats 1 and 2 as well as the '3-and' and '4-and' beats in *Get Up (I Feel Like Being a Sex Machine)* (see ***Fig. 4.8***). Whilst we previously found the bass

sixteenths to be moderately swung at a global mean ratio of 1.52, the off-beat pickups and syncopations anticipating 'the One' (beat 1) as well as the first backbeat (beat 2) are swung with significantly greater emphasis (1.88:1 and 1.72) – providing these heavy beats with greater tension and weight. The guitar, as we saw before, provides the remaining second back-beat (beat 4) with a highly anticipatory, virtually extending emphasis and therefore the majority of the beats of the main quarter note pulse are emphasized via these extending pickups and syncopations (including some off-beat locations). However, by virtue of most of the bass notes being rather short and staccato rarely lasting longer than an eighth-note, these abundant pickup gestures and syncopations never allow the groove to settle down on the strong beat for very long. That is, heavy beats are rarely allowed to last a full eighth note, never an entire quarter note, and as a result their energy is spread out by the sequences of snappy sixteenths. Butterfield would likely argue that, even though swung off-beat pickup and syncopation are anacrustic and serve to emphasize their ensuing heavy on-beats, if further syncopations or pickups are regularly stated on immediately ensuing off-beat sixteenths within the span of a quarter- or eighth-note heavy beat, the supplemental anacrusis and motional energy provided disperses the 'weight' and downbeat closure conferred to these heavy beats to varying degrees depending on how 'swung' or 'late' the off-beats are.

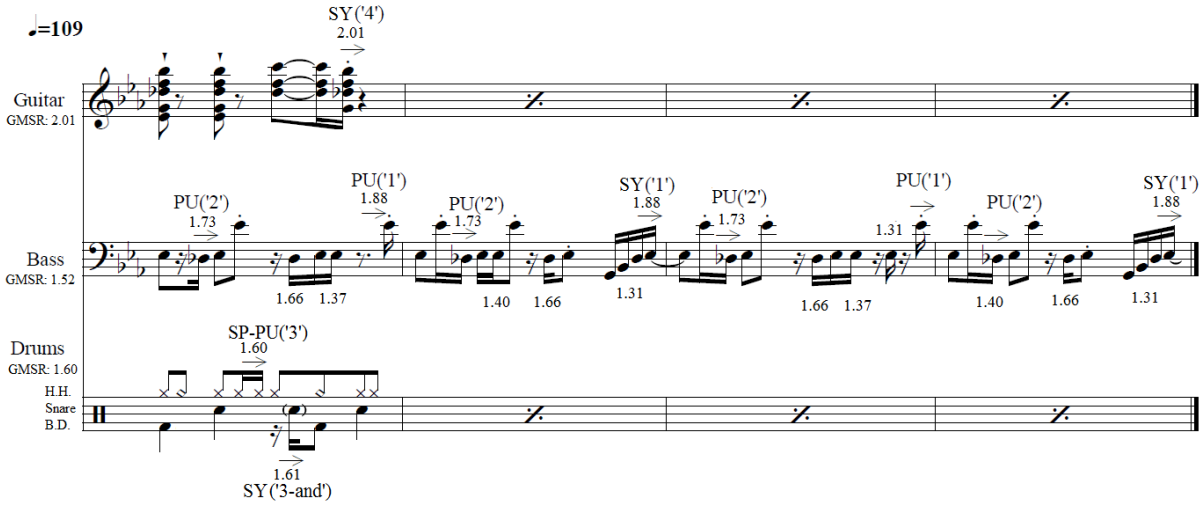

Fig. 4.8 *– Rhythm section basic unit (x2) of 'Get Up (I Feel Like Being a Sex Machine)' by James Brown. Numerical values over off-beats= local mean swing ratio. '→'= local beat swing emphasis. SP-PU= Swing Pair-Pickup, PU = Pickup, SY = Syncopation, (...)=beat, GMSR = Global Mean Swing Ratio.*

Essentially, in *Get Up (I Feel Like Being a Sex Machine),* via a myriad of syncopations and pickups swung to considerable degrees, at practically all times at least one instrument redirects attention from the main quarter note pulse (and its off-beats) to the sixteenth-note density referent level. By constantly displacing and offsetting 'weight' from the heavy beats, repeated used of syncopations and pickups destabilize the center of force and energy of the main pulse. However, when they do so in

such a regular and repeated fashion, the possibility that they might comprise larger virtual structural figures of a 'counter-rhythmic' nature arises.

4.6 Counter-Rhythm (Systematic Syncopations)

As defined earlier in section 4.2, off-beat syncopations are seen to 'momentarily' displace the accentuated the beats implied by the main 4/4 pulse, however, when a series of regularly occurring syncopations systematically accentuate a series of unexpected beat locations, eventually they cease to be heard as deviations from the pulse and may begin to be perceived as an independent pulse of its own. For example, in the context of an ongoing groove firmly entrenched within 4/4 meter, a sound event lasting ca. a sixteenth note beginning on the downbeat of a new bar then followed by an off-beat sixteenth syncopation prior to the second quarter note beat could be considered as virtually projecting a perception of that very second quarter note beat via anacrusis, according to Butterfield. However, if another sixteenth note is actualized at a distance of a dotted eight note duration away (three times a sixteenth note) on the '2-and' beat of the main pulse, then perhaps at this point it may begin set in motion the projection of an entirely new ternary virtual cross-rhythmic pulse, one which competes with the main binary 4/4 basic beat (see ***Fig. 4.9***). If once again, after a dotted sixteenth-note duration, an additional off-beat sixteenth is projected, the perception of this virtual cross-rhythmic pulse may be further strengthened, and the longer this pattern continues, the more it may be perceived to compete with the main 4/4 pulse for attention.

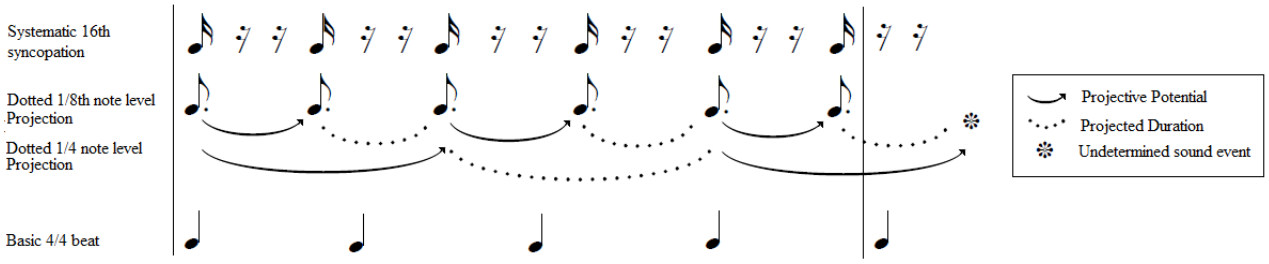

Fig. 4.9 *– Sequence of regularly syncopated 16ths and hypothetical projection of dotted eighth note cross-rhythm (and its double dotted ¼ note level) relative to a basic 4/4 beat, based on Hasty/Butterfield models.*

Whilst relatively rare in early funk, in jazz-funk soloists may be found to improvise melodies sustaining long chains of unbroken cross-rhythms on this dotted eighth level and other triple-based subdivisions juxtaposed against the main pulse and its duple subdivisions. However, accompaniment instruments in both funk and jazz-funk will typically only hint at such cross rhythms in the basic unit patterns, usually always anchoring a potentially cross-rhythmic motif back into the main duple quarter note or eighth pulse and forming instead what Danielsen terms as 'counter-rhythmic figures with a tendency towards cross-rhythm' (2006:75). One of the most basic of such counter rhythmic patterns

in funk typically groups the eighth-notes of a bar into asymmetrical figures of ||3+3+2|| (***Fig. 4.10(a)***) and we shall refer to as the regular '3:2 Standard Pattern' counter-rhythm ('3:2 SP').[23] The reason for this is that the first two strokes of this pattern form a 3:2 cross-rhythm over the first three beats of the main 4/4 pulse (two dotted quarter notes over three quarter notes) until the third stroke of the Standard Pattern coincides with the last fourth quarter note of the main pulse.[24] A 'double time' variation of this 3:2 pattern ('DT 3:2 SP'), which groups sixteenths into |3+3+2| of a half bar is also very common (***Fig. 4.10(b)***), and a '4:3' version ('4:3 SP') which further divide each of the durations of the regular 3:2 pattern in half, grouping the sixteenths of a bar into ||3+3+3+3+2+2|| (***Fig. 4.10(c)***) and pits four dotted sixteenths over three quarter notes, forms the back-bone of many a funk riff. A 'double time' version of the 4:3 SP counter-rhythm is only theoretically possible for it too fast to be played in funk grooves (***Fig. 4.10(d)***) however, it is virtually implied by the double time 3:2 standard pattern counter-rhythm in the same way as the regular 4:3 is implied by the regular 3:2.

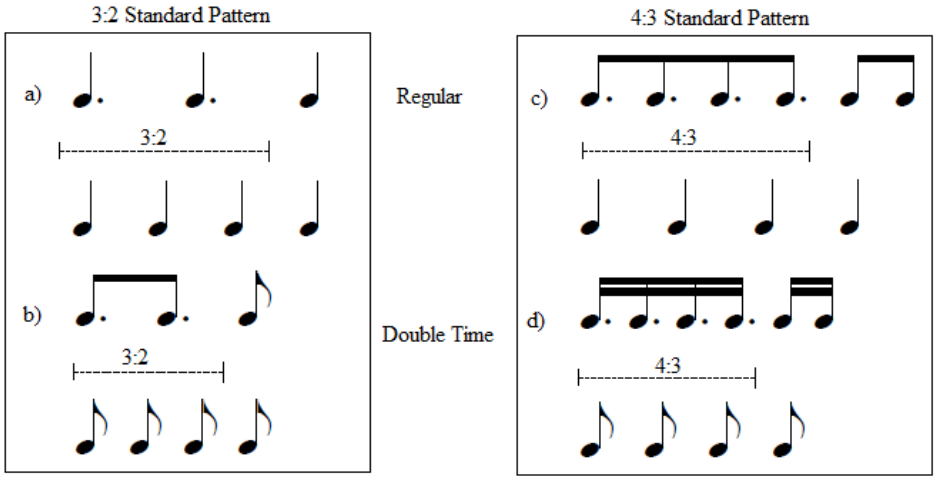

Fig. 4.10 *– Basic 3:2 and 4:3 Standard Pattern in 'Regular'* ***(a) (c)*** *and 'Double Time'* ***(b) (d)*** *variations in relation to a basic 4/4 beat and eighth-note level respectively.*

The main function of these counter-rhythmic figures is to disturb the main beat, however, unlike pure cross-rhythms, they do not serve do make a track "the product of two different pulse schemes" – instead they are woven into fabric of the groove in such a manner so that it appears as a "single rhythm" where the main still pulse rules (loc. cit.: 62). The ultimate function of this destabilization is "not to loosen the groove's grip but to make it even more powerful by bringing the tensions of the groove to the limit, but not beyond" (loc. cit.:135). Much like anacrusis in swing pairs, syncopations,

[23] In keeping with Danielsen (2006: 63) as it is basically a duple-meter simplified version of the so-called 'African Standard Pattern'. Notably, it is identical to the 'tresillo' portion of Cuban Son clave and also found in several guide patterns of various other Afro-Latin rhythmic traditions.
[24] The nomenclature rules for cross-rhythm seems to be that the longer note duration is placed before the shorter duration – so 3:2 rather than 2:3 and 4:3 rather than 3:4.

and pickups, counter-rhythmic gestures also serve to increase tension – not simply by imparting motional energy to heavy beats on off-beat strokes, but rather by contradicting the very dominance of these heavy beats of the main duple meter and creating a rhythmic 'friction' on the structural level which is further exacerbated if its sixteenth off-beat components are additionally swung.

