Impact of microtiming deviations upon perceived quality of drum beats

Boris Kuznetsov
Aalborg University CPH
bkuzne18@student.aau.dk

ABSTRACT

The link between the perceived quality of a beat in several aspects (e.g. driving, movement inducing) and deviations in microtiming magnitudes has been examined, especially in relation to humanization algorithms found in Digital Audio Workstations. Experiments with people from a variety of background were conducted and evaluated. The results seem to disagree in certain aspects with some of the related works, opening up possible future work in this field.

1 INTRODUCTION

1.1 Motivation

While extensive research has been conducted in the field of tempo and rhythm perception [6, 8], the impact of microtiming – minute temporal deviations from the musical grid – upon the perceived *quality* of a drum beat have not been discussed as extensively. However, as can be seen in plenty of literature aimed at professional musicians and producers [2, 5], slight variations in microtiming are an area of concern when producing beat-driven music. The following shall present a systematic evaluation to see if such deviations truly impact the way humans perceive beats.

1.2 Related Works

A study presented in the journal Frontiers of Psychology investigated groove ratings in funk and rock music for both music performed by humans, as well as quantized and music with exaggerated microtiming magnitudes [11]. The study found that groove ratings were similar for both quantized and regularly performed music were the same, while decreasing for exaggerated microtiming magnitudes. Notably, [7] found that perceived beat quality increased with decreased microtiming deviations, meaning that fully quantized beats were rated the highest by listeners, thereby being in conflict with the practices of professional music producers. Similarly, [10] found no link between microtiming deviations and groove ratings.

2 EXPERIMENT

2.1 Participants

The experiment was conducted by 12 participants, ranging from the ages of 20 to 28, from the countries USA, Canada, UK, Germany, Norway, Australia, Italy and the Netherlands. Educational backgrounds ranged from having finished high school to currently enrolled in a master's program. The educational backgrounds of all of the participants but one had no connection to music.

2.2 Setup

The experiment was set up using the drum sample library *DrumMica* by Sennheiser [4], playing back MIDI performances of real drummers provided by *Oddgrooves* [3]. Four different types of rock beats were chosen at random from the *Oddgrooves* library and named A, B, C and D respectively. The grooves can be found in the appendix. The beats were then loaded into the Digital Audio Workstation *Cockos Reaper* [1], which provides tools to quantize a MIDI performance, and also to humanize it by applying random variations to the microtiming of the notes. Each listener was asked to listen to each beat four times, i.e. to the original human performance, the same performance but quantized, with 7% humanization applied and with 14% humanization applied. The listeners were not informed about this fact, and the order in which humanized, quantized and original clips occurred was random. The listeners were asked to judge the quality of the beats in several different aspects on a scale for 1 to 10. The questions, taken directly from [9], were as follows:

1. I found the beat to be likable
2. I thought the beat was movement inducing
3. I thought the beat was steady
4. The beat can be described as bouncy
5. The beat can be described as driving

Additionally, age, educational background, country of residence, self-reported musical experience and self-reported amount of beat-driven music listened to have been collected from the participants, but due to time constraints this information was not used in the final evaluation. The experiment was conducted using online forms to be able to cast a wider net of possible participants, the participants were free to re-listen to the clips as much as they pleased, however it was not possible to go back to a previously-listened-to clip. The participants were split up into two groups, one listening to beats A and B, while the other group listened to beats C and D.

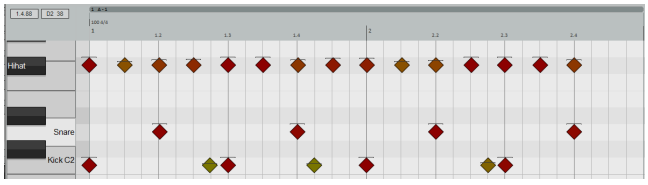

Figure 1: A beat, quantized. Taken from [3]

3 RESULTS

In the following an excerpt of the results will be presented, please find the rest in the appendix. The results are presented as bar plots with standard deviations, such as seen in figure 2. Two types of barplots have been deviced, one presenting the qualities of the beats as bars with the quantization techniques as headings and vice versa.

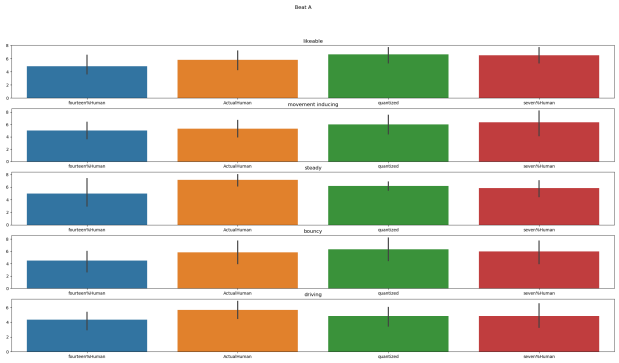

Figure 2: Bar plot for the A beat, sorted by category.

