

# The Role of Idiomaticism and Affordances in Bebop Improvisation

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## ABSTRACT

Improvisational styles rely on an implicit knowledge of various musical gesture, ranging from not-to-note transitions to those that exist on a more structural level. These prototypical musical gesture are linked and transformed over time, and are intertwined with instrumental idiomaticisms, which are derived from the structure of the instrument and the amount of effort required by certain musical gestures (see Huron and Berec, 2009; Gjerdingen, 2009). This study explores how these stylistic and physical constraints interact in bebop improvisation—specifically the transcribed solos of Charlie Parker, Dizzy Gillespie, and Clifford Brown. The aims of this study are fourfold. Firstly, we aim to replicate the finding of Huron and Berec (2009), which found that keys chosen for compositions correspond with the most idiomatic transitions. Secondly, we hypothesize that an “arc of idiomaticism” occurs throughout the course of an improvisation. Thirdly this study examines the most common structural schemata in the corpus, looking for the most common occurrences of temporally regular gesture, which were then categorized to create a schema-derived taxonomy. Lastly, this study examines the interaction of the idiomatic gestures with the most common improvisatory schemata in the corpus. Examining relationships between stylistic usage and affordant idiomaticism. This study used data taken from trumpets and saxophonists to provide a metric for the relative difficulty of not-to-note transitions, taken from the corpus. A web-based study then asked self-identified trumpeters and saxophonists to describe the relative difficulty of certain note-to-note transitions. A difficulty metric was then attached to each note-to-note transition in a corpus of bebop improvisations encoded in \*kern format (Huron, 1995). This study suggests that use of improvisational corpora can serve as a novel medium to further explore the relationship between stylistic and physical constraints.

## I. INTRODUCTION

Theories of jazz improvisation often fall into two broad camps: ones of schema-derived gestures (“licks”, motives, etc.), or ones of motor associations with sound that facilitate the creation of such gestures. Not only are these two not mutually exclusive, but they are also quite interdependent. For example, a schema might first become widely used because of physical, motor gestures that allow for the pattern to be played easily by a wide range of musicians. The current study examines the interaction between these two improvisational aspects in bebop improvisation, but specifically focuses on the role of instrumental affordances.

Owens (1974) examined the role of patterns in bebop (specifically Charlie Parker improvisations), drawing links to the tonal structure of the piece, but also creating a network between these gestures throughout the entire Charlie Parker output. Johnson-Laird (2002) argues that these patterns are stylistic constraints governed by the underlying harmonies. He constructs a computational model of improvisations that

focuses primarily on the immediate transitions of notes and their relationship to an immediate harmony, forgoing large scale patterns. (2002). Pressing (1988) suggests that it is a more momentary event, in which the production of an idea is influenced by those immediately preceding it. Pressing also speaks of the “underlying formal scheme” of a piece, as well as the motives, arpeggios, and patterns needed to perform it (Pressing, 1984). Norgaard’s (2014) work on Charlie Parker extends the idea of note-to-note transition probabilities and included specific intervallic patterns performed by bebop improvisers. Specifically, Norgaard found that a vast majority of Parker’s improvisatory gestures begin a four-interval pattern, and that a limited set of interval and rhythmic relations make up a large part of his improvisations.

The current study focuses primarily on this aspect of note-to-note transitions, and investigates the role of instrumental affordances on stylistic choices. We first aim to extend some of the work on the physical constraints of an instrument by attempting to obtain difficulty ratings of note-to-note transitions in a different, yet comparable way (see Huron and Berec, 2009). We similarly present the findings of a study in which participants were asked how idiomatic specific note-to-note transitions were on their instrument, and then fit those ratings onto encoded corpora of jazz improvisations, namely Charlie Parker, Dizzy Gillespie, and Clifford Brown. A more robust rating system would then hopefully be able to be applied to any sort of corpora to obtain difficulty and further explore instrumental idiomaticisms. The following paper is divided into two sections following our four main hypothesis listed below. We hypothesize that:

- Keys chosen for composition and improvisation will correspond to the most idiomatic or least difficult keys.
- Given the difficulty of transition ratings, we will find an “arc of idiomaticism” where improvisers will make musical choices more specific to their instrument throughout a solo?

Future work will use this data to address the questions pertaining to more top-down structures, such as schemata, and will specifically address the following hypotheses:

- Given melodic, bass, and harmonic information we will begin to recognize common schematic patterns used in improvised solos of Charlie Parker and Clifford Brown.
- Stylistic choices made between soloist given certain schemata will be objectively more difficult when mapped on to affordant ratings of other instruments.