The excerpts we analyzed in chapter 3 are rife with off-beat sixteenth swung pairs, pickups, and syncopations which could be interpreted as forming the core of various standard pattern counter-rhythms. We shall limit our focus, however, to cases of local off-beats found to significantly swing to a greater extent than the global mean swing ratio of the basic unit in section 3.4. Beginning with the prime exemplary case of *Get Up (I Feel Like Being a Sex Machine)*, as we've seen, the fourth stroke of the guitar pattern has already been considered as a particularly 'late' syncopation or as a tied triplet swung (2:1) sixteenth offbeat, as well as a virtual early quarter-note beat seeing as it almost coincides with such by only 46ms (within Butterfields threshold). By widening the scope of our analytical glance to consider the wider macro-structural context to increasingly greater degrees, this fourth guitar stroke could be seen as forming a part of either: a) an incomplete simple double time 3:2 Standard Pattern counter-rhythm, in which the third and fourth guitar stroke form the first and second counter-rhythmic figure, or b) a complete double time 3:2 Standard Pattern where the two first counter-rhythmic strokes are stated by guitar and then the final third stroke complemented by the first syllable of James Brown's vocal line of '*Get Up*-"[25], or c) an extended 4:3 Stand Pattern, as Danielsen suggests (2006:79), where the fourth stroke of the 4:3 segment is found across the first bar of the basic unit manifested by Brown's closing of the lyrical cell with an emphatic "*-pah!*' (see ***Fig. 4.11***).

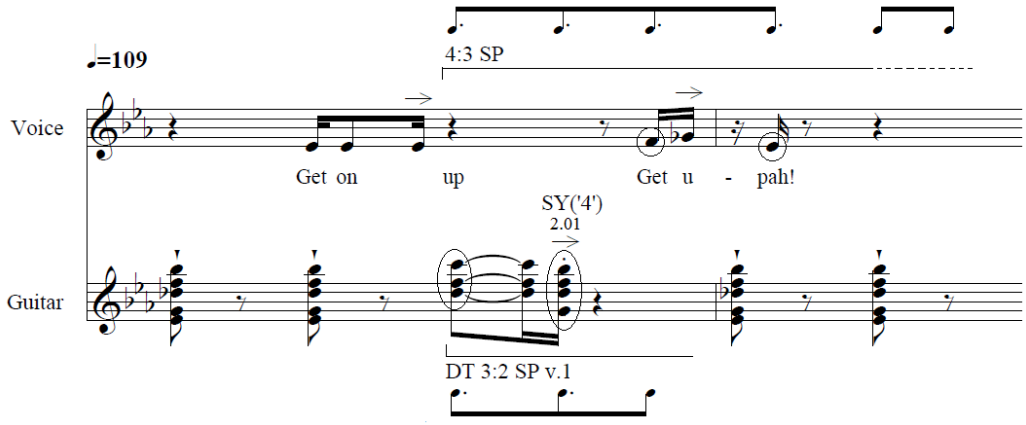

Fig. 4.11 *– Counter-rhythmic patterns (indicate by circles) formed by guitar and vocal lines in the basic unit of the verse ('A section') in Get Up (I Feel Like Being a Sex Machine). '▼' symbol indicates a stacatissimo note. Numerical values over off-beats = local mean swing ratio. '→'= local beat swing emphasis. SY = Syncopation, (...)=beat, GMSR = Global Mean Swing Ratio.*

What is vital to acknowledge here, is the fundamental ambiguous relationship of the swung off-beats' towards both the regular binary rhythmic pulse and its subdivisions and the counter-rhythmic figures

[25] Whilst we have not collected quantitative data on the swing ratio of the vocal's sixteenths are, much like all the rhythm instruments in the track it sounds significantly, perceptibly 'late' (behind the beat).

and the ternary pulse schemes they alludes to. Danielsen suggests that the single actualized sixteenth off-beat gestures are conditioned by the pre-existing virtual figures and subdivision schemes, however by virtue of them both being swung (blurring the lines between 'late' off-beats or 'early' on-beats) and forming counter-rhythmic patterns (simultaneously strengthening and challenging the main pulse and its subdivisions), the various virtual reference structures which engender them are 'confirmed and cancelled in the one and same move'. Objectively, the fourth guitar stroke in *Get Up* is too early to be on the quarter note pulse and too late to be either on the straight sixteenth subdivision level or Double Time 3:2/ regular 4:3 counter-rhythmic pattern – it is evermore betwixt and between. Such an inherently ambivalent positioning is part of what causes a feeling of subtle yet profound destabilization on the micro-level, one which throws doubt upon the authority of the virtual metric pulse schemes and figures which are assumed to be preliminary conditions for its performance.

Several other examples from our analyzed excerpts contain sixteenth off-beats which may be either be interpreted not just as swung pickups and syncopations or anticipated downbeats, but also as part of larger virtual counter-rhythmic figures. In the organ riff of the basic unit in Grant Green's *Ain't It Funky* for example, two 'sixteenth pair' locations were found to display swing ratios significantly higher than the mean global swing ratio (1.26). More specifically, these were an off-beat syncopation to the third quarter note beat and an off-beat pickup to the subsequent '3-and' beat, swung to a 1.45:1 and 1.47:1 ratio respectively (see ***Fig. 4.12***). Both of these off-beats were therefore approximately swung to a noticeably perceptible 'light' ratio of 1.5:1 whilst all other sixteenth off-beats were relatively straighter in comparison. The organ riff is essentially identical in both bars (with the exception of an extra sixteenth note on the D of the tail end of the second bar) and clearly could be interpreted as presenting a pattern of systematic syncopations which qualify as a slightly embellished 4:3 Standard Pattern counter-rhythmic figure, although one which is here displaced, or shifter forward by a quarter note in each measure. The first stroke its 4:3 cross-rhythmic portion begins on the $A^{\flat}$ on beat 2, the second on the swung F off-beat syncopation leading into beat 3, the third stroke coinciding with the on-beat sixteenth $A^{\flat}$on the '3-and' beat (which is picked up briefly by a melodically anticipatory, snappily swung F) and finally landed by a fourth and last stroke on an off-beat F pickup just prior to the '4-and' beat. In the second and final bar of the basic beat, this last pickup further descends to an ensuing on-beat location which lands onto a root D note, resolving both harmonic and (some) rhythmic tension before the basic bar repeats.

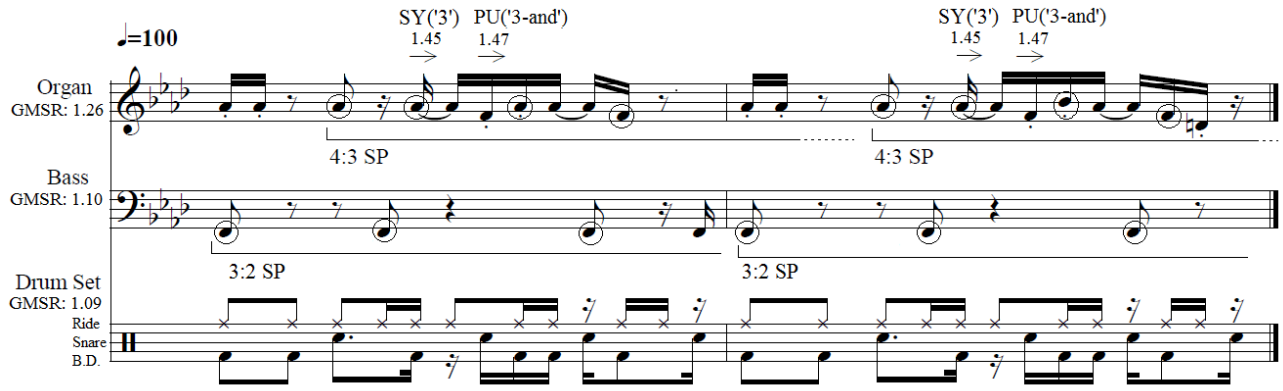

Fig. 4.12 *– Basic unit in 'Ain't It Funky' by Grant Green. Counter-rhythmic patterns indicated by circles. Numerical values over off-beats = local mean swing ratio. '→'= local beat swing emphasis. SP = Standard Pattern, SP-PU= Swing Pair-Pickup, PU = Pickup, SY = Syncopation, (...)=beat, GMSR = Global Mean Swing Ratio.*

Once again, the fact that only certain off-beat sixteenths in the organ pattern are swung to greater degrees than others may be interpreted as evidence that, at any given time, performers of funk-oriented grooves are able to both confirm and destabilize both virtual counter-rhythmic figures as well as the duple meter pulse and subdivisions which give them form. For example, the organ's swung pickup preceding the '3-and' may be seen as a gesture which derails the riff from the main quarter-note beats of the 4/4 pulse, destabilizing them by veering the riff into the territory of a swung virtual subdivision pulse, based perhaps on sixteenth quintuplets (as swung pairs of 1.5:1 are essentially akin to note durations lasting three quintuplet sixteenths + two quintuplet sixteenths). However, as Butterfield rightly points out, microrhythmic timing deviations of such minute magnitudes are not likely to lend themselves as being categorically perceived in terms of such small subdivision units, and rather the pickup is more likely heard as moderately anacrustic, 'lightly' swung sixteenth note. As such, though, it would still function to destabilize the eighth-note subdivision level (or main pulse's off-beats) by strengthening the 4:3 counter-rhythmic figure, since by virtue of its anacrustic qualities it emphasizes the ensuing on-beat note (the '3-and') which constitutes the third stroke of the counter-rhythm by imparting motional energy onto it (as well as a proportionally moderate degree of 'downbeat closure').

The organ riff's swung syncopation anticipating beat 3, which itself coincides with the location of the 4:3 counter-rhythm's second stroke, by virtue of being swung to a 1.45:1 ratio and therefore moderately anacrustic (without, however, imparting any downbeat closure), simultaneously 'confirms and cancels' the virtual counter-rhythm. Just as in the fourth guitar stroke of the verse basic unit of *Get Up,* it is too 'late' to be either on the counter-rhythm or the regular duple sixteenth subdivision level, or still too 'early' to be perceived as virtually coinciding with beat 3 of the main pulse. Therefore, the swung syncopation essentially destabilizes the duple based density referent and main pulse as well as the triple based cross-rhythmic pulse temporarily hinted at by the counter-rhythmic figure. It is to be noted, as an aside, that in *Ain't It Funky* we also see a clear display of a

regular (eighth-note level) 3:2 Standard pattern counter-rhythmic pattern in the bass riff, which in a parallel fashion to that of its double time (sixteenth level) variety, may also simultaneously confirm the dominance of the main pulse (beats 1 and 4) and destabilize it by accentuating its off-beats ('2-and'). This type of destabilization on the macro-level is, albeit, of a different nature and extent than that of subtler microrhythmic deviations on the sixteenth level, one which is both more obvious and forceful perhaps, yet not necessarily more significantly conducive towards rhythmic ambiguity in the groove overall.