4 Discussion

When examining the results, it could be observed that the results were quite different depending on the type of beat that was being listened to. For example, the actual human performance was described as very ”bouncy” in Beat B, however in Beat A the quantized version scored a lot higher in that category. Similar observations could be made for the other categories as well. The only performance that overall was lowest-in-class was the 14% humanized performance, presumably because at such high humanization percentages the beats started to sound out of time, impeding the quality of the groove. The former observation leads to the speculation that the choice of quantization technique largely depends on the beat used and the desired perceived quality of said beat. The fact that the quantized beat in some cases beats out human performances corroborates the observations made in [7, 10], however some cases seem to contradict it, meaning that more thorough research into the interplay of type of beat and level of quantization or humanization would be of interest.

5 Limitations

Seeing as Cockos, the manufacturer of Reaper, is a private company, there is no extensive insight into the exact humanization technique employed. A more systematic approach would be to use an open humanization algorithm to better account for the parts of the humanization that matter to the perception. Another problem encountered was in the way the online forms worked. Sufficient randomization could not be achieved, as sections had to be manually reshuffled for each iteration. For a larger scale study, it is necessary to employ a form which automatically shuffles the questions. While the backgrounds of the participants have been collected, they haven't been used in the results. In the future, this should be done to see if there are any correlations between perception and qualification or age. Another potential problem is a learning effect. Listeners were asked to listen to the same beat four times in a row, judgments on beats positioned later in the succession could be tainted by preceding beats. The problem persists for the recency and the primacy effect, where either the last or first beat could have been perceived as either better or worse than the rest of the beats. To curb this problem, randomization was employed. However, with only 6 persons per beat, this randomization might have not been sufficient to account for these effects. As mentioned in the discussion, a more systematic approach should have been used when picking beats and evaluating their individual microtiming magnitudes, however this was out of the scope of this paper. Additionally, it would be interesting to investigate varying the microtiming of just certain elements, say the snare or the hi-hats, to see if that, mixed with a fully quantized backbeat, has any positive influence on the perception.

6 Conclusion and Outlook

An illuminating outcome of this study is the apparent link between type of beat and type of quantization or lack thereof. Said link should be investigated more thoroughly in future studies, as it might give important insights to both composers and producers. Future experiments of this sort should be conducted with a more systematic approach especially in regards to beat choice, analysis of the beats and a more thorough analysis of the outcomes, using a wider variety of statistical measures. The combination of MIDI performance data and drum sample libraries however proved very successful, as none of the participants were able to tell they were listening to synthesized drum beats. Another interesting point of attack would be to combine the drum beats with other melodic instruments and see if the musical context possibly alters the perception of the microtiming, especially how it relates to other rhythmic instruments such as the bass guitar.

References

[1] Cockos reaper. `https://www.reaper.fm/`. Accessed: 2019-01-20.

[2] Humanizing beats. `https://www.lynda.com/Ableton-Live-tutorials/Humanizing-beats/133319/143933-4.html`. Accessed: 2019-01-20.

[3] Oddgrooves. `http://oddgrooves.com/`. Accessed: 2019-01-20.

[4] Sennheiser drummic'a. `http://sennheiser.us/drummica.html`. Accessed: 2019-01-20.

[5] Tips for humanizing drum loops and samples. `https://theproaudiofiles.com/video/tips-for-humanizing-drum-loops-and-samples/`. Accessed: 2019-01-20.

[6] D. Deutsch. *The Psychology of Music*. Cognition and Perception. Elsevier Science, 2012.

[7] J. Frhauf, R. Kopiez, and F. Platz. Music on the timing grid: The influence of microtiming on the perceived groove quality of a simple drum pattern performance. *Musicae Scientiae*, 17(2):246–260, 2013. doi: 10.1177/1029864913486793

[8] M. Jones, R. Fay, and A. Popper. *Music Perception*. Springer Handbook of Auditory Research. Springer New York, 2012.

[9] G. Madison and G. Sioros. What musicians do to induce the sensation of groove in simple and complex melodies, and how listeners perceive it. *Frontiers in Psychology*, 5:894, 2014. doi: 10.3389/fpsyg.2014.00894

[10] O. Senn, L. Kilchenmann, T. Bechtold, and F. Hoesl. Groove in drum patterns as a function of both rhythmic properties and listeners attitudes. *PLOS ONE*, 13(6):1–33, 06 2018. doi: 10.1371/journal.pone.0199604

[11] O. Senn, L. Kilchenmann, R. von Georgi, and C. Bullerjahn. The effect of expert performance microtiming on listeners' experience of groove in swing or funk music. *Frontiers in Psychology*, 7:1487, 2016. doi: 10.3389/fpsyg.2016.01487