## II. CORPORA USED

This paper also introduces two new corpora for the computational musicology community. The first is the Charlie Parker Omnibook (Aebersold and Slone, 1978). While not

entirely new as a melodic corpus, having been used in previous studies before, this corpus contains solos (N=59) with added in harmonic information and metadata (such as recording information, and information on the sidemen) in \*kern format for processing using David Huron's Humdrum toolkit (Huron, 1995). We also introduce solos (N=57) from the Complete Transcriptions of Clifford Brown by Marc Lewis (1991). While equal in number of solos compared to the Omnibook, this Brown corpus contains almost twice as much data and additionally contains realized chord progressions. We also use some transcriptions of Dizzy Gillespie (N=12). All corpus material is available for use upon request.

### III. IDIOMATICISM AND KEY CHOICE

Our first task was to replicate the findings from Huron and Berc (2009) that showed that compositional choices were found to be more idiomatic for the instrument if the composer of the piece were themselves considered a composer for that instrument. Our study is not an exact replication of this in that we rely on improvisatory material as opposed to composed music. Below we outline how this data was obtained. These ratings are then used throughout the rest of the studies.

#### A. Obtaining Ratings of Idiomaticism

A web study was set up to collect data on perceived difficulty of note-to-note transitions by instrument from advanced players. Respondents who identified as advanced level players on alto saxophone (N=11), tenor saxophone (N=7) and trumpet (N=15) made ratings on random subsets of a collection of notes presented on the treble clef from a pool of every note transition from G3 to G5. *A priori* we decided to only use natural, sharp, and flat notes, excluding all double sharps and flats since this study was not based on orthography. Participants were presented with the musical notation and asked to make a rating on the keyboard using a 7 point Likert scale with 1 indicating "One of the Easiest Intervals to Play" and 7 indicating "One of the Most Difficult Intervals to Play". Participants also had the option to respond with a 0 to indicate that an interval was unplayable on their instrument since the pool of notes used was not specific to either instruments range and will serve as the basis for collecting future data on note-to-note transitions on other instruments.

Ratings from each instrument were collected, pooled, averaged, and then mapped on to each corpus. Solos from each corpus were additionally transposed up and down 11 half steps with the appropriate difficulty ratings being mapped on to the new note transitions. Solos were transposed both up and down to further explore effects of range.

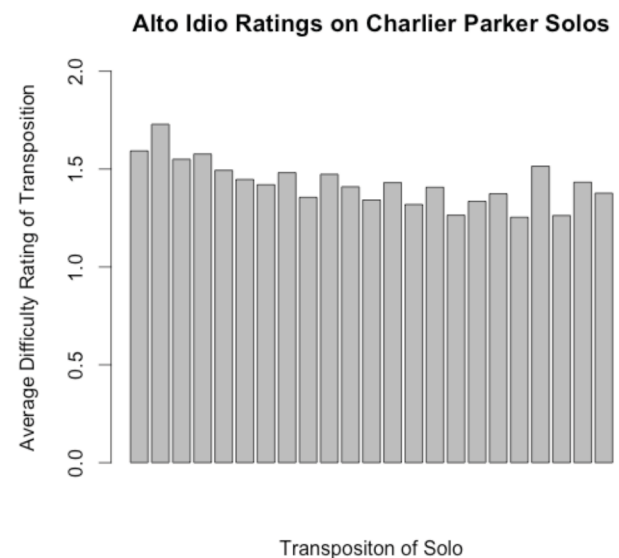
#### B. Improvisation and Key Choice

First, we examined the works of a trumpeter (much like the Huron and Berc study), performing a t-test between the original key Clifford Brown played his solos and two half steps up and down comparing average idiomaticism ratings of the original key with its transpositions. On average solos played at Brown's original transposition scored an average lower with a rating of 1.31 compared to the 1.39 rating from a half step above ( $p < .001$ ). Interestingly, no statistically significant difference was found in the idiomaticism ratings when transposed a half step below. This could be due to the fact that

