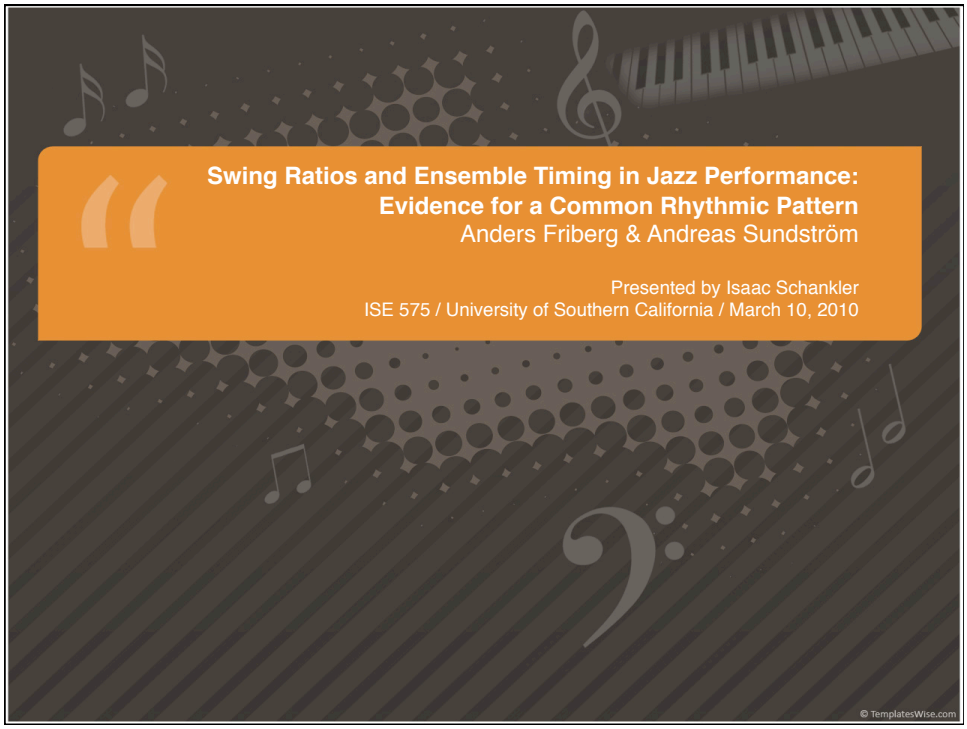


Introduction

- Swing eighth note pattern as essential part of jazz rhythm
- Investigate jazz timing via:
  - Swing ratios
  - Ensemble timing
- Well-known recordings of established musicians (as opposed to lab recordings)
  - Drummer's swing ratio
  - Soloist's swing ratio and ensemble timing
  - Pedagogical applications

Drummers' Swing Ratio: Recordings

- Measurements focused on ride cymbal
- Four drummers from four different groups:
  - Influential/well-known
  - Distinguishable playing styles
  - Live recordings (except the first example)

TABLE 1
Recordings Used in the Analysis

Recording	Year	Drums	Solo	Bass
John Coltrane *Aebersold Play-a-long* JA1244D	1983	Adam Nussbaum	NA	Ron Carter
Miles Davis *My Funny Valentine* CBS, CT9106	1964	Tony Williams	Miles Davis, trumpet George Coleman, tenor sax Herbie Hancock, piano	Ron Carter
Miles Davis *"Four" & More* CBS, CT9253	1964	Tony Williams	As above	Ron Carter
Keith Jarrett, Gary Peacock, & Jack DeJohnette *The Cure* ECM 1440	1990	Jack DeJohnette	Keith Jarrett, piano	Gary Peacock
Keith Jarrett, Gary Peacock, & Jack DeJohnette *Standards in Norway* ECM 1542	1989	Jack DeJohnette	Keith Jarrett, piano	Gary Peacock
Wynton Marsalis Quartet *Live At Blues Alley* CBS 4611091	1986	Jeff Watts	Wynton Marsalis, trumpet Marcus Roberts, piano	Robert Leslie Hurst III

Only the soloists included in the selected excerpts are listed.