More instances of double time 3:2 Standard Pattern counter-rhythms can be found in abundance in the patterns of both bass and drums in *The Emperor* by Donald Byrd at ca. 6:19 minutes. Whilst most of the bass' sixteenth-notes lack any perceptible swing (display a global mean swing ratio of 1.13) the off-beat syncopations leading into beat 2 are swung to a perceptible yet slight degree (1.38) (see ***Fig. 4.13***). Heard as a lone syncopation, it either emphasizes and strengthens the dominance of the main pulse by virtue of its forwardly directing anacrustic attention to the snare drums' backbeat, or virtually extends its beat location backwards in time, widening its locus. If heard in the context of its preceding and ensuing notes on the other hand, it clearly forms a three-stroke DT 3:2 SP (or even an extended 4:3 SP as outlined in parenthesis in the transcription) and the syncopated second off-beat stroke's role becomes one of destabilizing the very same snare backbeat and the main 4/4 pulse which it is entrenched in by projecting the seeds of a virtual cross-rhythmic layer which recedes as soon as it emerges.

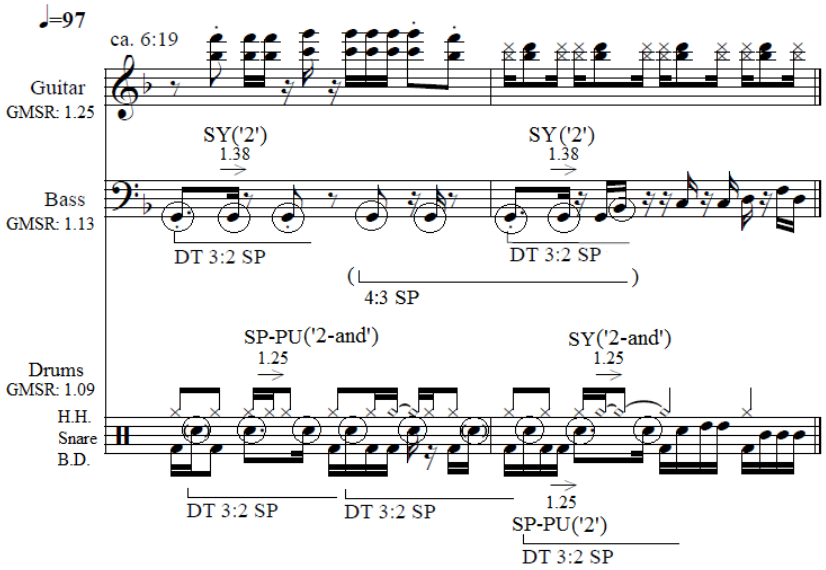

Fig. 4.13 *–Excerpt from 'The Emperor' by Donald Byrd (ca. 6.19 min.) Numerical values over off-beats = local mean swing ratio. '→'= local beat swing emphasis. DT = Double Time, SP = Standard Pattern, SP-PU= Swing Pair-Pickup, PU = Pickup, SY = Syncopation, (...) = beat, GMSR = Global Mean Swing Ratio.*

In the drums, only the hi-hat's swing pair pickup to the '2-and' beat in the first bar and a syncopation preceding the same beat in the second bar are swung just slightly above the swing JND threshold

(1.25). Whilst they do not seem to form part of any clear counter-rhythm, they do add some microrhythmic tension to the groove in a manner of which the otherwise straight sixteenths in the remainder of the drum pattern do not. In addition, they anacrustically emphasizing the '2-and' beat, which coincides with the third stroke of the bass's DT 3:2 SP counter-rhythm and further reinforces that location as a heavy beat in the groove. The snare drum hits in the basic unit, whilst not being swung, do in fact form three sequential DT 3:2 SP counter-rhythms which are each displaced, or shifted forward by a sixteenth note beginning in the first bar and stretching out until the end of the first half of the second bar. This slight displacement is essentially an 'off-beat' version of the regular 'on-beat' Double Time 3:2 Standard Pattern, and snare and bass counter-rhythms form an interesting antiphonal effect – when one instrument accents an on-beat location, the other immediately accents a complementary off-beat or *vice versa*, creating an overall push and pull effect that keeps the groove in continuous motion. It is noteworthy that the displaced off-beat counter-rhythm hints at an additional triple based virtual cross-rhythmic pulse schemes which itself is also 'off-beat' in relation to the one engendered by the regular DT 3:2 SP, further expanding the range of virtual schemes to which rhythmic gestures in the groove may stem from or generate themselves.

Basic Standard Pattern counter-rhythms may not only be displaced forward, as in the case of snare in *The Emperor,* but also backwards as in the bass and guitar riff of *Blue Juice.* Here, both bass and guitar frequently swing their off-beats from moderate to high degrees; the guitar swings quite regularly throughout at around a global mean ratio of 1.64, whilst the bass swings with greater emphasis only on the first three off-beat sixteenths, playing significantly straighter at end of the bar (see ***Fig. 4.14***). These first three notes, played in unison by both instruments at different octaves, viewed in isolation can be seen as simple statements of the 'One', followed by two consecutive swung off-beat syncopations, the first which anticipates the first back beat snare hit (beat 2), particularly strongly by the bass, which is swung to an extremely high 3.16:1 ratio as to be virtually coincident with the snare (ca. 55 ms behind, i.e. only minutely above Butterfield's threshold of being perceived as a microrhythmically early virtual on-beat), and the second syncopation which anticipates a heavy beat on the off-beats of the main pulse instead. However, in terms of counter-rhythm, we may consider these swung off-beats in terms of a Double Time 3:2 Standard Pattern shifted a dotted sixteenth backwards. Alternatively, if as Willie Anku's (2000) claims that the original African Standard Pattern is often 'rotated' according to preference by various ethnic traditions, then here too the position of the first quarter note downbeat (the 'One') in the Double Time 3:2 Standard pattern can be said to be rotated one stroke forward, beginning on its second stroke and deriving what we may term its 'Second Rotation' ('DT 3:3 SP R2'). This variation therefore groups the sixteenths of a half measure into |3+2+3|, or |  |. Whilst there are many rotational possibilities (including off-beat variations of such), we shall not attempt to review any more than necessary for the extent to which funk-oriented

musicians seem to play with, re-arrange and re-mould the basic form of the duple Standard Pattern is far beyond the allotted scope of this thesis.

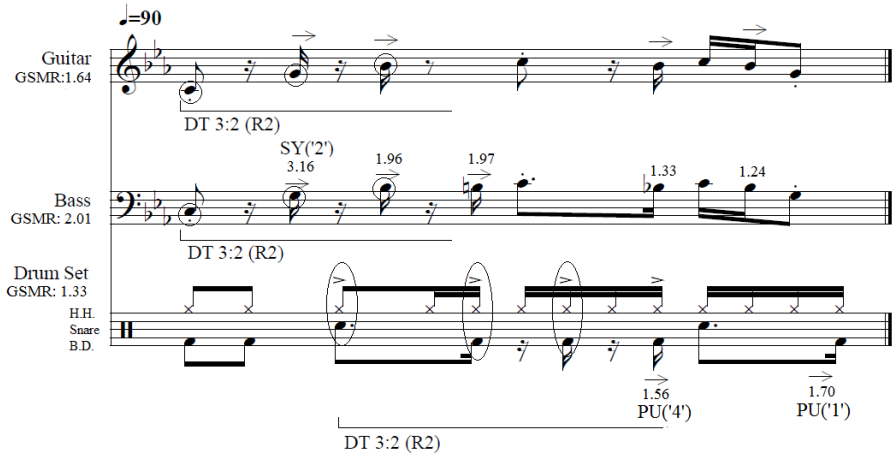

Fig. 4.14 *–Basic unit in 'Blue Juice' by Jimmy McGriff. Counter-rhythmic patterns indicated by circles. Numerical values over off-beats = local mean swing ratio. '→'= local beat swing emphasis. DT = Double Time, SP = Standard Pattern, SP-PU= Swing Pair-Pickup, PU = Pickup, SY = Syncopation, (...) = beat, GMSR = Global Mean Swing Ratio.*

The point, moreover, is that the first two off-beat syncopations in the basic unit riffs of bass and guitar in *Blue Juice* may therefore also be construed as conforming to a counter-rhythmic pattern, although one which varies from the 'original' or basic DT 3:2 SP variant by alternating the sequence of accentuation of the main pulse and its off-beats, and consequentially the location of its momentary 3:2 cross-rhythmic segment as well. The fact that their off-beat syncopated elements are swung once again only add to increase the feeling of anticipation and tension by virtue of their significantly ambivalent microtiming relation to the myriad of virtual schemes and structures conditioned by them. The swung off-beats in the second half of the bar (including the off-beat to beat 3), are more specifically pickups rather than syncopations and therefore, whist also contributing to the perception of a virtually swung sixteenth subdivision level (though less so in the bass's case as the last two are relatively straight overall), they seem to function mainly to fasten the riff back into the dominant duple quarter note pulse and its off-beats (eighth-note level) via various degrees of downbeat closure. Lastly, it is curious to note that the drums may be seen as forming a counter-rhythmic pattern in the combination of its accented hi-hat with bass drum and snare together, which also forms the very same second rotation of the counter-rhythm used by the other two instruments. In fact, its figure is virtually identical to bass guitar's – a DT 3:2 SP (R2) followed by a swung pickup which prevents a 4:3 SP from emerging (and the hinted cross-rhythmic layer to further establish itself) and anchors its riff back into the main 4/4 pulse. Just like in *The Emperor,* it seems that all the instruments of the rhythm section in *Blue Juice* utilize the same variation of a counter-rhythms as a motif which they may displace in different ways, however, this is likely more coincidental than anything for it is just as common for instruments to utilize different versions the Standard Pattern in the same basic unit.

4.7 Summary

On a most basic structural level of beat reference structures, swung sixteenth off-beat gestures – whether as part of complete swing pair figures or standing alone as a pickups or syncopations – may be considered to project a virtual layer of sixteenth-note subdivision layer. The fact that this level may be either swung consistently in a regular fashion, or, as is the more often the case with funk, in an irregular, fluctuating manner, allows off-beat sixteenth gestures to add various degrees of microrhythmic tension to the structural patterns of the groove. In light of Butterfield's interpretation of swing as 'anacrusis', it would seem that instrumentalists in funk and jazz-funk adjust the degree of swing ratio applied to sixteenths depending on the extent of 'motional energy' (and parallel 'downbeat closure') that they wish to impart towards particular heavy beat locations. Viewed from a slightly different, yet similar perspective, sixteenth off-beat pickups and syncopations may be seen as extending these heavy beats, and when swung to a sufficiently high degree may even at times be perceived as instances of virtual early 'downbeats in anticipation'. Lastly, these swung off-beat gestures may concomitantly be seen as forming various counter-rhythmic figures, which add further tension and motion to a groove at the macro-structural level by challenging (but not usurping) the dominance of the main 4/4 pulse and its duple subdivisions in subtle but effective ways.

