

Sonifying motor skills with

PIZZICATO

a game for motor behavior research

Martin Starkov, Scott Jochems, Joris Rijsdijk, Ravi Snellenberg, Luca Stoffels,
Amir Zaidi, Rafael Bidarra




Sonification and motor skills


- sonification
 - the use of sounds as feedback for specific actions
- motor skills
 - allow performing tasks that require control over joint movements
- role of sonification in motor learning
 - neuropsychology research, incl. diagnostic and rehabilitation

The challenges

- sonification research
 - use of complex setups & devices
- agency and accessibility
 - synchronization does not improve motor learning
 - unsuitable for use outside of a lab



*“How can a serious game provide
an **accessible** and **engaging** way to
investigate the impact of sonification
on learning motor skills?”*

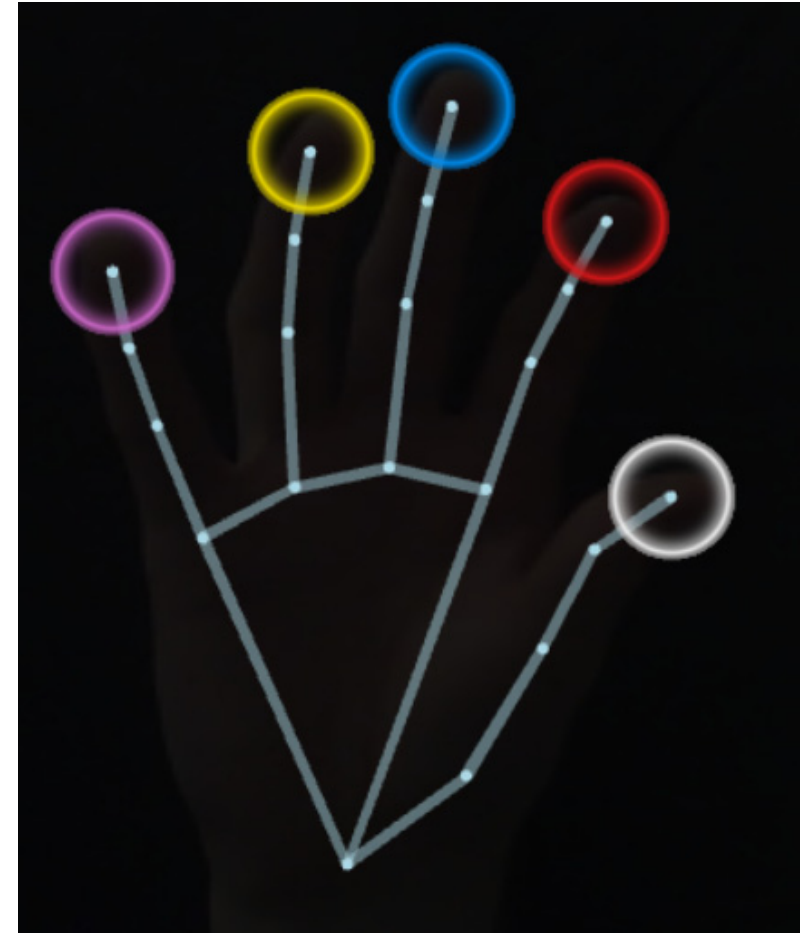


Core design principles

- player agency
 - important for sonification
- accessible
- enjoyable
 - engagement
- measurable
 - repeatable