Drummers' Swing Ratio: Method

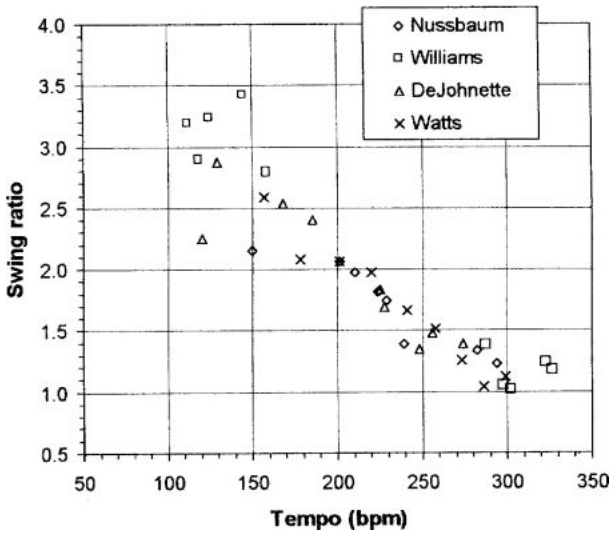
- Songs in "swing style" with section of ride cymbal used
- Most ballads disregarded
- Excerpts from beginning of first solo (when ride cymbal started to play swing eighths)
- Four excerpts selected from one song on each recording to see if swing ratios differed within same song
- Length ranged from 10 s to 26 s

Drummers' Swing Ratio: Method

- Timing of cymbal strokes measured on spectrogram
- To estimate tempo:
  - Measured duration from one stroke to another stroke 10-16 beats ahead
  - Tempo measurement repeated from different positions in difficult-to-measure excerpts (max span +/-3 bpm)
- To estimate swing ratio:
  - only patterns of two consecutive eighth notes followed by a stroke on the beat were used
  - For each excerpt, 10 such pairs were collected
  - Swing ratio calculated as onset-to-onset duration of first note divided by onset-to-onset duration of second note
  - Estimated measurement precision +/-3 ms
  - When strokes very close together (~20 ms) loudest one was chosen

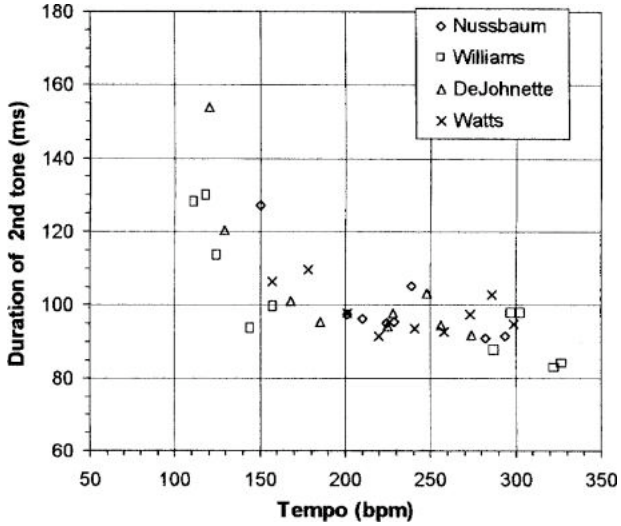
Drummers' Swing Ratio: Results

- Linear decrease in mean swing ratio with increase in tempo
- Between 1 and 3.5
- 2:1 "triple feel" around 200 bpm



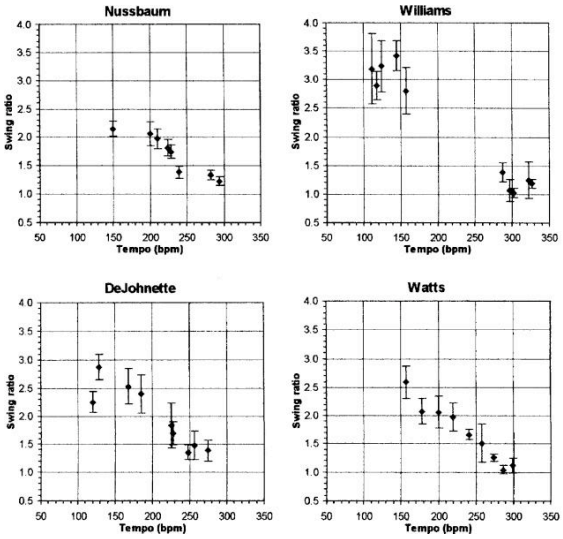
Drummers' Swing Ratio: Results

- For medium to fast tempi, absolute duration of second note about constant at ~100 ms
- Limit of note duration?