What seemingly makes Funk-oriented rhythm so unique and appealing, as Danielsen (2006) keenly observes, is the exciting presence of a 'perfectly imperfect' balance between macro-structural 'rhythm and counter-rhythm', however coupled with a 'highly accurate inaccuracy' in the sense of the ambiguous microtiming positioning of sixteenth-note rhythmic gestures. A concrete way, then, in which funk-rhythm achieves this perfectly imperfect balance, is via the ambiguous fashion in which swing is applied to the groove. In the tracks where we find that individual instruments swing more or less uniformly throughout a groove, they are always counter-balanced by other instruments that don't swing. More frequently though, various instruments will swing in subtle ways on only certain local positions of the groove. In such cases, they aid in cultivating a finer form of rhythmic ambivalence by allowing various counter-rhythmic patterns to reside within the scope of both straight and swung virtual reference structures depending on the degree to which their off-beat components are swung.

5 Conclusion

5.1 Swing as one factor of a Fundamentally Ambiguous Funk Rhythm Aesthetic

The main purpose in part I of this thesis was to gain insight into the extent to which core rhythm instruments in early funk and jazz-funk swing their most basic rhythmic units, their sixteenth notes. In our microanalyses of excerpts from thirteen prototypical funk and jazz-funk recordings, we found that in terms of instruments' overall mean swing of all sixteenth pairs per measure (global mean swing ratio), in the majority of our excerpts (nine out of thirteen) at least one instrument was found to swing their sixteenth-notes above theoretically perceptible degrees either globally or at certain points in the groove, (values for mean of instruments ranged from 1:2 to 2.1:1). Most of the instruments which were found to swing globally, however, tended to do so usually between the subtler swing ratio range of 1.2:1 and 1.5:1. Generally, no simple linear relationship between increasing tempo and decreasing swing ratio was found for any of the instruments in neither separate style category, nor in relation to all excerpts combined.[26] Tempo did seem to have an effect on swing ratio though, in the sense that only in the two slowest tracks of each style category did any instrument swing at more explicitly noticeable degrees from 1.5:1 to 2.0:1, whilst very few instruments in both styles tended to swing above 1.2:1 in their respective medium to fast tempo ranges. In general, these findings are in accordance with several previous studies (Collier and Collier 1996; Friberg and Sundström 2002; De Haas 2007; Honing and De Haas 2008) and lend further evidence to the 'timing is tempo-specific' hypothesis which purports that swing performance is tempo-dependent.

Furthermore, results of the local mean swing analysis revealed that when instruments are found to swing their sixteenths, in the majority of cases, they are swung more or less irregularly throughout a measure rather than uniformly. Singular local sixteenths were frequently found to swing to significantly higher ratios than the overall global mean, even in cases where instruments did not swing the majority of their sixteenths globally. This occurs proportionally for both funk and jazz-funk musicians and it would seem that Funk-oriented instrumentalists are generally skilfully and flexibly able to adjust the nature of the referential subdivision structures which guide the performance of their gestures on the sixteenth-note level. Both funk and jazz-funk therefore join the gamut of musical repertoires derived from practices of Afro-diasporic communities that "are known today for their sense of swing," but may be "best understood as using fast non-isochronous pulses at the metric subdivision level" (Polak and London 2014:[106]).

In light of both the swing analyses combined, in virtually all of the excerpts (twelve out of

[26] With the exception of guitar/organ in Jazz-Funk – however considering the mixed instrument nature of this category, and the limited size of our sample, its reliability is very limited and no real conclusions can be drawn from such a preliminary correlation.

thirteen), some form of swing – whether global or local – can be found in at least one instrument. Few differences in patterns of swing between funk and jazz-funk were found in general, expect for a slight tendency for Jazz rhythm section instruments to synchronize more to a common swing ratio, whilst the funk tracks showed a more consistent pattern of one instrument (guitar) swinging higher than bass and drums. It was speculated that one reason for this might be the effect of heavily swing-based styles which jazz-funk artists were accustomed to before adopting funk rhythms. In both styles, however, rather than all accompaniment instruments swinging at approximately the same rate, as is more typical in straight-ahead jazz styles (Friberg and Sundström 2002; Rose 1989), a combination of both instruments playing straighter whilst others swinging more noticeably was observed in general. Our findings therefore lend further evidence to claims that an ambivalent mix of straight and swung subdivisions is a characteristic aesthetic-stylistic trait of funk rhythm in general (Danielsen 2006; Stewart 2000).

In part II, utilizing the empirical results from the swing analyses, we ventured to show how microrhythmic expression on the sixteenth note level interacted with foundational referential beat structures (such as the main 4/4 pulse and its off-beats) as well wider macro-structural counter-rhythmic patterns typically found in funk-based styles. To do so, we explored some rhythmic theories which offer possible explanations for *why* funk-based rhythm instrumentalists might swing their sixteenths in the first place. We generally found that swung sixteenth off-beats tend to focus attention towards their ensuing on-beat locations by proxy, serving therefore to emphasize heavy beats of the groove on the main pulse quarter-note level or the eight-note subdivision. In light of Butterfield's (2006; 2011) conception of swing as 'anacrusis', much like eight-note off-beats in swing-based jazz styles, swung sixteenths off-beats in funk grooves may be perceived as rhythmic devices that impart 'motional energy' which "perpetually generate a forward propulsive energy toward… [heavy] beat[s]" (2006: [par. 20]). Roughly summarized, the higher the swing ratio, the greater feeling of 'drive' produced. When certain local sixteenths are swung to radical extents, particularly in the form of syncopations, they may in fact possibly not be necessarily perceived as elements of a swung sixteenth subdivision as such, but as virtual extensions of the on-beat locations which they precede, acting as what Danielsen terms as (2006) 'downbeats in anticipation'. On an even wider scale, systematic sequences of off-beat pickups and syncopations can be seen as comprising typical counter-rhythmic patterns which add tension to the more foundational rhythmic levels, further compounding the overall rhythmic ambivalence of the groove when swung.

Danielsen maintains that the relationship between microrhythmic expression in the form of swing and counter-rhythm in funk-oriented grooves is paramount, going as far as to speculate that "[p]erhaps it is only against such a fabric of cross-rhythms that funk's many small and specifically funky musical gestures can be (per)formed as early or late, as (almost) on the beat and (almost) on

another as well" (2006:71). That is to say, without stylistically typical cross-rhythmic figures to guide the production of funk grooves, the microrhythmic placement of gestures and their uncertainty regarding metrical positions might not arise to the degree that they do in the styles of early funk and jazz-funk. When rhythmic gestures on the sixteenth level are swung to varying degrees, they allow various figures to simultaneously comprise a part of the rhythm (binary main pulse and subdivisions) and counter-rhythm (figures with hints of ternary cross-rhythm), and not comprise either at the same time. This inherent ambivalence, of almost constant belonging and not belonging, creates a lack of rhythmic clarity on the micro-level which seems to have developed into a unique and salient feature of funk and jazz-funk already in their early incarnations.

In the beginning of this thesis, the very first question posed was whether funk rhythms could be said to 'swing'. Findings from our microrhythmic investigations would suggest that, just like the use of key stylistic structural rhythmic devices such as pickups, syncopations and counter-rhythmic patterns, a certain degree of swing on the sixteenth level is indeed a salient ingredient of funk grooves – or at least those of the early funk and jazz-funk masters of the late 60's to early 70's which we have studied. However, it is not the clear-cut use of regular swinging subdivisions that seems to define the general microrhythmic character of the classic funk groove, but rather a subtle juxtaposition of straight and swung sixteenths which is manifested on one level between the interaction of globally swinging and non-swinging instruments of the rhythm section, much like in the 'funky' rhythmic approach of New Orleans R&B artists of the late 50's to early 60's. On a another, deeper level, however, this blend of swing and straight subdivision can additionally be found within the fluctuating local swing patterns of single individual instruments, suggesting that perhaps the early funk and jazz-funk pioneers took the practice of mixed rhythms to a further, even subtler extent, honing and refining the use of understated swing as one vital element amongst several, which contributed to the overall aesthetic of rhythmic ambiguity that came to define funk.

5.2 Strengths and Limitations of the Present Study

Perhaps the greatest limitation of our microanalysis was the relatively small size of our data set. A considerably larger sample of both funk and jazz-funk tracks would be needed to substantiate whether our findings could be held as valid for the styles at large. The general validity of our results, however, could simply be strengthened if only the tools for conducting microrhythmic analyses of audio recordings were invested in and improved to a greater extent. At the present time, the slow and tedious nature of the manual data collection method necessary for such work clearly represents a limitation as to how large a data set can be. Automatic procedures, such as offered by most 'beat detection' tools, whilst available, are of severely limited use since the results they generate are seemingly always imperfect to some degree, therefore invariably requiring a process of 'fine-combing' through, and end

up resembling the manual plotting methods they are designed to avoid in the first place. In addition, the limited or outright lack of basic data processing capabilities of most audio plotting applications means that transferring collected onset locations and IOI durations data to appropriate remains highly ineffective. My hope is to be able to contribute to possible cross-application integration processes in the future, helping craft better and more effective tools suited for large scale microanalyses of audio recordings.

Compared to empirical studies of swing based on live experiments with isolated musicians, such as De Haas' (2007), studies such as this one may perhaps never rate in terms of the sheer amount of collected data points to work with, or the invariably higher accuracy resulting from the clean audio recordings of single signal sources of such studies. Even so, as mentioned in the method section, our microanalytical approach has major advantages, much like that of Friberg and Sundström's (2002), in that it analyzes real musical settings rather than contrived laboratory experiments and thus have substantial ecological validity. In this thesis we were are to reveal a significant portion of the microrhythmic patterns of some of the most influential musicians in coining funk and jazzfunk as a musical style, which would be impossible to discern otherwise, considering many are no longer alive or likely limited in their musical technical capacities (not to mention stamina) due to old age. We have been granted access into the depths of the groove, the very core of the microrhythmic world of the original funk 'masters' such as drummers Clyde Stubblefield, John 'Jabo' Starks and Idris Muhammed, bassists William 'Bootsy' Collins and Bernard Odum, guitarists Jimmy Nolen, George Benson and Grant Green, organists Lonnie Smith, Jimmy McGriff and many, many more.

This is not to say that studies based on experiments with live musicians cannot yield useful information. Only that, unless the subjects of those experiments are proven reputable professionals and play in near perfect realistic settings, what they can tell us is limited in nature. For further research, it would be most interesting to conduct experiments on funk-related rhythms which involved complete rhythm section ensembles, rather than just isolated instruments. Additionally, rather than simply measuring timing aspects, motion capture techniques could be applied in order to account for physical gestural or perceptual factors that also might affect microrhythm in funk performance. The possibilities are endless – The Funk, on the other hand, as we have seen, is always swung, but just a little bit, and at just the right times.