APPENDIX

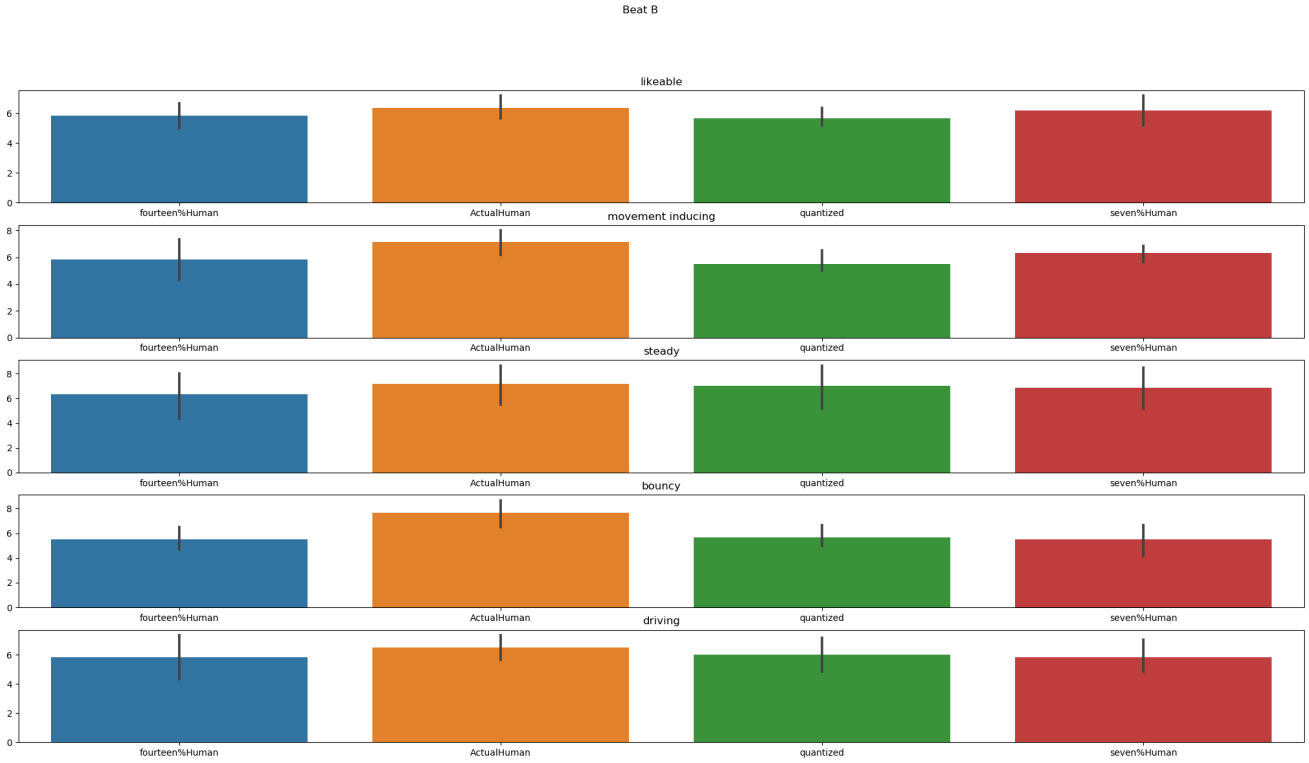

Figure 3: Bar plot for the B beat, sorted by category.