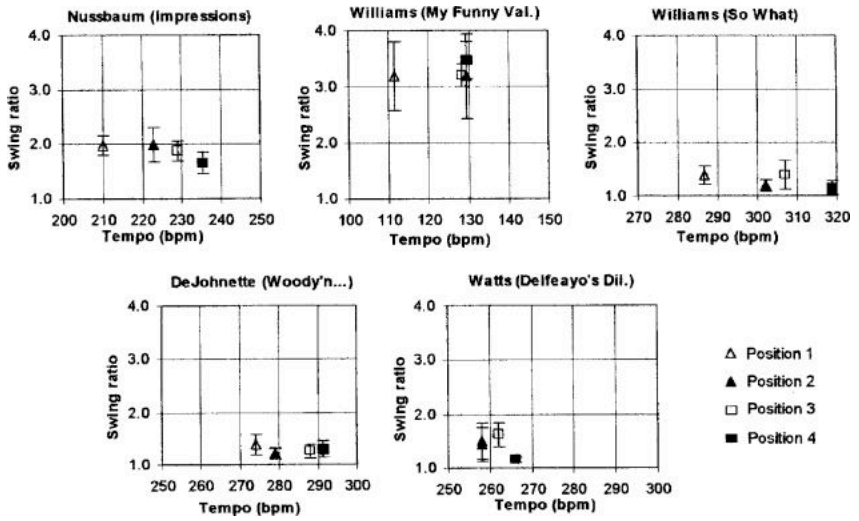


Drummers' Swing Ratio: Results

- Drummers display consistent swing ratio despite differences in style
- Most differences found in tempi less than 200 bpm
- Two-way analysis of covariance confirmed significance of influence of tempo and influence of drummer, but not interaction of tempo and drummer
- Williams had greatest standard deviation, Nussbaum least



Drummers' Swing Ratio: Variations Within Songs



Ensemble Timing and Soloist Swing Ratio: Method

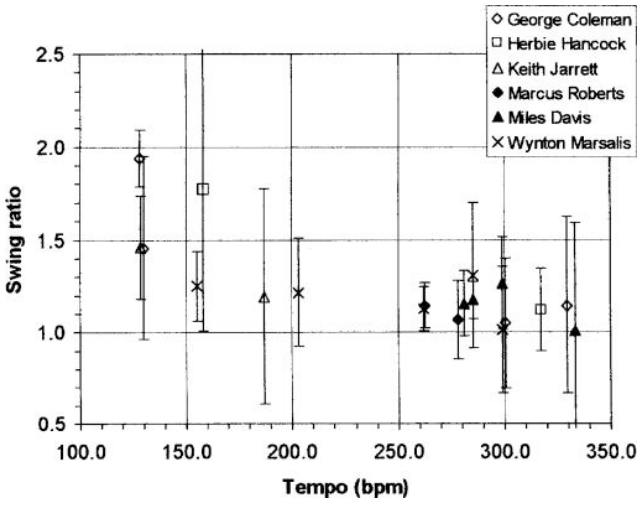
- 21 of original 40 excerpts could be used
- Excerpts selected in which soloist played consecutive eighth notes
- No drum or bass solos
- Cymbal onsets, solo onsets, and bass onsets measured
- Swing ratios computed from two consecutive interonset intervals
- Beat and offbeat delays between drummer and soloist/ bass estimated from all simultaneous tones in same sequence

Ensemble Timing and Soloist Swing Ratio: Method

- Excerpts containing fewer than 3 estimated points omitted
  - For swing ratio:
    - Two excerpts omitted
    - Mean number of estimated points = 11
  - For beat measurements:
    - Minimum of estimated points = 5
    - Mean of estimated points = 18
  - For offbeat measurements:
    - Four excerpts omitted
    - Mean of estimated points = 6
  - Delay of bass could be estimated in 13 excerpts
  - Lowest number of estimated points = 5
  - Mean number of estimated points = 19

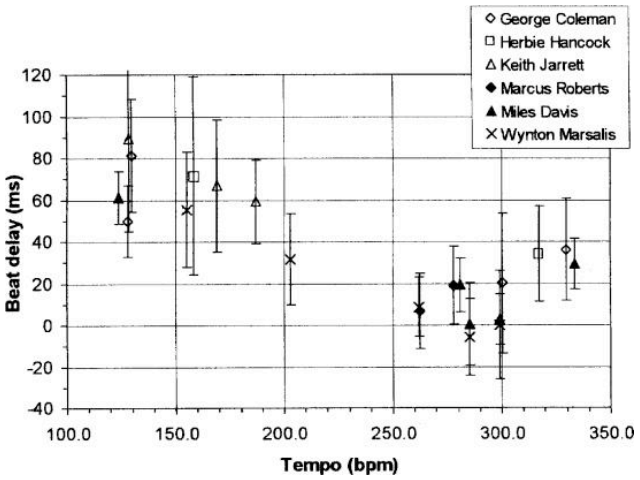
Ensemble Timing and Soloist Swing Ratio: Results

