

# A STUDY OF TIMING IN TWO LOUIS ARMSTRONG SOLOS

BY: COLLIER & COLLIER

A PRESENTATION BY  
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## PROBLEM

- HOW TO QUANTIFY THE NATURE OF SWING IN JAZZ MUSIC
- WHAT PERFORMER DO WE STUDY
- WHAT ELEMENTS OF SWING TO ANALYZE

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## OUTLINE

- **WHAT IS SWING MUSIC**
- WHY LOUIS AMSTRONG
- WHY POTATO HEAD AND CHOP SUEY
- EXPERIMENTAL PROCEDURE
- METHODS OF ANALYSIS
- SWING RATIO
- COMPARISON WITH CLASSICAL TRUMPET

## JAZZ SWING MUSIC

- FORM OF JAZZ MUSIC
- RHYTHM SECTION - DOUBLE BASS AND DRUMS
- LEAD SECTION - BRASS INSTRUMENTS
- MEDIUM TO FAST TEMPO
- LILTING SWING TIME RHYTHM

## DEFINITION OF A SWING

- PROGRESSIVE RETARDATION & ACCELERATION
- SUBTLE DRAGGING OR PUSHING OF A BEAT
- REMAINS IN THE VICINITY OF THE BEAT BUT FLOATS ON EITHER SIDE
- SPORADIC SKIDDING OF AN AUTOMOBILE ON A WET PAVEMENT
- DELAY OR ANTICIPATE NOTES AROUND THE BEAT

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## WHY LOUIS AMSTRONG

- SWING EIGHTH
- ([http://en.wikipedia.org/wiki/Swung\\_note](http://en.wikipedia.org/wiki/Swung_note))
  - UNEQUAL ACCENTS OF THE FIRST AND SECOND BEAT OF EACH MEASURE
  - THEY ARE PAIRED. FIRST WEIGHTED AT THE EXPENSE OF THE SECOND
  - WEIGHTED BY VOLUME, SHARPNESS OF ATTACK, DURATION
- INSPIRATION & MODEL

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## SELECTION OF PIECES

- CORNET CHOP SUEY & POTATO HEAD BLUES
- ([http://www.smithsonianjazz.org/class/armstrong/la/la\\_potatohead.mp3](http://www.smithsonianjazz.org/class/armstrong/la/la_potatohead.mp3))
- (<http://www.youtube.com/watch?v=-xy6nxea2A>)
- REASON FOR SELECTION
  - STOP-TIME : DEVICE WHERE SOME MEMBERS PLAYED ONLY ON CERTAIN SELECTED BEATS. EASY TO ISOLATE SOLOIST.
  - MOST ADMIRED PERFORMANCES
  - MODEL FOR THOUSANDS OF PLAYERS

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## EXPERIMENTAL PROCEDURE

- INPUT PIECE
- ONSET MEASUREMENTS
- DISCREPENCY SCORES
- OUTPUT SWING RATIO

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## METHODS

- CHOP SUEY AND POTATO HEAD
- ANALYSIS USING COOL EDIT 96
- PIECES DIGITIZED - 44 KHz 16 BIT CD QUALITY
- TRUNCATED AT ONSET OF FIRST NOTE TO PROVIDE ZERO REFERENCE

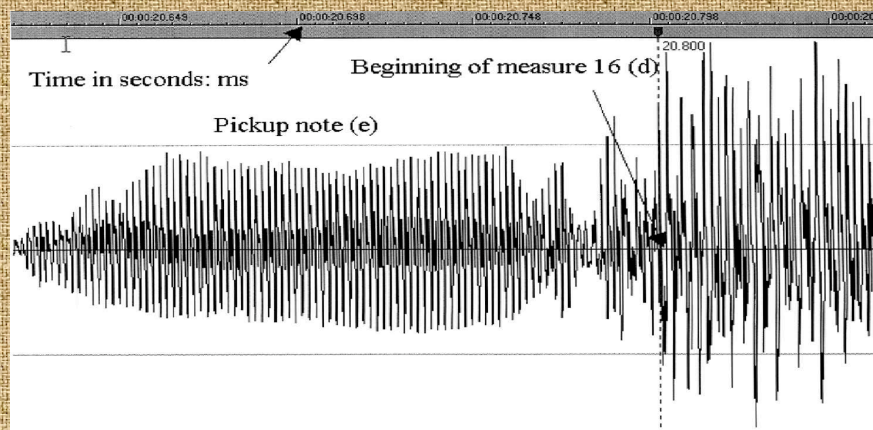
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## ONSET MEASUREMENT

