APPENDIX B

Pilot Study

In this appendix I briefly describe the pilot study mentioned in Chapter 9. I found the results interesting, although I didn't end up continuing this line of research in Musicat. With Steve Larson's help I designed an experiment in which 14 subjects — mostly undergraduate or graduate students from the Jacobs School of Music at Indiana University, with the others having significant musical training — were asked to listen to two notes and to sing an improvised melody beginning with those two notes. There were 25 possible note pairs used as cues in the experiment: all 12 possible intervals, from the unison to the octave, were possible, and furthermore, each interval (with exception of the unison) could be presented in either the ascending or descending direction. For example, a participant might hear the two notes C–F (ascending) or D–C (descending) and then sing a melody that started with those two notes. For each participant, all 25 cues were transposed to lie in a comfortable vocal range (based on self-identification of bass, tenor, alto, or soprano voice type), and these transposed cues were presented in random order. Each participant performed this entire procedure two times, resulting in 50 improvised responses per participant. My research assistant Elton Joe transcribed the sung responses into standard music notation, and included the key and meter that were implied by the performance.

Participants were asked to sing the same improvised melody twice in a row, which helped solidify the key and meter, facilitating the transcription task. Also see (Carlsen, 1981) for a very similar but larger-scale experiment with 91 participants and 15 repetitions of the task for each person; Carlsen's data analysis had a different focus than mine (he looked only at pitch expectation and tonal function, not at meter); otherwise, his results would have been sufficient.

My hypothesis was that the choice of initial interval would influence both the key (with respect to the first note) and the meter of the resulting improvised melody. For instance, I expected that given an ascending step as the cue, such as C–D, most people would hear the C as the tonic, and generate a response in C major. Furthermore, I expected people to sing responses in 4/4 meter the majority of the time for this cue. However, given an initial ascending perfect fourth such as D-G as the cue, I expected people to hear the G as the tonic, and also to hear the G as a downbeat, with the D as a pickup note.

I examined several features in the data resulting from the experiment:

- Effect of the initial interval on the inferred key;
- Effect of the initial interval on the inferred meter and metric placement of the interval;
- Percentage of time that the first note is heard as the tonic; and
- Tonal distribution of the first several response notes.

Indeed, there were interesting effects (but because this was only a pilot study with a very small number of participants, I make no claims about its significance). As in Carlsen's study, the initial intervals had both tonal and rhythmic implications.

Meter is usually based on 2 or 4 beats per measure (duple meter) or 3 beats per measure (triple meter). (For simplicity in this analysis, I also treat compound meters such as

6/8 as members of the category "triple meter".) In the experiment, 79% of the responses were in duple meter; 21% were in triple meter. This is similar to the results of other studies that show a default bias for Western tonal-music listeners to expect duple meter. However, for the initial interval of an ascending half step (such as B–C, ascending), 32% of the responses were in triple meter — an 11% increase. Similarly, the ascending perfect fourth and descending perfect fifth each resulted in triple meter for 26% of the responses — a 5% increase over the baseline. For all three of these cases, the second note of the interval is often perceived as the tonic. For example in the ascending B-C interval, the B is often heard as the leading tone to a tonic C.

Why did these intervals increase the tendency for people to generate responses in triple meter? The data suggests a simple explanation. In these cases where the second note was heard as the tonic, it was more likely than normal to be heard as a downbeat (and hence the first note heard as an upbeat). Specifically, consider the following select group of seven interval types that lead to an increased proportion of responses with an upbeat:

Descending: perfect fifth

Ascending: half-step, perfect fourth, tritone, minor sixth, major sixth, minor seventh

In this group of intervals, the first note was heard as an upbeat 22% of the time, in contrast to the other 18 interval types, which were heard as starting with an upbeat only 10% of the time. In terms of tonal function, the first note was heard as something other than the tonic a whopping 84% of the time, in contrast to 57% for intervals not in this group. Therefore, it seems clear that for these intervals in particular, the first note doesn't usually sound like a tonic. Often, then, the second note is heard as the tonic. This leads the listener to hear the first note as an upbeat more of the time than normal. Finally —here's the point — hearing the first note as an upbeat is positively correlated with hearing the passage in triple meter (given an upbeat hearing of the first note, triple meter responses occur 30% of the time, versus 19% if the first note was heard as a downbeat). This is not too surprising, because upbeats are a common feature of triple-meter melodies. For intervals in our select group, triple meter occurs 29% of the time, versus 17% for non-group intervals.

Looking at the data in general, I find that if an interval is heard both as starting with an upbeat and as starting with a non-tonic note, the response is in triple meter 33% of the time (in contrast to the 21% baseline). The data strongly suggest relationships between the initial interval, inferred tonal function, and inferred meter. This is important because it illustrates how tonal function and meter are inexorably linked. A future version of Musicat that is not given the key and meter *a priori*, but must infer them on its own, will need to account for these complexities.

Rhythmic considerations aside, I also looked at some simple frequency distributions of the tonal function of the first notes of the responses. The first note was heard as the tonic 35% of the time. The second note was heard as the tonic 30% of the time. The third note (chosen by the participant) was the tonic 15% of the time. The following diagram shows the frequency of each tonal function for the first note of each response.