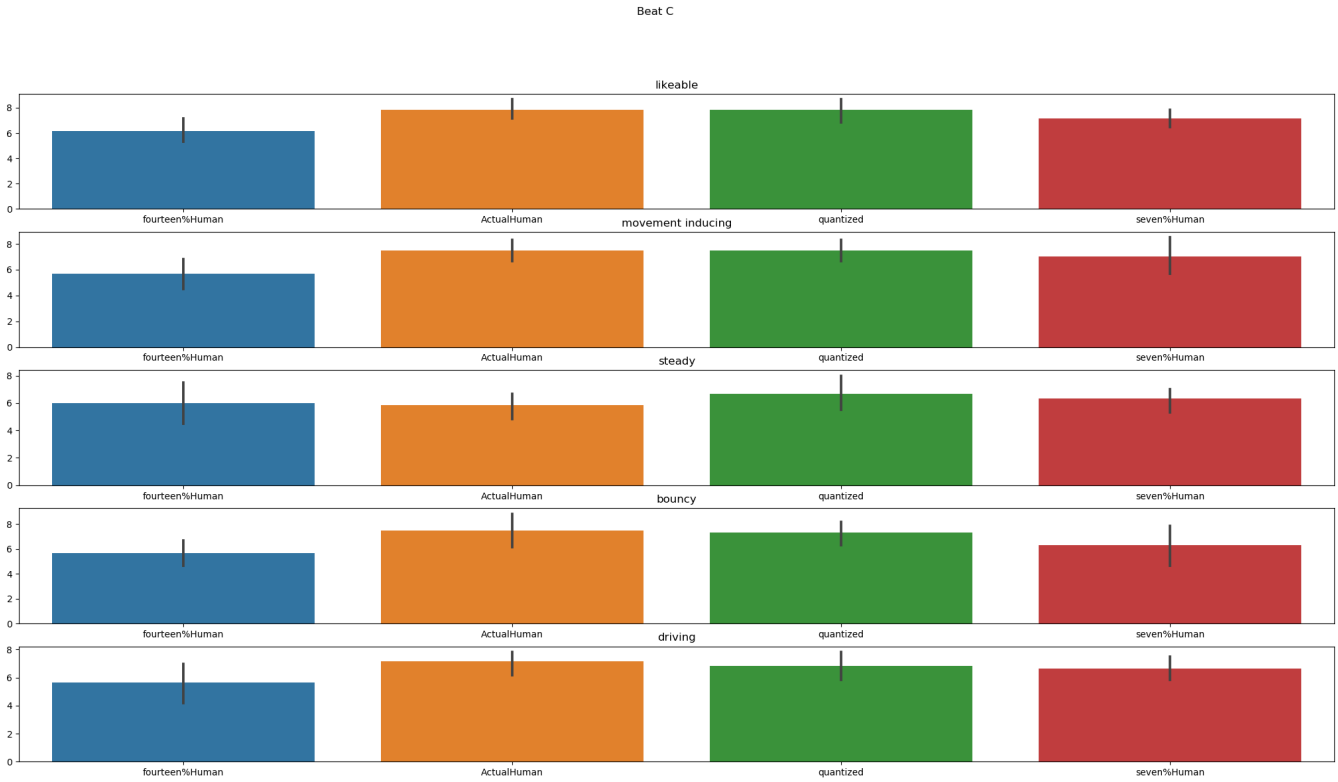

Figure 4: Bar plot for the C beat, sorted by category.

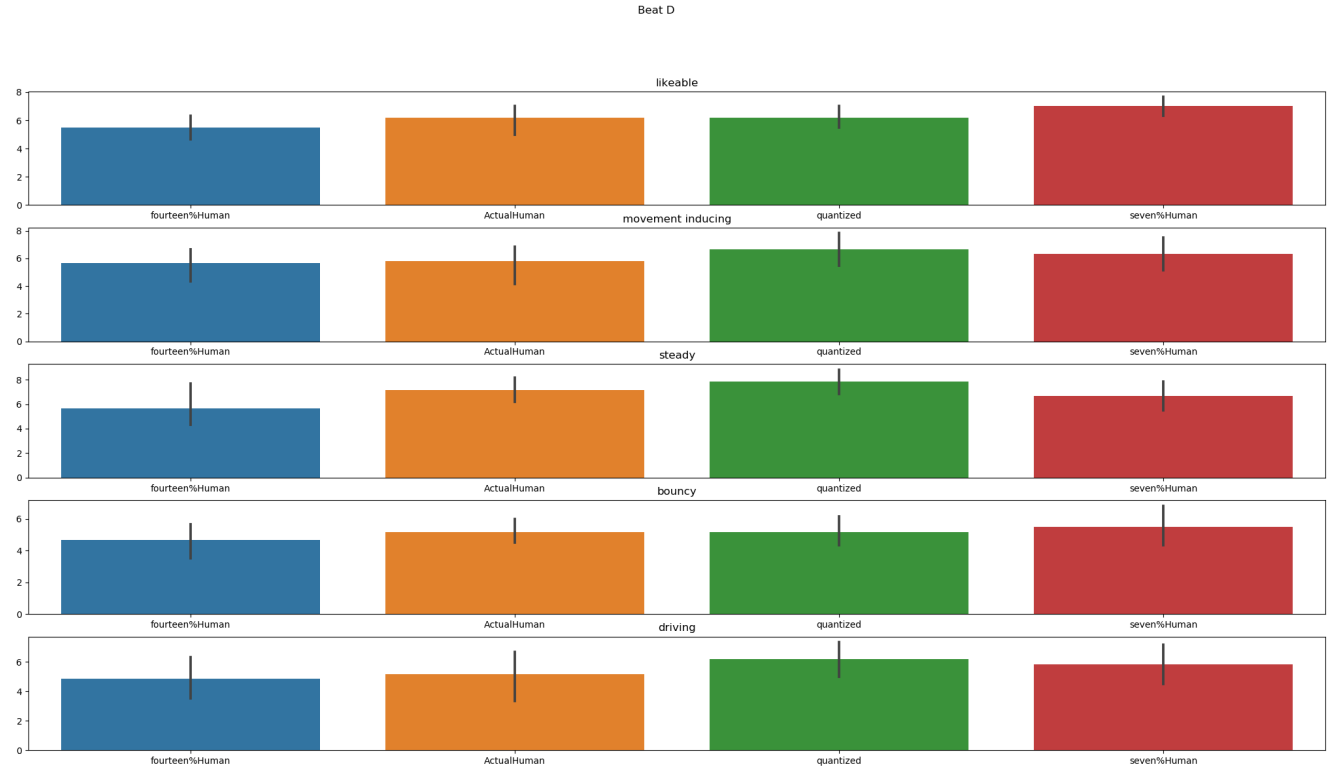

Figure 5: Bar plot for the D beat, sorted by category.