6 Bibliography

Anku, Willie. 2000. “Circles and Time: A Theory of Structural Organization of Rhythm in African Music.” *The Online Journal of the Society for Music Theory* 6 (1), January. http://www.mtosmt.org/issues/mto.00.6.1/mto.00.6.1.anku_essay.html

Barker, Danny. 1998. *Buddy Bolden and the Last Days of Storyvill*e. New York: Continuum.

Belfiglio, Antonio. 2008. *Fundamental Rhythmic Characteristics of Improvised Straight-Ahead Jazz*. PhD Thesis, University of Texas at Austin.

Benadon, Fernando. 2006. “Slicing the Beat: Jazz Eighth-Notes as Expressive Microrhythm.” *Ethnomusicology* 50 (1): 73–98.

Bengtsson, I., & Gabrielsson, A. 1983. “Analysis and Synthesis of Musical Rhythm.” In *Studies in Music Performance*, edited by J. Sundbeg: 27–60. Stockholm: Royal Swedish Academy of Music.

Brown, J., with Tucker, B. 1986. *James Brown: The Godfather of Soul*. New York: Macmillan

Brown, James, with Tucker, B. 1986. *James Brown: The Godfather of Soul.* New York: Da Capo Press.

Brown, Matthew. 1994. “Funk Music as Genre: Black Aesthetics, Apocalyptic Thinking and Urban Protest in Post-1965 African-American Pop.” *Cultural Studies* 8 (3): 484–508.

Butterfield, Mathew. 2006. “The Power of Anacrusis: Engendered Feeling in Groove-Based Musics.” *The Online Journal of the Society for Music Theory* 12 (4). December http://www.mtosmt.org/issues/mto.06.12.4/mto.06.12.4.butterfield.html

———2011. “Why Do Jazz Musicians Swing Their Eighth Notes?” *Music Theory Spectrum* 33 (1):3–26

Clarke, Eric F. 1985. “Structure and Expression in Rhythmic Performance”. In *Musical Structure and Cognition*, edited by P. Howell, I. Cross and R. West: 209–36. London: Academic Press

———1987. “Categorical Rhythm Perception: An Ecological Perspective.” In *Action and Perception in Rhythm and Music,* edited by A. Gabrielsson: 19–34 Stockholm: Royal Swedish Academy of Music.

———2000. “Categorical Rhythm Perception and Event Perception.” In *6th International Conference on Music Perception and Cognition (ICMPC) and 4th Triennial Conference of the European Society for the Cognitive Sciences of Music (ESCOM)*, edited by Chris Woods, Geoff Luck, Renaud Brochard, Fred Seddon, and John Sloboda. http://www.escom.org/proceedings/ICMPC2000/Tue/Clarke.html

Cohen, Aaron. 2007. “James Brown's Musicians Reflect On His Legacy.” *Downbeat Magazine web*, February 15. http://prince.org/msg/8/334918[Accessed 02.05.2016]

Collier, Geoffrey L., and James L. Collier. 2002. "A Study of Timing in Two Louis Armstrong Solos." *Music Perception* 19 (3): 463–83.

Danielsen, Anne. 2006. *Presence and Pleasure: The Funk Grooves of James Brown and Parliament.* Middletown, CT: Wesleyan University Press.

———2010. Introduction. In *Musical Rhythm in the Age of Digital Reproduction,* edited by. A. Danielsen: 19–36. Farnham: Ashgate.

De Haas, W. Bas. 2007.*The Role of Tempo in Groove and Swing Timing.* Master's Thesis Utrecht: Utrecht University.

DeVeaux, Scott and Giddins, Gary. (2009). *Jazz.* New York: W.W. Norton & Company, Inc.

DeVeaux, Scott. 1991. "Creating the jazz tradition: Jazz Historiography." *Black American Literature Forum* 25 (3): 525–560.

Du Noyer, Paul. 2003. *The Illustrated Encyclopedia of Music (1st ed.).* Fulham, London: Flame Tree Publishing.

Efron, Robert. 1970. "The Relationship Between the Duration of a Stimulus and the Duration of a Perception." *Neuropsychologia* 8 (1): 37–55.

Ellis, Mark C. 1991. "An Analysis of 'Swing' Subdivision and Asynchronization in Three Jazz Saxophonists." *Perception and Motor Skills* 73 (3): 707–13.

Friberg, Anders and Johan Sundberg. 1995. "Time discrimination in a monotonic, isochronous sequence." *Journal of the Acoustical Society of America* 98 (5): 2524–2531.

———1997. "Preferred swing ratio in jazz as a function of tempo." *Speech, Music, & Hearing Quarterly Progress and Status Report* 4: 19–28.

———2002. "Swing Ratios and Ensemble Timing in Jazz Performance: Evidence for a Common Rhythmic Pattern." *Music Perception: An Interdisciplinary Journal* 19 (3): 333-349

Gridley, Mark. 2014. *Jazz Styles.* Harlow: Pearson Education Limited.

Hasty, Christopher F. 1997. *Meter as Rhythm.* New York: Oxford University Press.

Honing, Henkjan and W. Bas de Haas. 2008. "Swing Once More: Relating Timing and Tempo in Expert Jazz Drumming." *Music Perception: An Interdisciplinary Journal* 25 (5):471–476.

Honing, Henkjan. 2012. "Structure and Interpretation in Ryhthm of Music" in *Psychology of Music (3rd Edition)*, edited by Deutsch, D: 369–404. London: Academic Press.

Hughes, Timothy S. 2003. "Groove and Flow: Six Analytical Essays on the Music of Stevie Wonder." PhD thesis, University of Washington.

Iyer, Vijay. 2002. "Embodied Mind, Situated Cognition, and Expressive Microtiming in African-American Music." *Music Perception* 19 (3): 387–414.

Johansson, Mats 2010. "The Concept of Rhythmic Tolerance – Examining Flexible Grooves in Scandinavian Folk-fiddling." In *Musical Rhythm in the Age of Digital Reproduction*.

edited by Danielsen, A.: 69–83. Farnham: Ashgate.

Keil, Charles M. H. 1987. “Participatory Discrepancies and the Power of Music.” *Cultural Anthropology* 2 (3): 275–83.

Kilchenmann, Lorenz and Olivier Senn. 2015. “Microtiming in Swing and Funk affects the body movement behavior of music expert listeners.” *Frontiers in Psychology* 6: 1232 http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4542135/

London, Justin and Rainer Polak. 2014. “Timing and Meter in Mande Drumming from Mali.” *The Online Journal of the Society for Music Theory* 20 (1) March. http://www.mtosmt.org/issues/mto.14.20.1/mto.14.20.1.polak-london.html

Milkowski, Bill. 2012. “Professor Funk, Jim Payne Holds Court On The Art Of Groove” in *Drummer World* http://www.funkydrummer.com/JPpages/press_MD_0011_trans.html [Accessed 02.05.2016]

Moore, Allan F. 2001. “Categorical Conventions in Music Discourse: Style and Genre.” *Music & Letters* 82 (3): 432-442.

Pareles, Jon. 2006. “James Brown, the ‘Godfather of Soul’ dies at 73.” *The New York Times,* December 26. http://www.nytimes.com/2006/12/26/arts/music/26brown.html?page wanted=1&ei=5087&en=aef74e8250526096&ex=1182920400 [Accessed 02.05.2016]

Payne, Jim and Harry Weinger. 1996. *Give the Drummers Some! The Great Drummers of R&B, Funk & Soul*. Whitehorse: Face the Music Productions.

Rose, Richard F. 1989. *An Analysis of Timing in Jazz Rhythm Section Performance*. D.M.A. Thesis, University of Texas at Austin.

Rosenthal, David. 1988. “Hard Bop and Its Critics.” *The Black Perspective in Music* 16 (1): 21-29.

———1992. *Hard Bop: Jazz & Black Music 1955–1965.* Oxford: Oxford University Press.

Rout Jr., Leslie B. 1968. “Some post-war developments in Jazz.” *Midcontinent American Studies Journal* 9 (2): 27–50.

Schaffer, Dean (2010-08-20). "Secrets of the Blue Note Vault: Michael Cuscuna on Monk, Blakey, and the One That Got Away". In *Collectors Weekly*. Market Street Media LLC. http://www.collectorsweekly.com/articles/secrets-of-the-blue-note-vault-michael-cuscuna-on-monk-blakey-and-the-one-that-got-away/ [Accessed 02.05.2016]

Stewart, Alexander. 2000. “‘Funky Drummer’: New Orleans, James Brown and the Rhythmic Transformation of American Popular Music.” *Popular Music* 19 (3): 293–318.

Vincent, Ricky (1996) *Funk, The Music, The People, and The Rhythm on the One.* New York:St. Martin’s Griffin

Waadeland, C. H. 2006. “Strategies in empirical studies of swing groove,” Studio Musicologica Norvegica 32, 169–191.

———2011. “Rhythm performance from a spectral point of view,” in *Proceedings of the International Conference on New Interfaces for Musical Expression*, edited by A. R. Jensenius, A. Tveit, R. I. Godøy, and D. Overholt:248–251. University of Oslo

Welch, Catherine. 2007. “Two Films Unveil a Lost Jazz Legend.” National Public Radio, December 15. http://www.npr.org/templates/story/story.php?storyId=17260407 [Accessed 02.05.2016]

Discography

Brown, James. 1967. ‘Cold Sweat pts. 1 and 2’. *Single*. King 6110.

———1967. ‘There was a Time’. *Single*. King 6144.

———1968. ‘Give it up or Turnit’ a Loose. *Single*. King 6213.

———1970. ‘Get Up (I Feel Like Being a Sex Machine)’. *Single*. King 6318.

———1970. ‘Super Bad pts. 1 and 2’. *Single*. King 6329.

Donald Byrd. 1971. ‘The Emperor’. *Ethiopian Knights*. Blue Note BST 84380

Donaldson, Lou. 1967. ‘Alligator Boogaloo’. *Alligator Boogaloo*. Blue Note Records BST 84263.

Green, Grant. 1970. ‘Ain’t It Funky’. *Green is Beautiful*. BST 84342.

Lonnie Smith. 1970. ‘I Can't Stand it’. *Live at Club Mozambique*. Blue Note B1-31880.

McGriff, Jimmy. 1968. ‘Blue Juic’e. *The Worm*. Solid State Records SS 18045.

Rusty Bryant. ‘Fire Eater’. *Fire Eater*. Prestige PR 10014

Smith, Lonnie. 1968. ‘Son of Ice Bag’, *Think!* Blue Note Records BST 84290.

Wilson, Reuben. 1969. ‘Orange Peel’. *Blue Mode*. BST 84343.