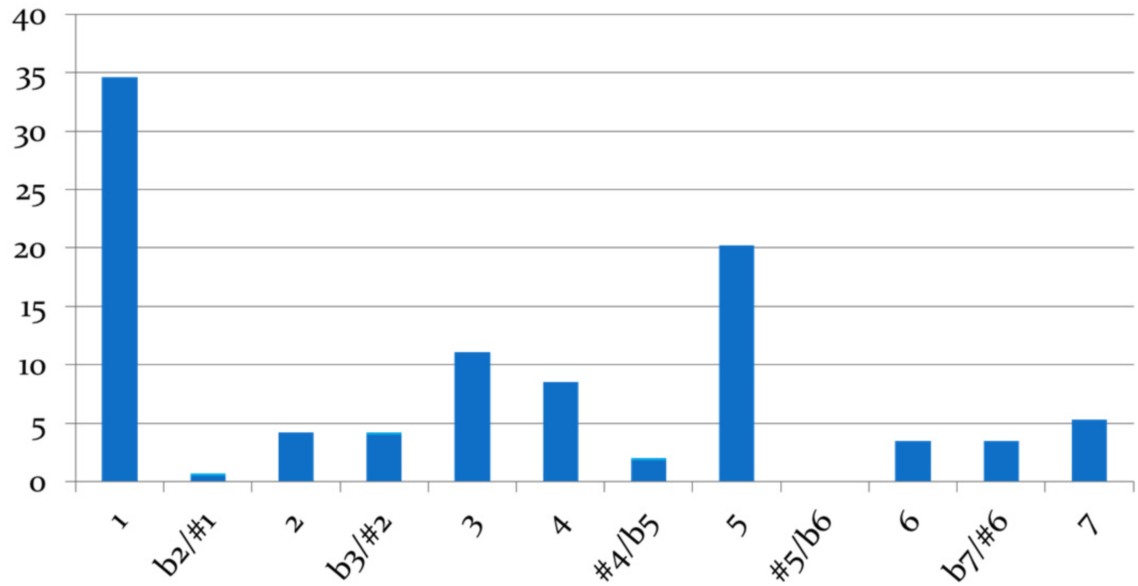

Figure 10.1: Frequency counts of tonal functions for first notes.

The picture in Figure 10.1 is evocative of the Krumhansl and Kessler (1982) key profiles, reproduced in the following figure for both major and minor modes:

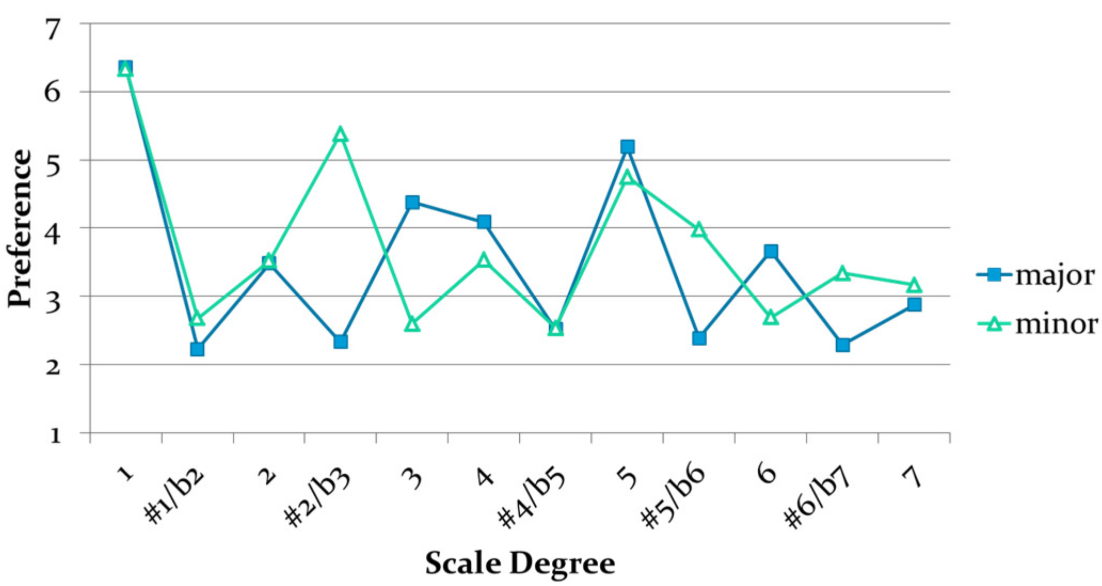

Figure 10.2: Krumhansl and Kessler's key profiles.