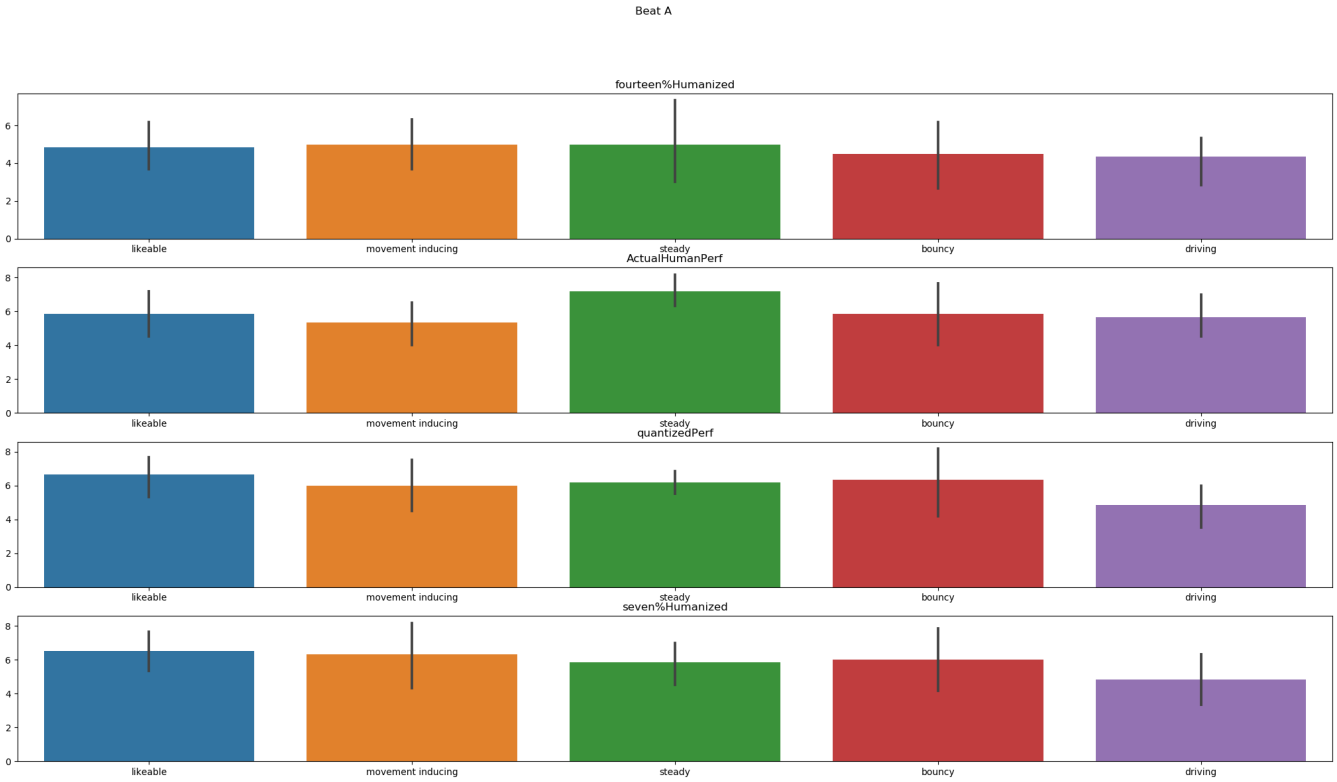

Figure 6: Bar plot for the A beat, sorted by quantization technique.