7 Appendix

7.1 Tables

***Table 7.1** – Local Mean Swing Ratios of all instruments from all excerpts. Empty fields indicate absence of 16th note pairs. SR values = or > 1.2:1 (10% Swing JND Threshold) are highlighted in yellow, SR = or >1.5:1 ('Light Swing') are highlighted in green. Empty fields indicate instruments without sixteenth notes events within their respective groove's basic unit.*

		DRUMS																
		Local Mean SR (per swing note pair)								GMSR	Standard Deviation (per swing note pair)								GSD
Track	Tempo (b.p.m.)	1	2	3	4	5	6	7	8		1	2	3	4	5	6	7	8	
Blue Juice	90 ±4				1.08	1.10	1.56	1.15	1.70	1.33				0.12	0.13	0.43	0.13	0.40	0.39
Fire Eater	94 ±2	1.09	1.05		1.16	1.06	1.14	1.19	1.03	1.12	0.09	0.09		0.10	0.13	0.06	0.14	0.08	0.09
The Emperor	97 ±2	1.16	1.25	1.25	1.04	0.92	0.95	1.03	1.15	1.09	0.11	0.22	0.15	0.11	0.07	0.07	0.06	0.06	0.10
Ain't it Funky	101 ±2	-	-	-	1.19	1.14	1.08	0.99	1.07	1.09	-	-	-	0.06	0.17	0.07	0.10	0.22	0.12
Get Up (Sex Machine)	109±3	-	-	-	1.60	1.61	-	-	-	1.60	-	-	-	0.05	0.13	-	-	-	0.09
Give it Up or Turnit...	110 ±4	1.54	-	-	1.05	0.97	1.29	-	1.40	1.16	0.05	-	-	0.05	0.08	0.10	-	0.09	0.23
Cold Sweat	114 ±3	1.06	-	-	1.05	1.11	-	-	-	1.07	0.31	-	-	0.23	0.33	-	-	-	0.31
I Can't Stand It	115 ±3	1.05	-	2.39	1.18	1.11	-	1.55	1.10	1.30	0.20	-	0.28	0.41	0.20	-	0.39	0.15	0.45
Orange Peel	121 ±3	-	-	-	1.43	-	-	-	-	1.24	-	-	-	0.03	-	-	-	0.00	0.31
Superbad	125 ±3	-	1.06	-	1.13	-	1.19	-	1.10	1.13	-	0.15	-	0.01	-	0.02	-	0.04	0.11
There was a Time	127 ±4	-	-	-	1.06	1.19	0.93	-	0.95	1.03	-	-	-	0.14	0.25	0.14	-	0.32	0.21
Alligator Boogaloo	128 ±4	1.13	-	-	1.09	1.07	1.06	1.17	-	1.10	0.33	-	-	0.20	0.17	0.18	0.10	-	0.21
Son of Ice Bag	132 ±3	0.88	-	1.23	0.96	0.96	-	1.22	0.84	1.04	0.02	-	0.02	0.03	0.03	-	0.03	0.02	0.18

		GUITAR/ORGAN																
		Local Mean SR (per swing note pair)								GMSR	Standard Deviation (per swing note pair)								GSD
Track	Tempo (b.p.m.)	1	2	3	4	5	6	7	8		1	2	3	4	5	6	7	8	
Blue Juice	90 ±4	-	1.75	1.82	-	-	1.63	1.52	-	1.64	-	0.55	0.46	-	-	0.20	0.22	-	0.46
Fire Eater	94 ±2	-	-	-	-	1.23	1.07	1.29	-	1.15	-	-	-	-	0.24	0.26	0.13	-	0.24
The Emperor	97 ±2	1.25	1.26	1.20	1.35	1.29	1.29	1.19	-	1.25	0.20	0.25	0.33	0.10	0.25	0.21	0.19	-	0.22
Ain't it Funky	101 ±2	1.09	-		1.45	1.47	1.12	1.18	-	1.26	0.13	-	-	0.07	0.14	0.08	0.10	-	0.20
Get Up (Sex Machine)	109±3	1.56	-	1.75	1.69	2.04	1.89	-	-	1.86	0.26	-	0.20	0.17	0.34	0.33	-	-	0.28
Give it Up or Turnit...	110 ±4	1.50	-	1.41	1.43	1.35	1.15	1.79	-	1.43	0.05	-	0.04	0.05	0.03	0.03	0.04	-	0.31
Cold Sweat	114 ±3	1.41	-		1.15	1.21	-	-	-	1.24	0.32	-	-	0.30	0.05	-	-	-	0.25
I Can't Stand It	115 ±3	1.10	1.12	1.15	1.00	1.08	1.10	1.12	1.17	1.11	0.26	0.14	0.31	0.15	0.27	0.19	0.27	0.27	0.23
Orange Peel	121 ±3	0.93	-		1.03	0.98	-	-	-	1.00	0.05	-	-	0.05	0.04	-	-	-	0.22
Superbad	125 ±3	1.33	1.23	1.25	1.27	1.25	1.12	1.12	1.20	1.22	0.34	0.22	0.16	0.13	0.23	0.17	0.24	0.37	0.23
There was a Time	127 ±4	-	1.20	-	0.90	1.20	-	1.23	1.03	1.12	-	0.21	-	0.10	0.18	-	0.03	0.10	0.20
Alligator Boogaloo	128 ±4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Son of Ice Bag	132 ±3	-	-	-	-	0.93	-	-	-	0.93	-	-	-	-	0.09	-	-	-	0.09

		BASS/ORGAN PEDALS																
		Local Mean SR (per swing note pair)								GMSR	Standard Devataion (per swing note pair)								GSD
Track/Artist	Tempo (b.p.m.)	1	2	3	4	5	6	7	8		1	2	3	4	5	6	7	8	
Blue Juice	90 ±4	-	3.16	1.96	1.96	-	1.33	1.44	-	2.04	-	0.84	0.75	0.50	-	0.21	0.09	-	0.89
Fire Eater	94 ±2	-	1.05	1.19	1.08	-	1.17	1.23	-	1.13	-	0.21	0.16	0.22	-	0.21	0.27	-	0.24
The Emperor	97 ±2	-	1.38	1.06	1.05	0.93	1.09	1.07	-	1.13	-	0.35	0.14	0.06	0.09	0.11	0.12	-	0.26
Ain't it Funky	101 ±2	-	-	-	-	-	-	-	1.10	1.10	-	-	-	-	-	-	0.00	0.11	0.11
Get Up (Sex Machine)	109±3	-	1.73	1.40	-	1.66	1.37	1.31	1.88	1.52	-	0.45	0.12	-	0.30	0.24	0.21	0.67	0.40
Give it Up or Turnit...	110 ±4	-	-	1.21	-	1.27	1.14	-	1.31	1.23	-	-	0.14	-	0.15	0.12	-	0.23	0.18
Cold Sweat	114 ±3	-	-	-	-		-	-	-		-	-	-	-		-	-	-	
I Can't Stand It	115 ±3	-	-	-	-	1.15	-	-	-	1.12	-	-	-	-	0.31	-	-	-	0.32
Orange Peel	121 ±3	-	-	-	0.91	-	-	1.21	-	1.14	-	-	-	0.06	-	-	0.10	-	0.61
Superbad	125 ±3	-	-	-	0.93	-	0.92	-	-	0.93	-	-	-	0.20	-	0.18	-	-	0.20
There was a Time	127 ±4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Alligator Boogaloo	128 ±4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Son of Ice Bag	132 ±3	-	-	0.85	-	-	-	1.17	-	0.93	-	-	0.06	-	-	-	0.17	-	0.04

***Table 7.2** - Correlation results of Global Mean Swing Ratio (GMSR) vs. Tempo*

Excerpts	Instrument GMSR vs. Tempo	r^2 Value	*p* Value
All	Drums	0.083	0.339
	Bass/Org. Pedals	0.310	0.095
	Guitar/Organ	0.263	0.088
Funk	Drums	0.375	0.272
	Bass/Org. Pedals	0.444	0.536
	Guitar/Organ	0.596	0.126
Jazz-Funk	Drums	0.085	0.484
	Bass/Org. Pedals	0.353	0.159
	Guitar/Organ	0.663	0.026

***Table 7.3** - Correlation results of Inter-Instrument Global Mean Swing Ratio (GMSR)*

Excerpts	Instrument vs. Instrument GMSR	*r2* Value	*p* Value
All	Guitar/Organ - Drums	0.578	0.003
	Guitar/Organ - Bass/Org. Pedals	0.584	0.002
	Bass/Org. Pedals - Drums	0.465	0.010
Funk	Guitar - Drums	0.946	0.005
	Guitar/Organ - Bass	0.946	0.005
	Bass - Drums	0.876	0.019
Jazz-Funk	Guitar/Organ - Drums	0.287	0.171
	Guitar/Organ - Bass/Org. Pedals	0.806	0.006
	Bass/Org. Pedals - Drums	0.465	0.010

***Table 7.4** – Correlation results of Absolute Duration of Sixteenth Pairs' Second Note vs. Tempo (excluding outliers)*

Excerpts	Absolute Duration of 16th Pairs' 2nd Note vs. Tempo	*r2* Value	*p* Value
All	Drums	0.727	<0.001
	Bass/Org. Pedals	0.442	0.036
	Guitar/Organ	0.037	0.756
Funk	Drums	0.044	0.735
	Bass/Org. Pedals	0.409	0.558
	Guitar/Organ	0.037	0.756
Jazz-Funk	Drums	0.909	0.000
	Bass/Org. Pedals	0.514	0.070
	Guitar/Organ	0.757	0.011

Table 7.5 *– Pearson's correlation tests results for Absolute Duration of Second Note vs. Tempo (including outlier values)*

Excerpts	Absolute Duration of 2nd Note (ms) v. tempo	r^2 Value	*p* Value
All	Drums	0.727	<0.001
	Bass/Org. Pedals	0.442	0.036
	Guitar/Organ	0.037	0.756
Funk	Drums	0.044	0.735
	Bass/Org. Pedals	0.409	0.558
	Guitar/Organ	0.037	0.756
Jazz-Funk	Drums	0.909	<0.001
	Bass/Org. Pedals	0.514	0.070
	Guitar/Organ	0.757	0.011

Table 7.6 *- Pearson's correlation tests results for Absolute Duration of Second Note vs. Tempo (excluding outlier values)*

Category	Absolute Duration of 2nd Note (ms) v. tempo	r^2 Value	*p* Value
All	Drums	0.942	<0.001
	Bass/Org. Pedals	0.837	0.001
	Guitar/Organ	0.791	0.001
Funk	Drums	0.854	0.076
	Bass/Org. Pedals	N/A	N/A
	Guitar/Organ	0.447	0.332
Jazz-Funk	Drums	0.953	<0.001
	Bass/Org. Pedals	0.956	0.001
	Guitar/Organ	0.880	0.006

7.2 Excerpt Transcriptions

The transcriptions below are simplifications of rhythm sections' patterns. Not all excerpts' formal sections (e.g. A + B sections) which were measured in each track are included here. Only the most exemplary sections from which most sixteenth note measurements were taken from are presented.