- ARBITRARINESS DUE TO GRADUAL INCREASE IN THE ONSET WAVEFORM
- CONSERVATIVE CODER- ESTIMATES COMPARED WITH THE AUTHOR
- FIGURE SHOWS DIFFICULTY IN OBTAINING ONSET TIMES- SWEEPING PLAYBACK OF A SEGMENT IS SHOWN

## CHOP SUEY WAVEFORM – ONSET TIME



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## METHODS OF ANALYSIS

- CONVERT ONSET TIMES TO DEPENDANT MEASURE- FIRST EVENT IN EACH MEASURE OCCURRED AT TIME ZERO
- BAND ATTACK OR AMSTRONGS ATTACKS USED AS EVENT
- IF NO ATTACK – INTERPOLATE BETWEEN ANALOGOUS EIGHTHS IN THE CURRENT AND PRECEDING MEASUREMENTS

## DISCREPANCY SCORES

- DIFFERENCE BETWEEN EACH NOTES ONSET TIME RELATIVE TO THE BEGINNING OF THE BAR, AND ITS EXPECTED TIME HAD AMSTRONG BEEN PLAYING METRONOMIC EIGHTH NOTES.
- EXPECTED NOTE ONSETS CALCULATED BY MULTIPLYING THE BAR DURATION TIMES  $1/8, 2/8, 3/8 \dots$
- $DISCREPANCY = ACTUAL - EXPECTED$

## PROPORTIONAL DISCREPANCY

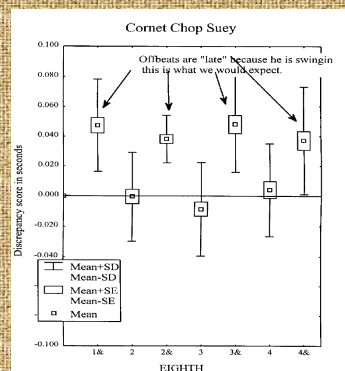
- MOST APPROPRIATE METRIC FOR ANALYSIS
- GIVEN BY :  $(DISCREPANCY / BAR DURATION)$
- TAKES INTO ACCOUNT BAR-TO-BAR TEMPO FLUCTUATIONS
- NEGATIVE SCORE- EARLY RELATIVE TO METRONOMIC TIMING.
- POSITIVE SCORES INDICATE DELAY

## TRANSCRIPTION OF POTATO HEAD BLUES

- LARGE NUMBERS – BAR DURATION (sec)
- SMALLER NUMBERS – DISCREPANCIES (ms)
- STARS- BAND ATTACK- ONCE EVERY TWO MEASURES – “STOP-TIME”
- FIRST NOTES OF EACH MEASURE ARE UNMARKED – REFERENCE POINTS

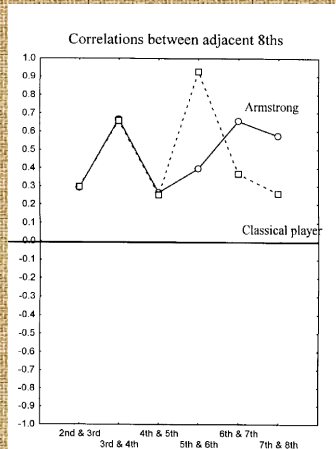
## AHEAD OF THE BEAT/BEHIND THE BEAT ANALYSIS

- WHERE DOES AMSTRONG PLACE HIS DOWNBEATS ?