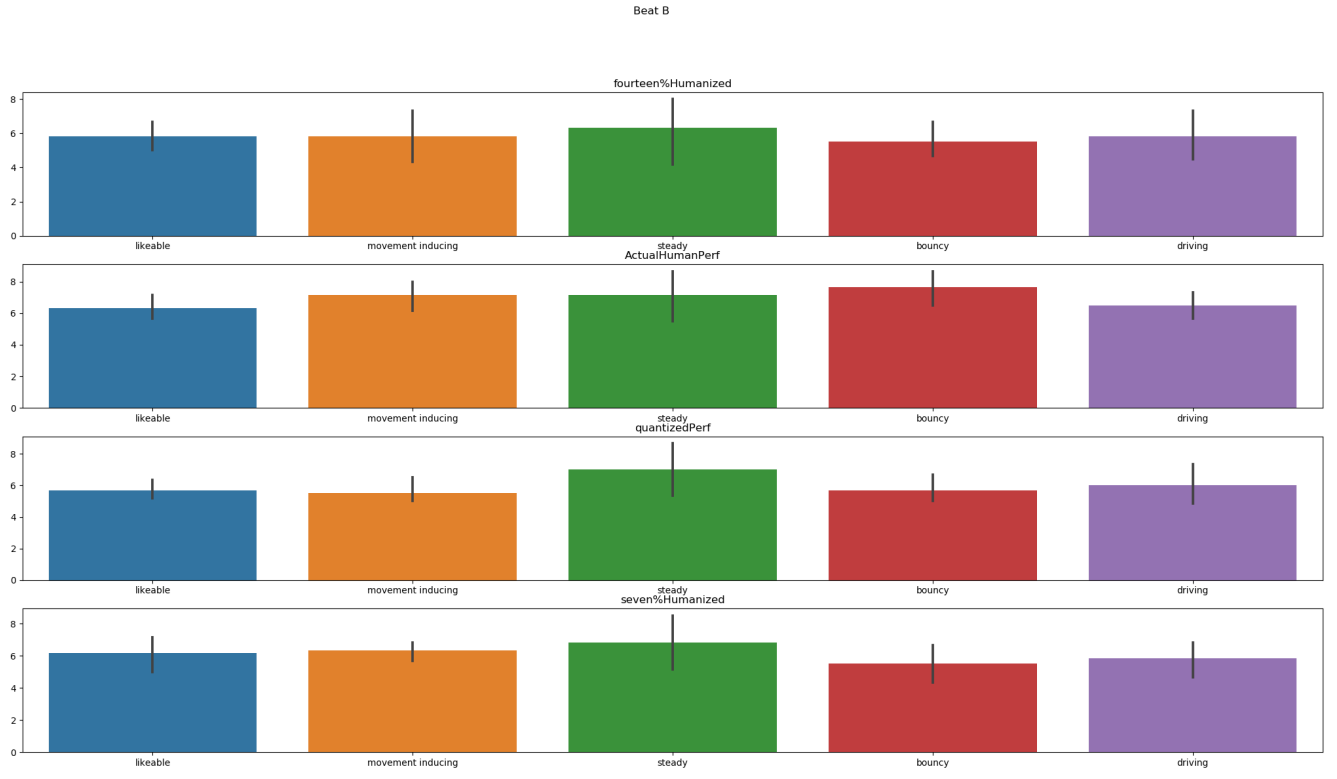

Figure 7: Bar plot for the B beat, sorted by quantization technique.

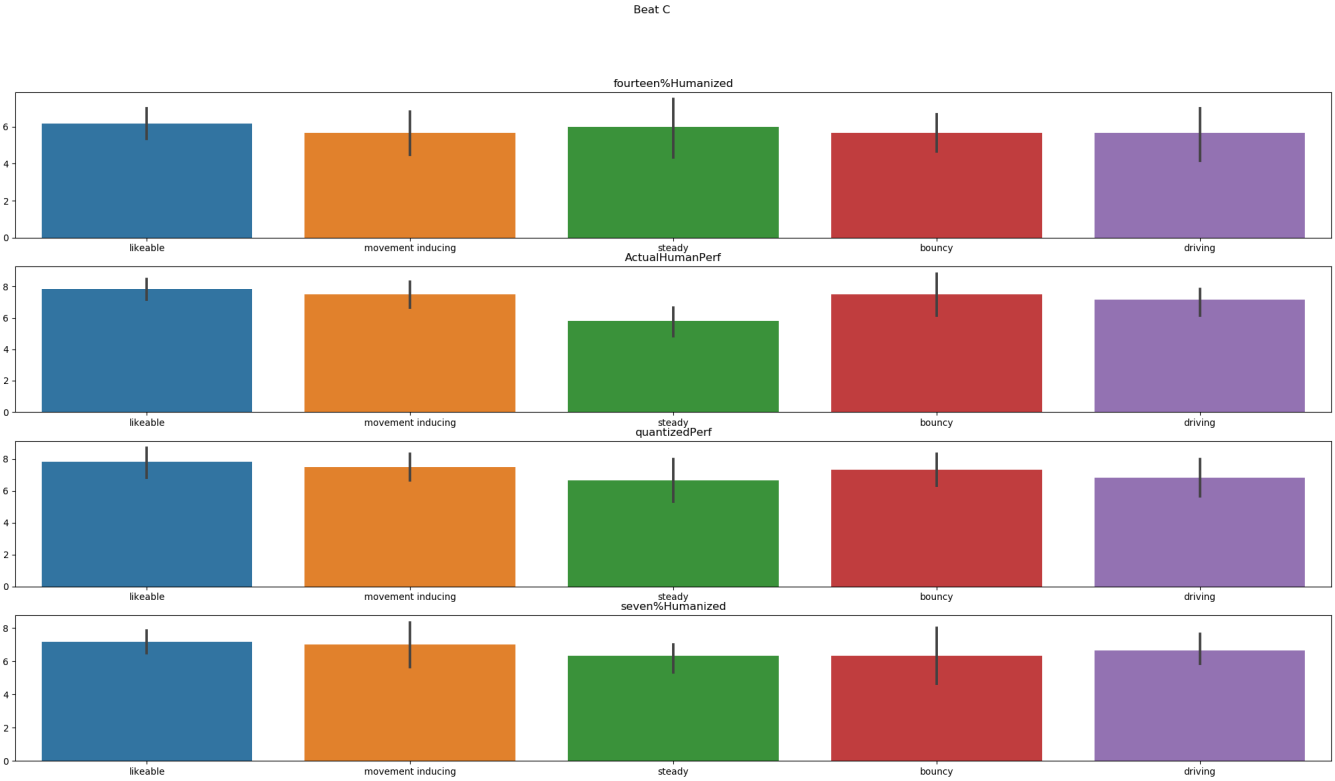

Figure 8: Bar plot for the C beat, sorted by quantization technique.