- For medium tempi, soloists' ratios lower than drummers'
- All soloists' mean ratios between 1 and 2
- Not enough data to make meaningful conclusions about each musician



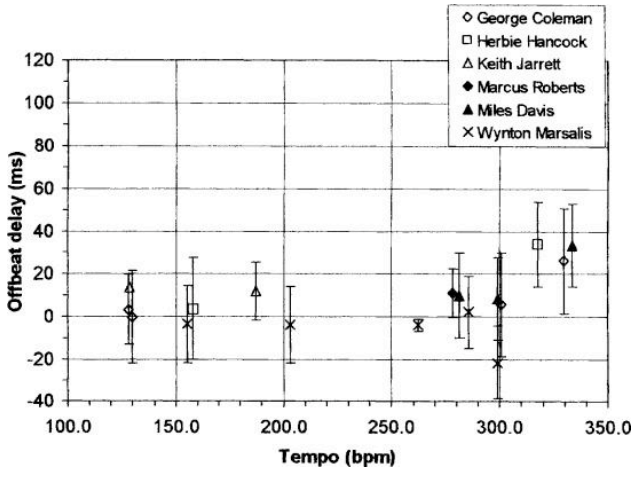
Ensemble Timing and Soloist Swing Ratio: Beat Delay

- For downbeats, soloists tend to play after the ride cymbal
- Out of 21 excerpts, only 1 exception (negative mean value)



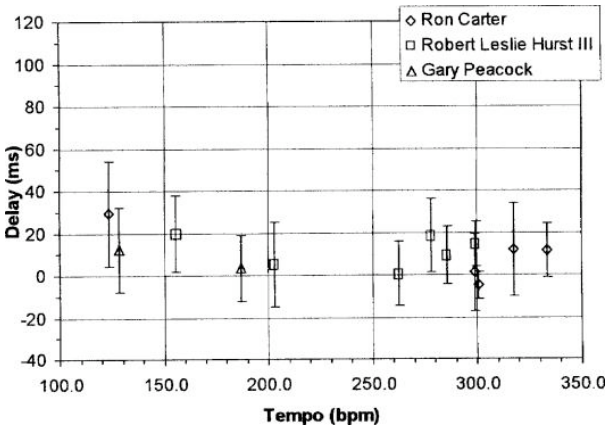
Ensemble Timing and Soloist Swing Ratio: Offbeat Delay

- For off beats, soloists tend to sync with the ride cymbal
- Standard deviations smaller than for downbeats
- Placement of downbeats expressive, offbeats rigid?
- Delay range smaller for offbeats because interonset interval (100 ms) too small to react before downbeats?



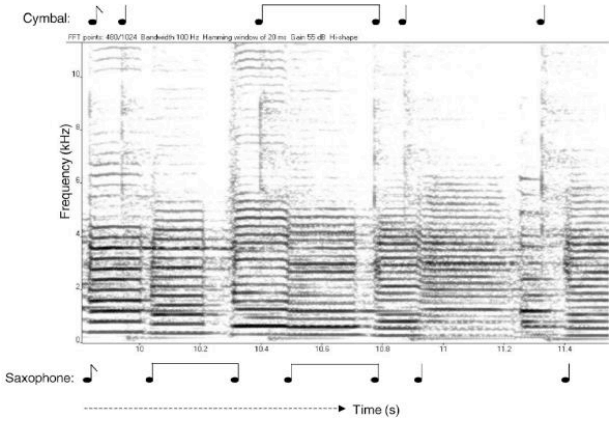
Ensemble Timing and Soloist Swing Ratio: Bass Delay

- Bass tends to be slightly delayed relative to ride cymbal
- Slightly longer delays at slower tempi?



Pedagogical Applications

- Few attempts made to define exercises for jazz timing, despite its importance
- Simplifications (e.g. “triplet feel”) can lead to undesirable results
- Can a student practice delaying downbeats and synchronizing offbeats?
- Real-time spectral analysis as an aid?



Discussion and Conclusions

- In classical music, melody often precedes accompaniment: why?
  - First notes are perceptually emphasized
- In jazz, melody follows accompaniment on downbeats and syncs with accompaniment on offbeats: why?
  - Soloist easily recognized (spectral differences, mic placement)
  - “Laid-back” or “behind the beat” impression, yet still good sync?
  - Playing styles obtained by changing timing pattern instead of playing whole pattern early or late?
- How perceptible are deviations in swing ratio?
  - Just noticeable difference (JND) estimated between 10% (at 120 bpm) and 20% (at 300 bpm), but for a reliable estimation, it would have to be measured at several tempi and swing ratios