The Modeling and Perception of Melodic Similarity in Jazz Improvisation

David John Baker and Daniel Shanahan
Louisiana State University

Background

- Fair amount of research exists looking at symbolic musical similarity
  - Computational or algorithmic approaches tend to look at music as abstract mathematical phenomenon
  - Behavioral research takes musical context and listener background into effect
- After establishing both mathematical models of similarity and contextual models, finding parallels is next logical step
- We were also interested in expanding the stimuli selection to move outside of the Western Art/Folk song repertoire much of the prior work has been based in.

Paradigms have been created that require participants make decisions about similarity that mitigate effects of context, but these paradigms have not been tested comprehensively (Allan, 2007)

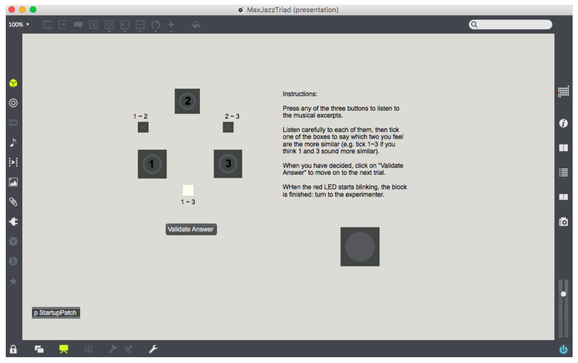

Figure 1: Experimental Interface

Hypotheses and Power Calculations

- H_1: Participants will identify at each 3AFC in accordance with the the algorithm or distance measure used
- H_2 Participants will be in accordance with the algorithm or distance measure used across all trials
- Large Effect Size: $\omega = .5$, $df = 2$, $\alpha = 0.05$, $\beta = .8$, need 39 participants
- Medium Effect Size: $\omega = .25$, $df = 2$, $\alpha = 0.05$, $\beta = .8$, need 155 participants

Materials

Participant Demographics

- N = 44, 13 Female
  ($\bar{X} = 20.16, SD = 1.45, R = 18 - 24$)
- Undergraduate Music Students at LSU

Stimuli and Design

- Based on earlier research investigating similarity based on context (Farrugia, 2016)
- Normalized for Key (C), tempo, timbre, randomly selected from LSU Bebop Database
- Three blocks of randomized set of stimuli
- N=4533 Observations

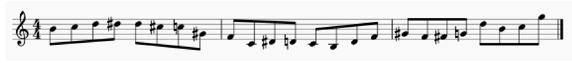

Figure 2: Warming Up on a Riff, Segment 37

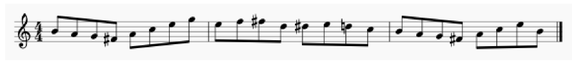

Figure 3: Passport, Segment 9

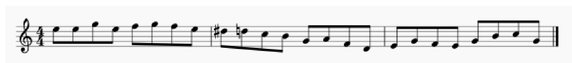

Figure 4: Chasing the Bird, Segment 14

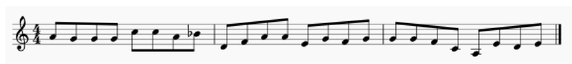

Figure 5: Cardboard, Segment 6

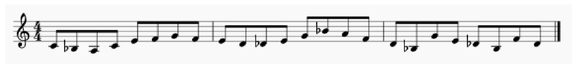

Figure 6: Bird Gets the Worm, Segment 11

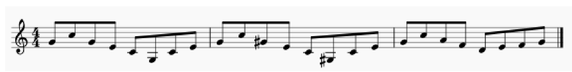

Figure 7: Anthropology, Segment 14

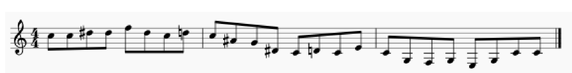

Figure 8: Another Hairdo, Segment 11

Results

Include trials where participants' decision was same as Damereu-Levenshtein Edit Distance.

H_2 **Analysis**
Block 1: $\chi^2(2, 35) = .25, p > 0.05$
Block 2: $\chi^2(2, 35) = .03, p > 0.05$
Block 3: $\chi^2(2, 35) = .71, p > 0.05$

Post Hoc H_1

Return to H_1 and come up with ideas about what could be contributing to judgments of similarity.

Table 1: Subject Agreement

	Set	Oddball Stimuli	Trials Agreed
1	437	4	96
2	714	4	86
3	675	5	85
4	134	4	77
5	674	4	76
6	367	6	75
7	136	6	73
.	.	.	.
29	642	2	24
30	265	2	24
31	573	7	20
32	352	2	19
33	563	6	18
34	531	1	14
35	245	5	11

- Appears that stimuli 4 consistently appears in agreements between Edit Distance and human judgments
- Comparing stimuli, opening contour seems to play an important role in judgments of similarity

Conclusion and Future Directions

- Data suggests that edit distance should not be used as a stand in for any human judgments of similarity
- While we were not intending to use edit distance as a model for human perception, we are still interested in finding measures that will mirror how humans form similarity judgments.
- Participant dataset created
- Investigate effect of individual differences on similarity judgments
- Ad Hoc Investigation of human and computer similarity
- Begin to explore other Computational Measures of Similarity
  - Earth Mover's Distance
  - Point Set/Compression Algorithms
  - Contour Models
- Use more exploratory, as opposed to NHST methods to explore relationships between data to generate further hypotheses

Table 2: Contour Correlation Comparisons

	Set	S 1-2 r	S 1-3 r	S 2-3 r	Human	Correl
1	124	-0.105	0.158	0.361	1	1
2	134	0.492	0.158	0.589	4	1
3	136	0.492	0.057	0.039	6	6
4	137	0.492	0.281	0.787	7	1
5	156	-0.394	0.057	-0.585	1	5
6	243	0.361	0.428	0.589	3	2
7	245	0.361	0.393	0.080	5	5
.	.	.	.	.	.	.
29	645	-0.089	-0.585	0.080	5	6
30	674	-0.071	-0.089	0.656	4	6
31	675	-0.071	-0.585	-0.090	5	5
32	714	0.281	0.656	0.158	4	1
33	716	0.281	-0.071	0.057	6	6
34	725	0.207	-0.090	0.393	7	7
35	754	-0.090	0.656	0.080	4	5