- MEAN & DISTRIBUTION OF DISCREPANCIES FOR BOTH DOWNBEATS AND OFF-BEATS.
- HIS BEATS WERE NOT DIFFERENT FROM THE BAND
- DOWNBEATS 2,3,4 DID NOT DIFFER SIGNIFICANTLY FROM 0 AND AMONG THEMSELVES

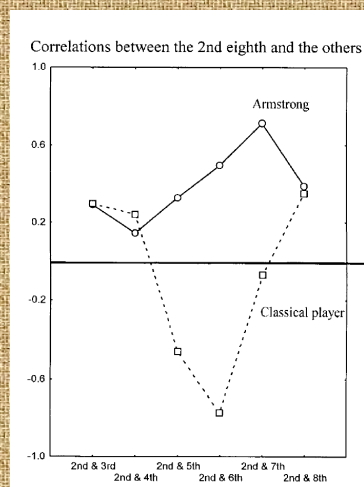
## AUTOCORRELATION ANALYSIS OF CHOP SUEY



- CORRELATION BETWEEN ADJACENT EIGHTH NOTES.
- 2<sup>nd</sup> & 3<sup>rd</sup>, 3<sup>rd</sup> & 4<sup>th</sup> ...
- AMSTRONG AND THE CLASSICAL PLAYER
- SUB-SERIES CORRELATIONS- VECTORS DON'T OVERLAP LIKE AUTOCORRELATION
- STANDARD DEVIATION (DR) AND COVARIANCE(NR) CALCULATED FROM AVAILABLE NOTES

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- CORRELATION BETWEEN THE SECOND EIGHTH NOTE AND EACH OF THE REMAINING EIGHTH NOTES

### OBSERVATIONS

- GENERAL POSITIVE CORRELATION TREND FROM THE TWO GRAPHS
- HE DISPLAYED SHORT REGIONS OF DISCREPANCY SCORES
- BEHIND AND AHEAD NOTES TEND TO COME IN PATCHES
- NO INTERPRETATION FOR THE PATCHES

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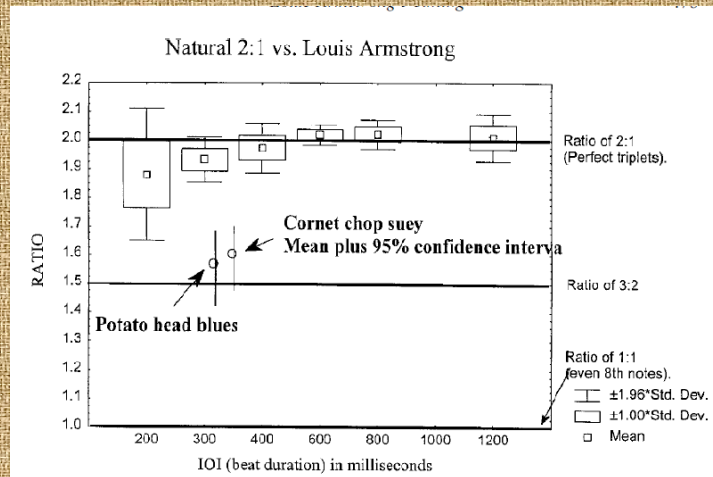
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## SWING RATIO

- NOT MUCH DIFFERENCE BETWEEN STOP-TIME AND PLAYING CASES
- NULL HYPOTHESES
  - EVEN EIGHTH NOTES AT FAST TEMPO DUE TO TECHNICAL DIFFICULTY
  - HYPOTHESIZE THAT THE SWING RATIO IS NOTHING MORE THAN A SIMPLE NATURAL 2:1 RATIO

## SWING RATIO COMPARISON GRAPH



## REJECTING THE NULL HYPOTHESES

- CHOP SUEY-72% OF PAIRS OF SWING EIGHTHS HAVE FIRST NOTE LONGER THAN THE SECOND
- POTATO HEAD-95% OF THE TIME THE FIRST NOTE IS LONGER THAN THE SECOND
- SWING RATIOS ARE NOT FIXED BY 2:1. IT IS CLOSER TO 3:2 FOR THE TWO PIECES.
- SWING RATIO DOES NOT DEPEND SYSTEMATICALLY ON MUSICAL FACTORS.

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## EXPERIMENT 2- CLASSICAL TRUMPET PLAYER

- MARY HASTINGS-CLASSICAL PLAYER-NO JAZZ EXPERIENCE-PLAYED FROM THE SCORE-STRAIGHT PERFORMANCE
- SAME METHOD OF ANALYSIS AS PREVIOUS EXPERIMENT

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