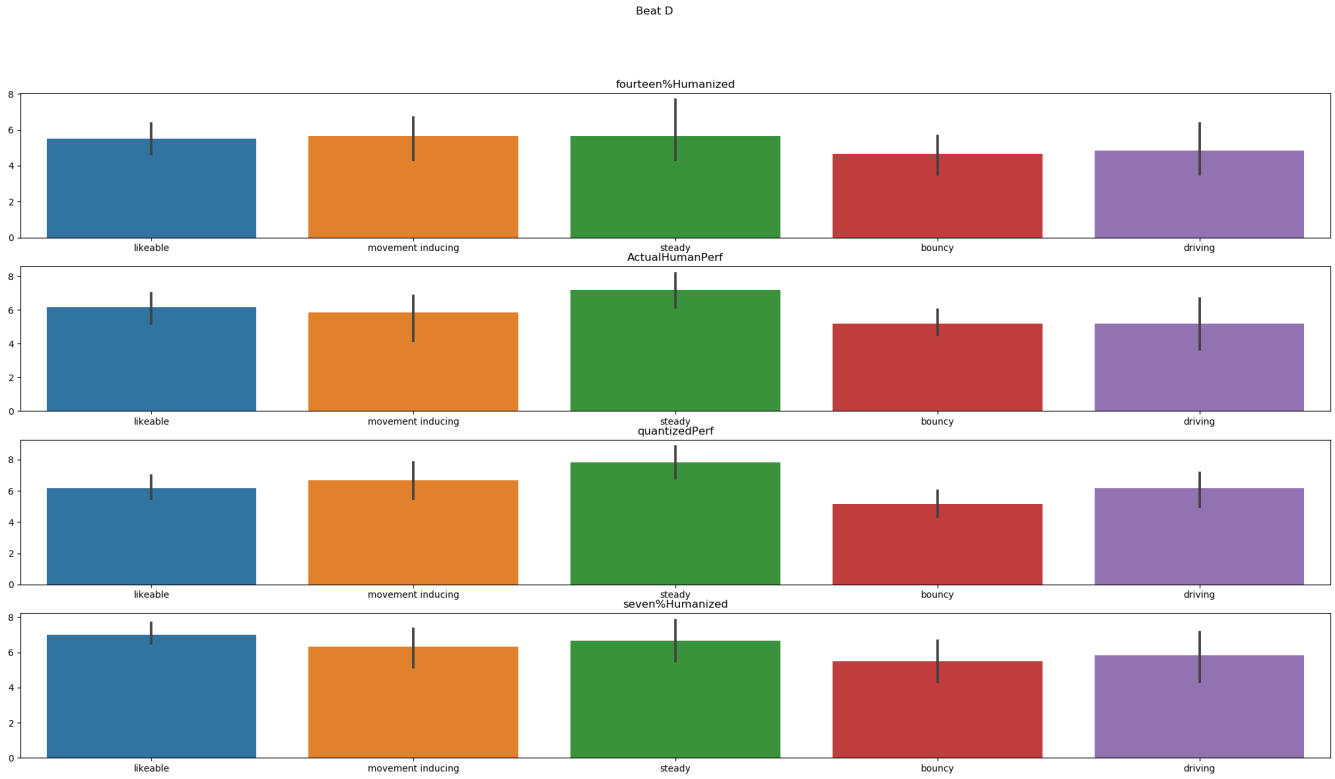

Figure 9: Bar plot for the D beat, sorted by quantization technique.