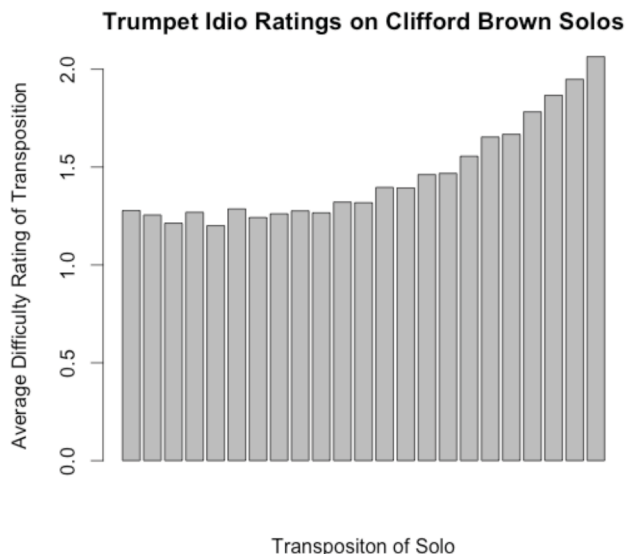
the study took all pieces and averaged them together, or we simply need more musicians to rate the pieces to provide a more accurate model.

We decided to also examine the relationship between the instruments transposed pitch and its concert pitch. We performed a t-test between the original key Charlie Parker played his solos and two half steps up and down comparing average idiomaticism ratings of the original key with its transpositions. On average original key solos scored an idiomaticism ratings of 1.25 with a half step above scoring on average 1.48 ( $p < .001$ ) and a half step below scoring 1.47 ( $p < .001$ ). Significance was still maintained after using the Bonferroni correction for multiple t-tests.

Additionally difficulty ratings for each instrument were mapped onto each corpus to explore the effect of difficult ratings on transpositions. The first three charts below (Figures 1-2) show how ratings from the three instruments map on to the Charlie Parker Corpus. Although individual differences between keys are not overwhelming, there is a clear effect of range.



**Figure 1.** Difficulty ratings mapped onto Charlie Parker Solos. The middle of the graph is the untransposed rating, with transpositions up twelve semitones to the right, and down twelve semitones to the left.



**Figure 2.** Trumpet Ratings Mapped to Clifford Brown Corpus. Difficulty ratings mapped onto Charlie Parker Solos. The middle of the graph is the untransposed rating, with transpositions up twelve semitones to the right, and down twelve semitones to the left.

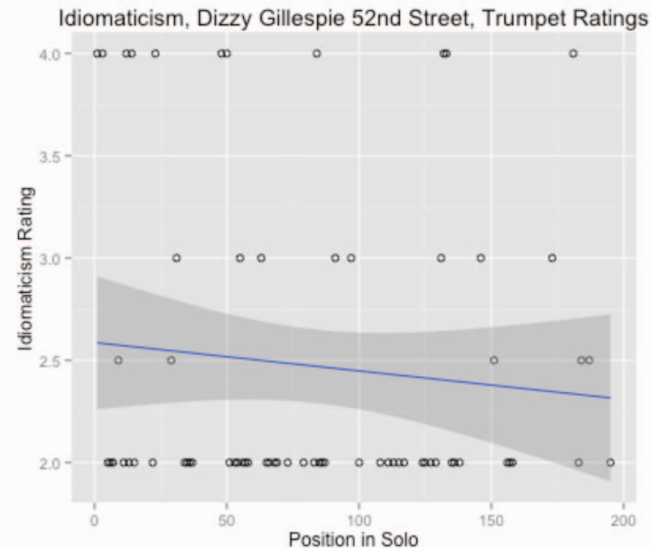
### C. Discussion

This first study yielded interesting results, but we would ideally have more data from subjects. As it currently stands, simply due to the sheer number of intervals presented to participants, very few intervals were rated by more than 3-4 players. We would ideally have enough data for each note transition to have a more reliable estimate. While the results support the notion that transpositions on the saxophone were less idiomatic when you moved them away from the original key, we had difficulties with the trumpet data. There is obviously an effect of instrumental range (especially for the trumpet); as things are mapped to the higher register difficulty ratings increase, an effect that we do observe with the saxophone difficulty ratings (see Figure 2).