7.2.1 Funk Excerpts

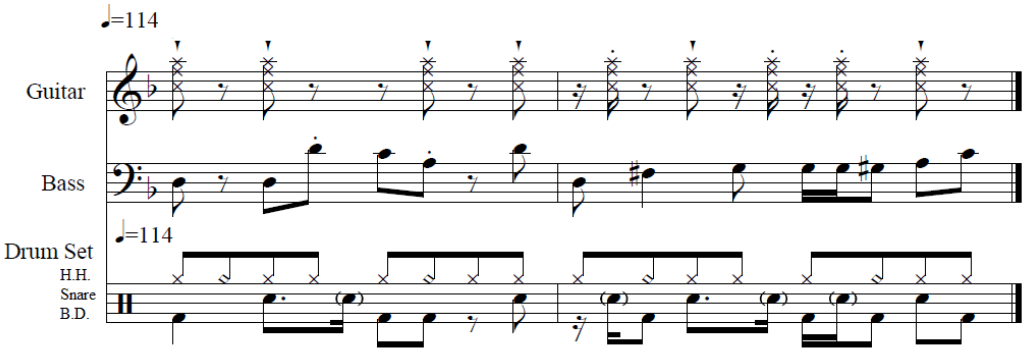

Fig. 7.1 *– Basic unit of A-section in Cold Sweat, (James Brown)*

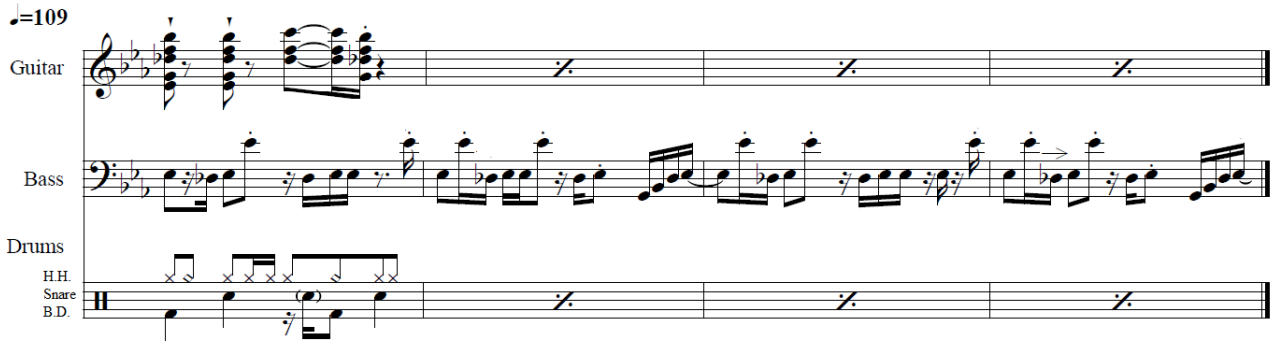

Fig. 7.2 *–4 x basic units of A-section in Get Up (I Feel Like Being a Sex Machine)*

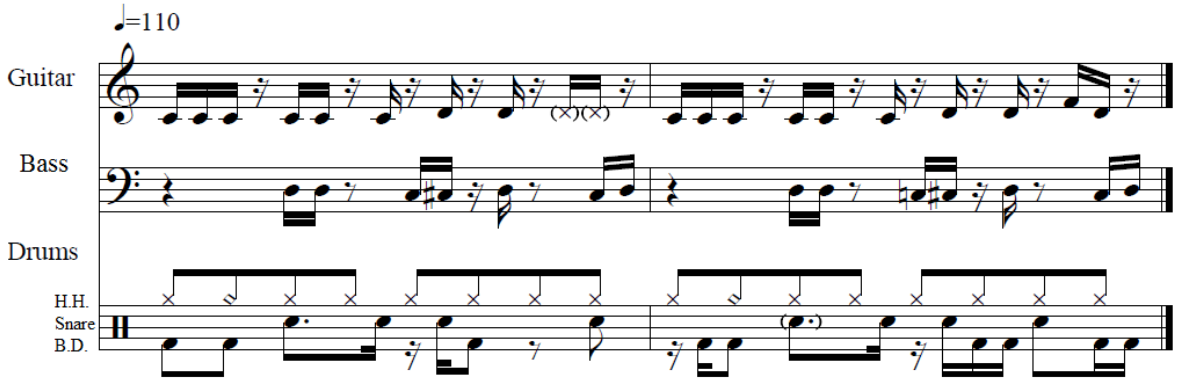

Fig. 7.3 *– Basic unit in A-section of Give It Up Or Turnit a Loose (James Brown)*