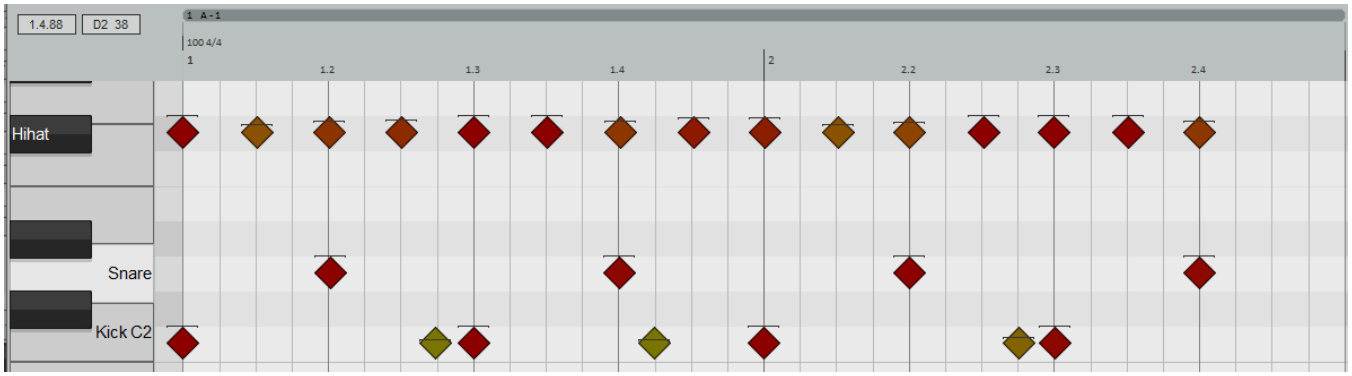

Figure 10: Groove B

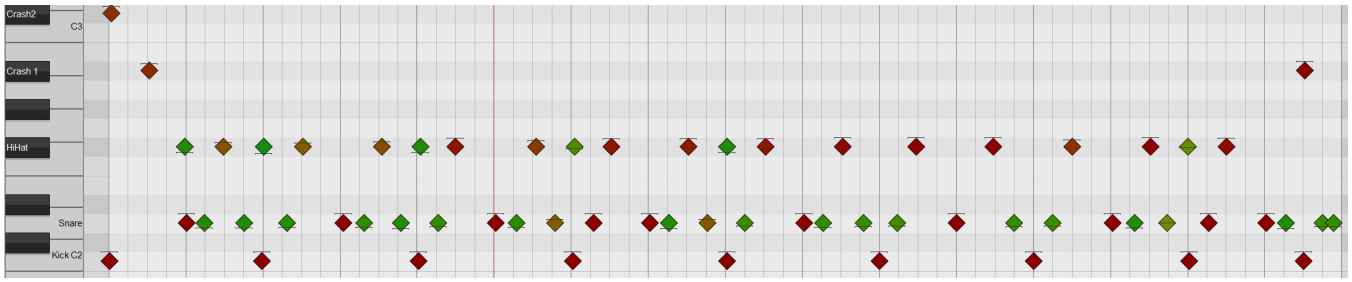

Figure 11: Groove B

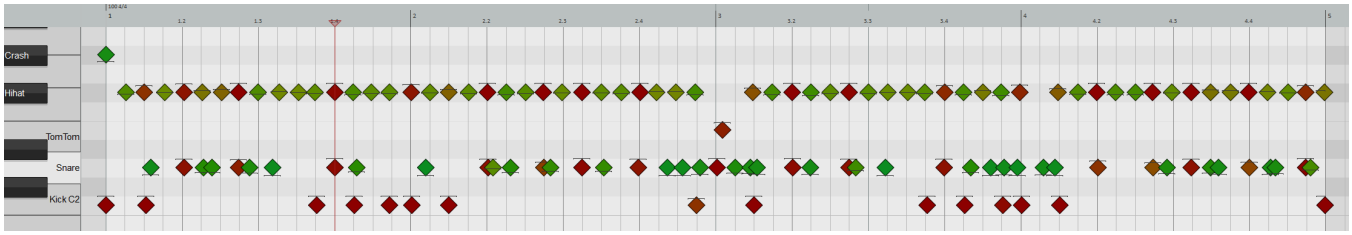

Figure 12: Groove C

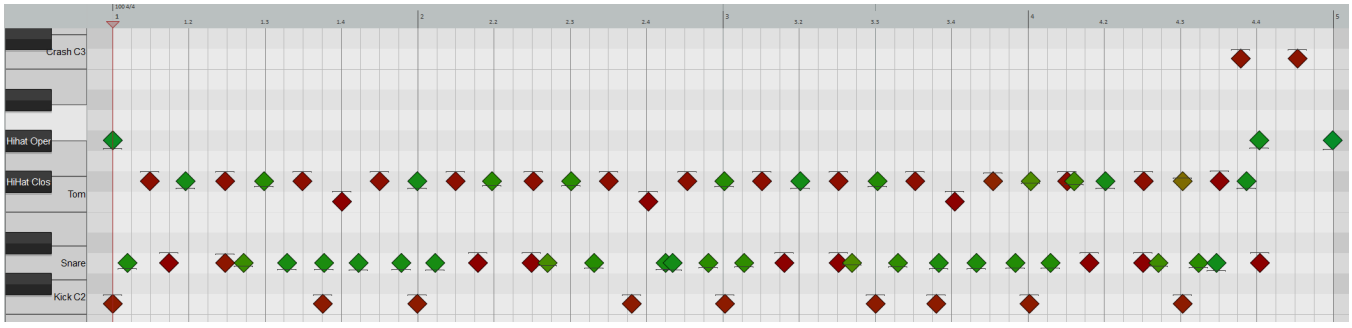

Figure 13: Groove D