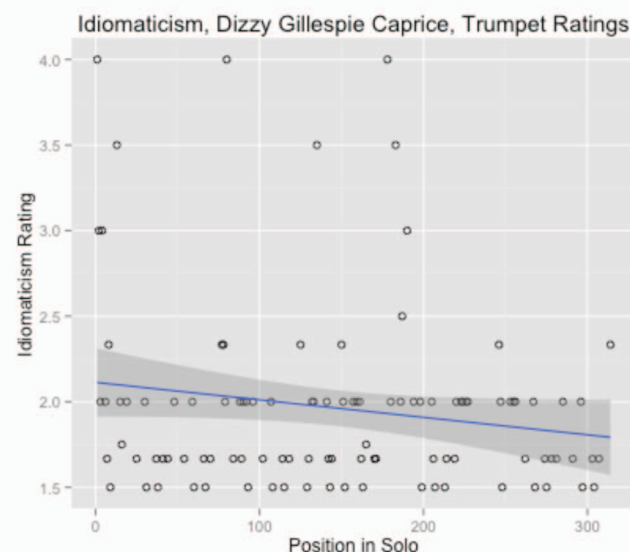
## IV. ARC OF IDIOMATICSIMS

Our second hypothesis argued that there would be a trajectory of idiomaticism throughout an improvisation: pieces might exhibit an arc, or perhaps simply a linear relationship over the course of an improvisation. We figured that soloists would play more difficult intervals as the solo would go on, perhaps as a way of generating more interest during repeated choruses. In order to look at this, we took solos and examined their placement over the course of the improvisation with the Humdrum Toolkit (Huron, 1995). As jazz improvisations (like most music) consists mainly of step motion we discarded the ratings that were a “level 1”, as we were concerned with getting a floor effect.

As can be seen from Figure 3 (the solo to “52<sup>nd</sup> Street”), we originally had reason to believe that a linear relationship might be present, although the trend was not significant. Interestingly, a decreasing (but similarly non-significant) trend was found over the course of Gillespie’s “Caprice” solo.

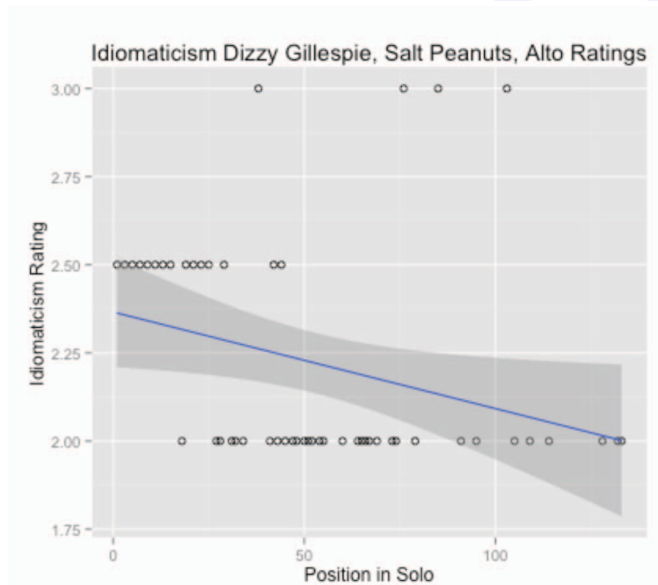


**Figure 3.** Difficulty ratings of note-to-note transitions (in the original key) over the course of Gillespie’s “52<sup>nd</sup> Street” solo.



**Figure 4.** Difficulty ratings of note-to-note transitions (in the original key) over the course of Gillespie’s “Caprice” solo.

Surprisingly, the ratings do often exhibit a downward trend (contrary to our hypothesis) when mapped onto a mismatching instrument. For example, in Figure 5, we can see the difficulty ratings decreasing over the course of Gillespie’s “Salt Peanuts” solo. This effect is not replicated throughout the corpus, and it’s difficult to find any such consistent effects.



**Figure 5.** Alto saxophone difficulty ratings of note-to-note transitions (in the original key) mapped onto Gillespie's trumpet solo over the course of "Salt Peanuts".

## V. CONCLUSION

Our current study attempted to demonstrate the role of note-to-note affordances on improvisation. While there does seem to be some effect on key-choice, it is not always replicable when going up a half step when looking at trumpet ratings, a result that came as a surprise to us (including the jazz trumpeter in the group). Our second hypothesis regarding a trend in difficulty ratings over the course of an improvisation showed no significant trends in either direction, and we therefore failed to reject our null hypothesis. Future work will gather more data on these note-to-note transitions, in the hopes of having more reliable ratings, and will expand to look at the interactions between difficulty ratings, entropy measures, and rhythmic aspects, as well as the top-down effects of harmony, improvisational interaction, and schema.

## ACKNOWLEDGMENT

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