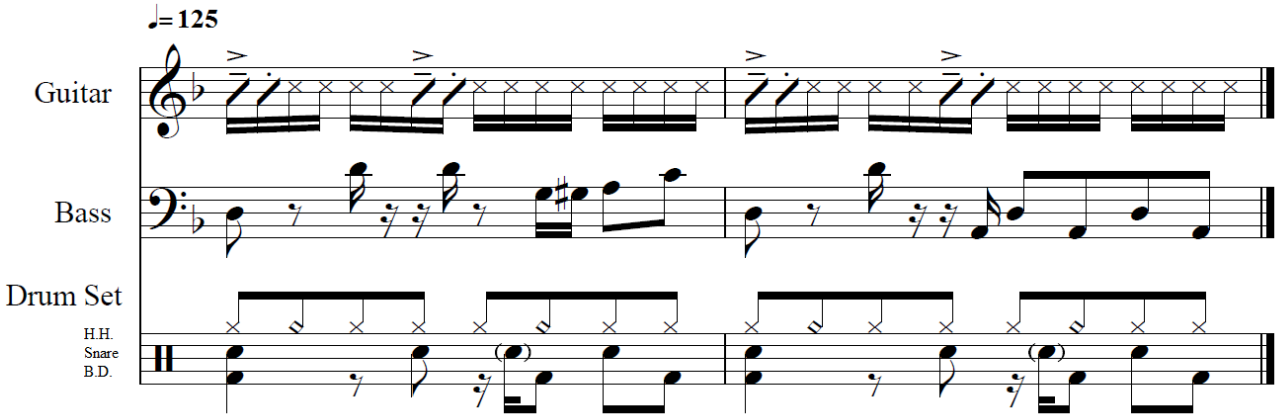

Fig. 7.4 *– Basic unit of A section in Superbad (James Brown)*

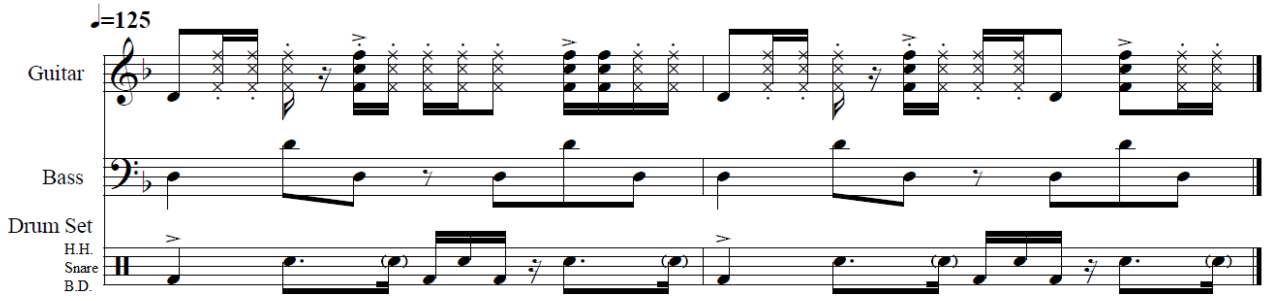

Fig. 7.5 *– Basic unit of A section of There Was a Time (James Brown)*

7.2.2 Jazz-Funk Excerpts

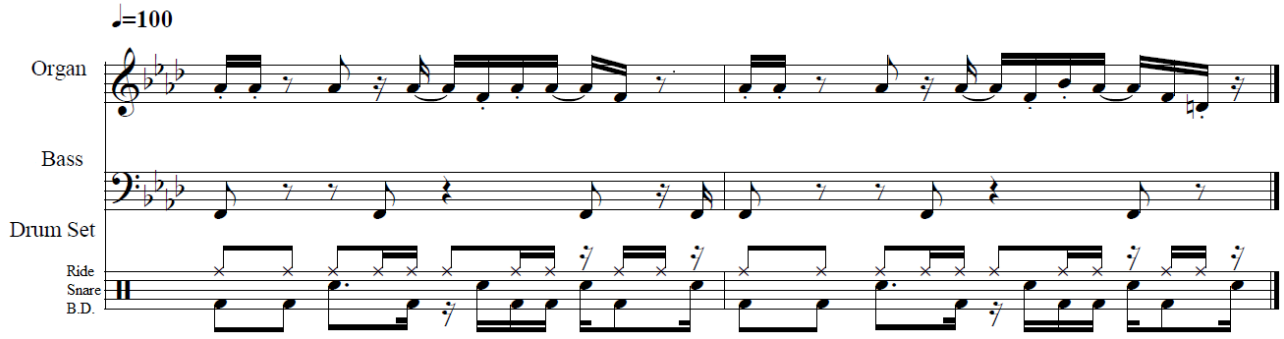

Fig. 7.6 *– Basic unit of A-section in Ain't It Funky (Grant Green)*

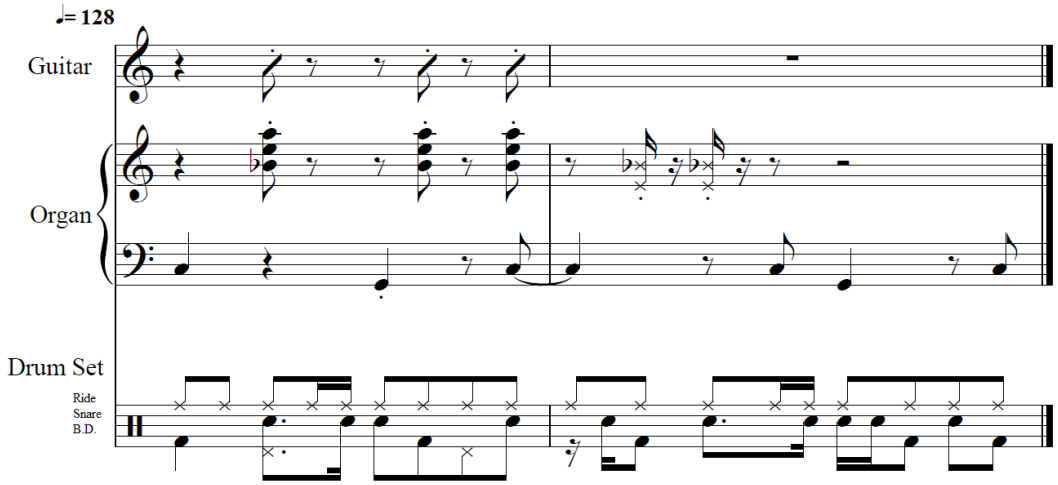

Fig. 7.7 *– Basic unit of A-section in Alligator Boogaloo (Lou Donaldson)*

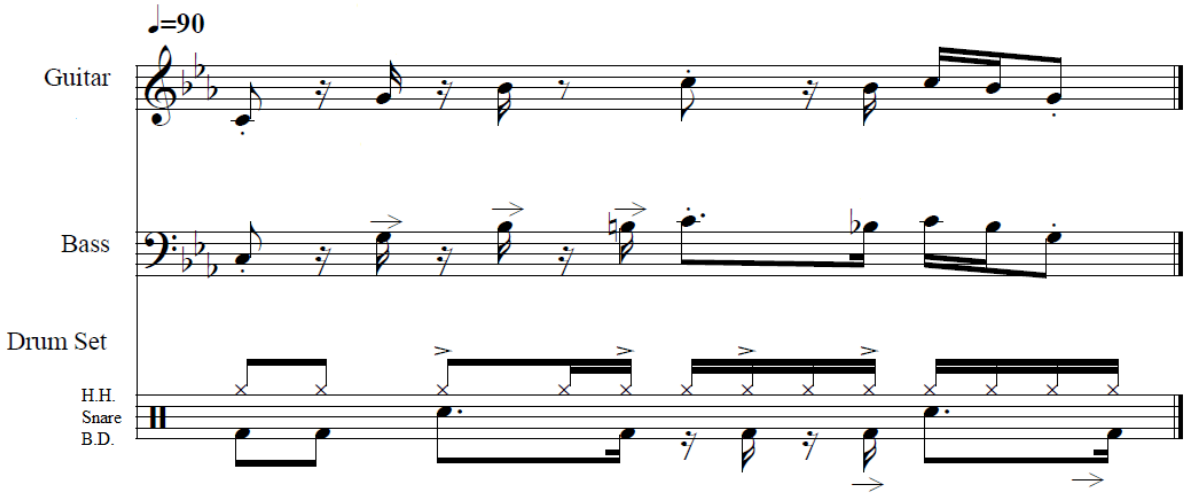

Fig. 7.8 *– Basic unit of A-section in Blue Juice (Jimmy McGriff)*

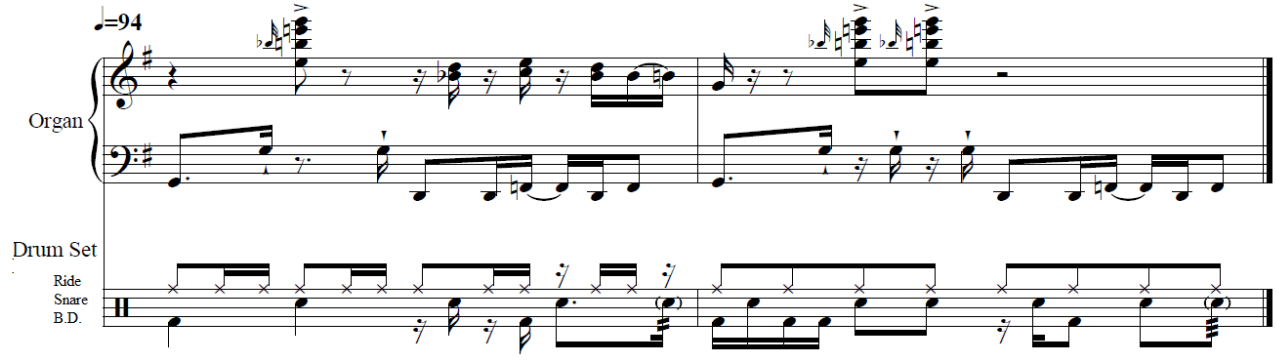

Fig. 7.9 *– Basic unit in sax solo segment (Rusty Bryant)*

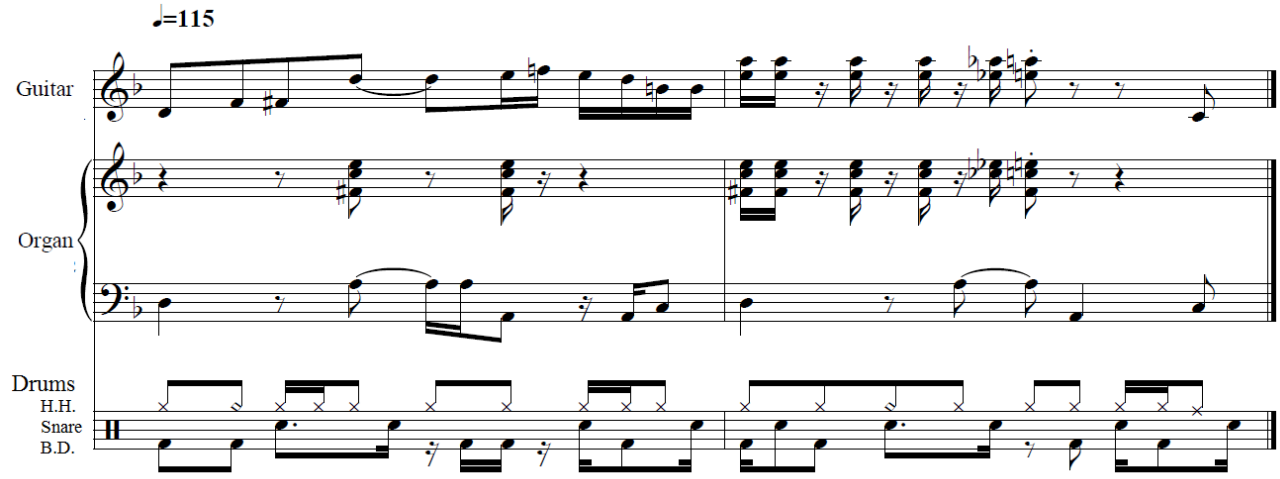

Fig. 7.10 *– Basic unit in A-section in I Can't Stand It (Lonnie Smith)*

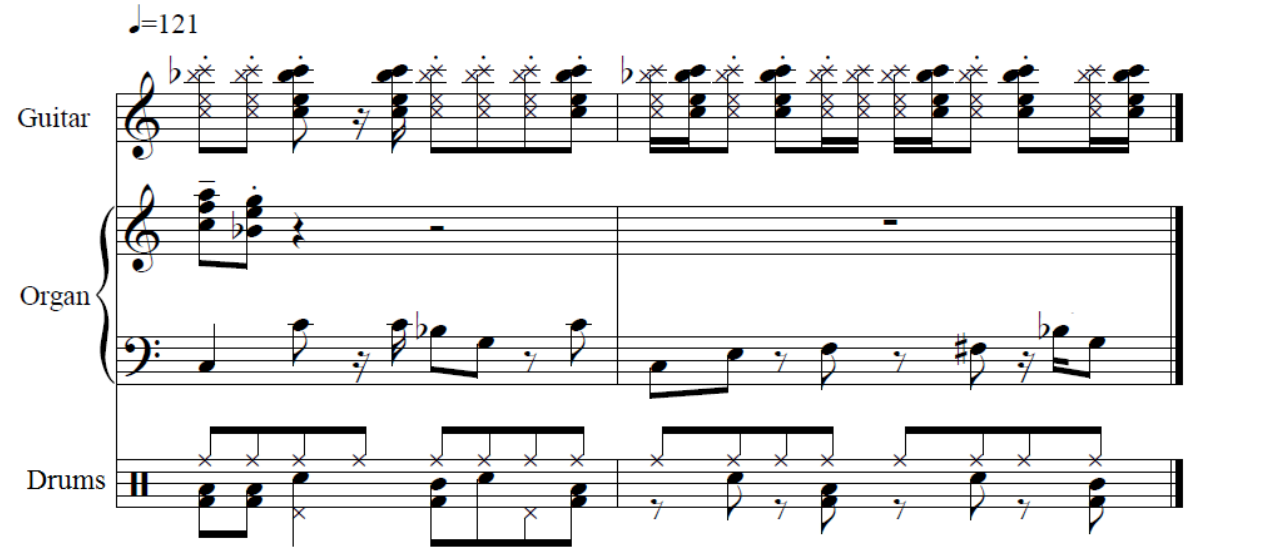

Fig. 7.11 *- Basic unit in A-section of Orange Peel (Reuben Wilson)*

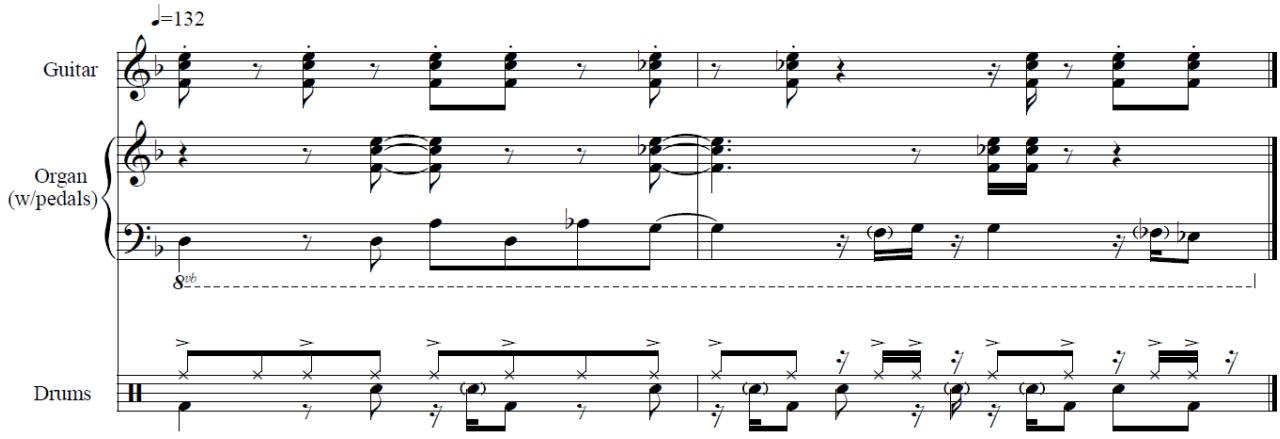

Fig. 7.12 *– Basic unit in A section of Son of Ice Bag (Lonnie Smith)*

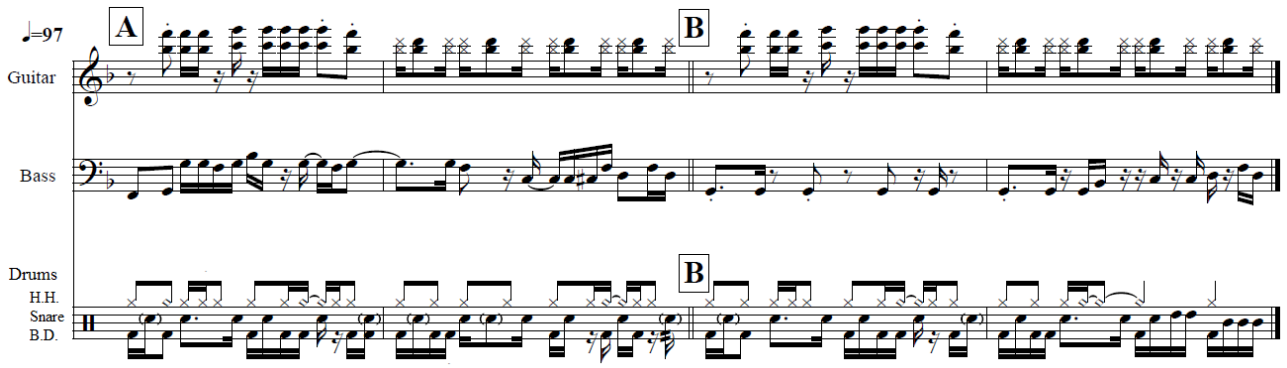

Fig. 7.13 – Basic unit in two different portions (A and B) of vibraphone solo section of The Emperor (Donald Byrd)