I compared my results based on frequency of scale degree in the first notes of responses to the key profiles in Figure 10.2 by generating a single key profile from the Krumhansl and Kessler (1982) data, weighting the major profile by 0.72 and the minor profile by 0.28, corresponding to the rate of major and minor mode responses in my data. Then I scaled the frequencies from Figure 10.1 to match the 1–7 "preference" range. The resulting graph follows:

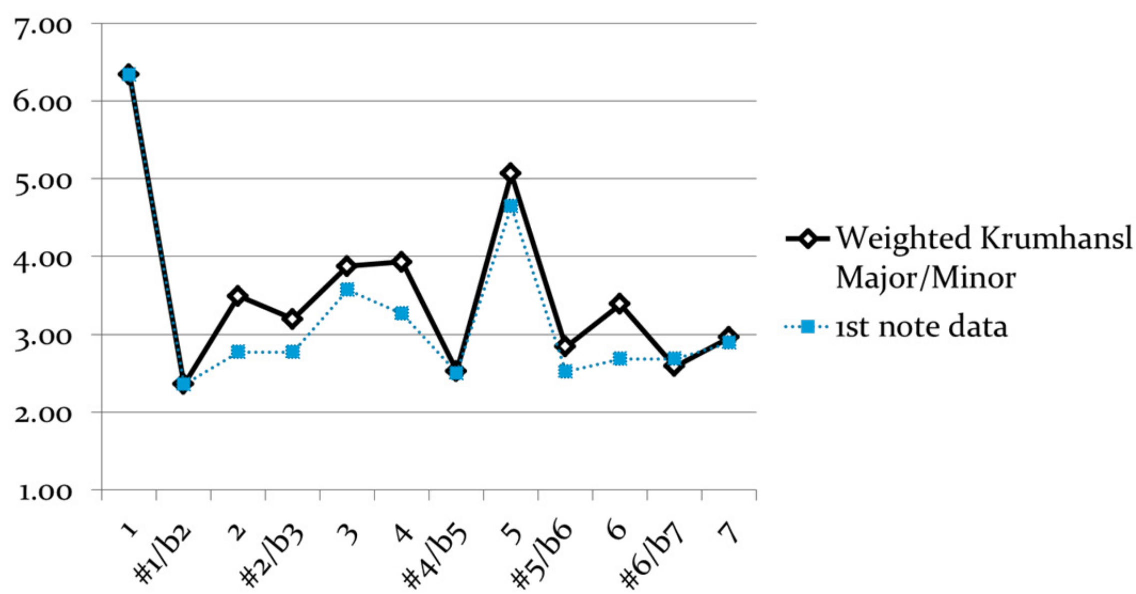

Figure 10.3: Comparison of first note data with weighted Krumhansl and Kessler profiles.

The shapes of the two lines in Figure 10.3 are roughly the same. This is interesting, because whereas the Krumhansl and Kessler profiles are based on preference ratings for scale degrees in a tonal context, my data are based solely on frequency counts of inferred scale degrees for the first note of an improvised melody.

I made a similar graph including results from the second and third notes, respectively (Figure 10.4).

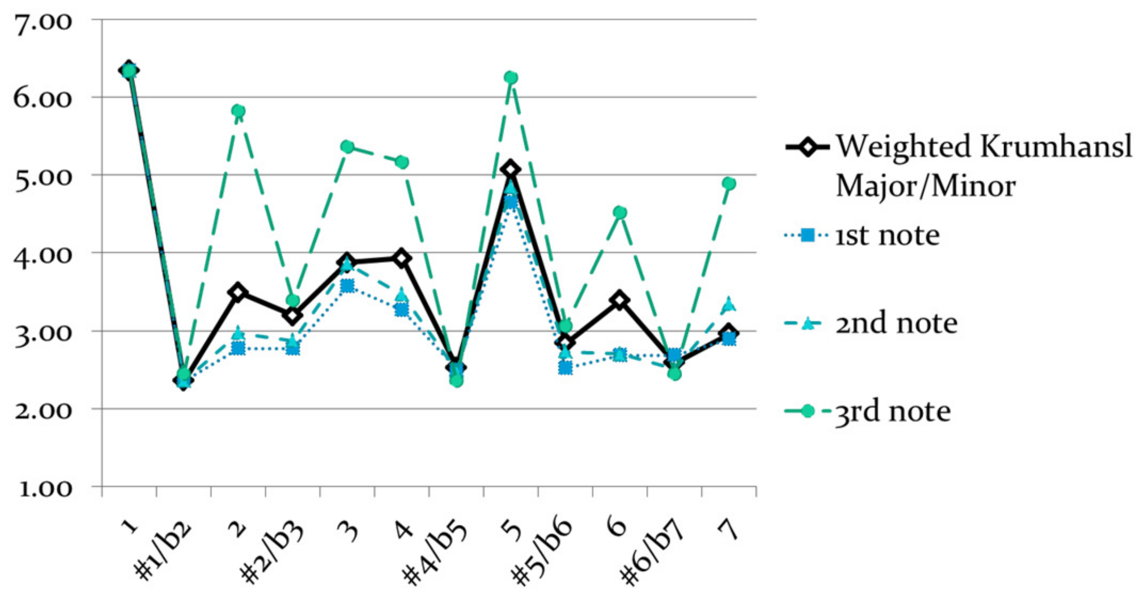

Figure 10.4: More comparisons.