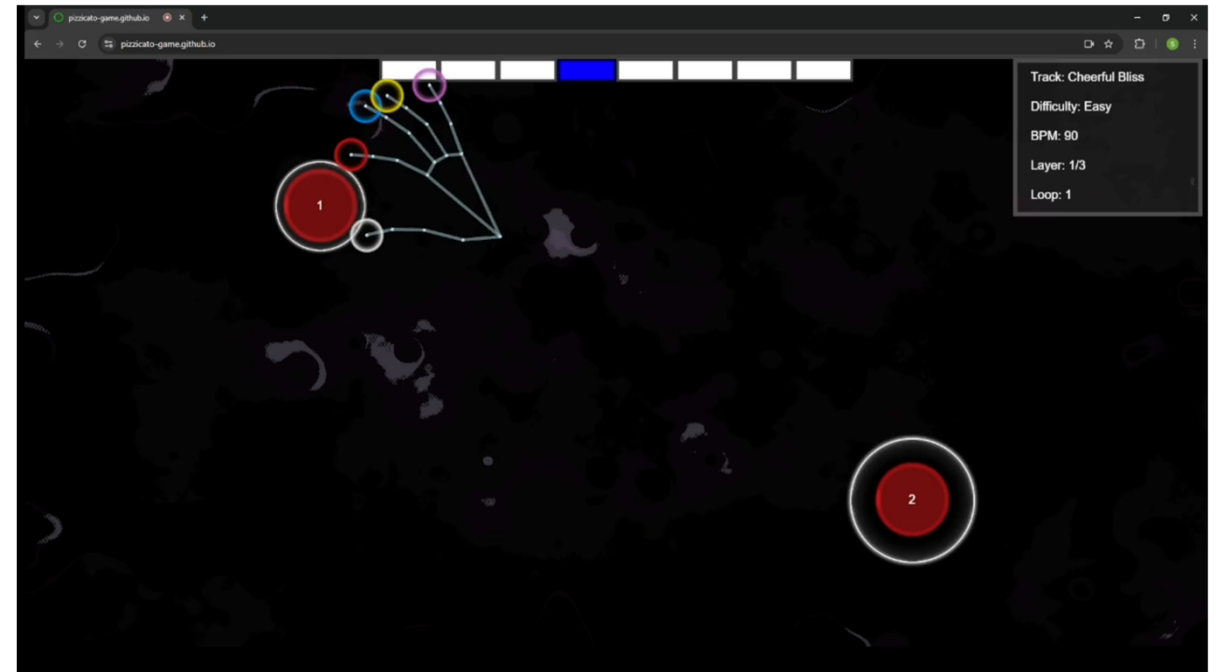
Player input

- hand tracking
 - webcam
 - accessible
 - wide range of motor skills



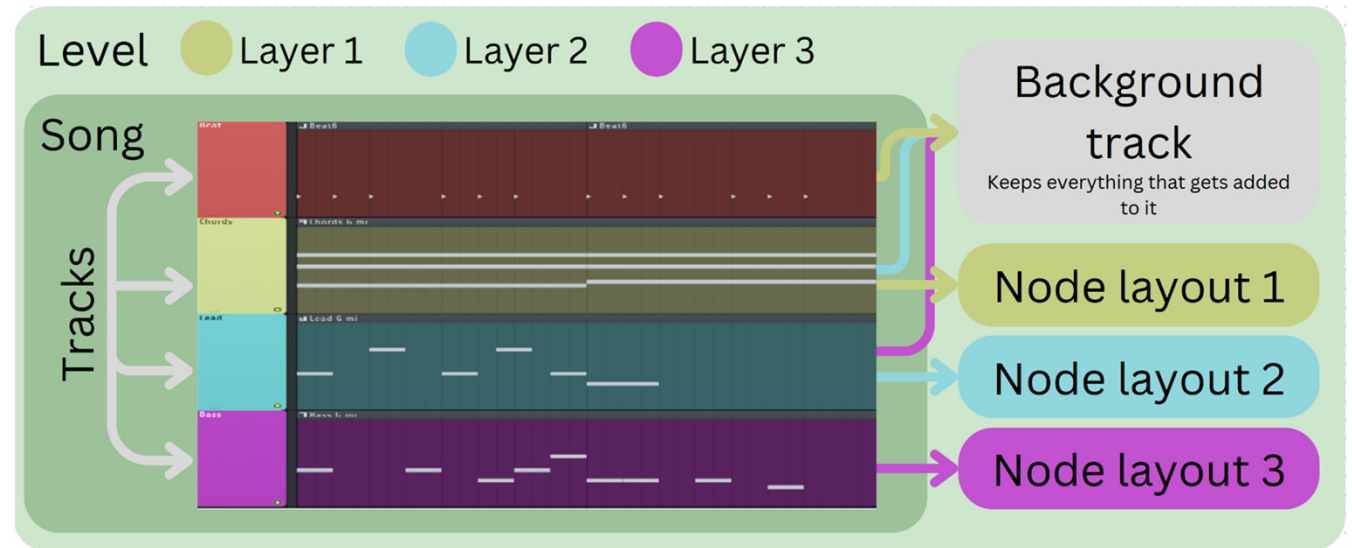
Game mechanics

- rhythm game
- pinching a node...
 - at the correct place and time
 - discrete steps
- ... produces a corresponding sound
 - also when node is pinched at the incorrect time!
- sounds played add up to playing background



Level design

- challenges
 - BPM
 - multiple fingers
- building the music up
 - do well on current layer to advance
- show progress and scores



Highly customizable

- Over 400 changeable settings
- Intuitive options menu





DEMO

Gathered data

- Research insight
- Node hit-miss timeline
- Aggregate statistics

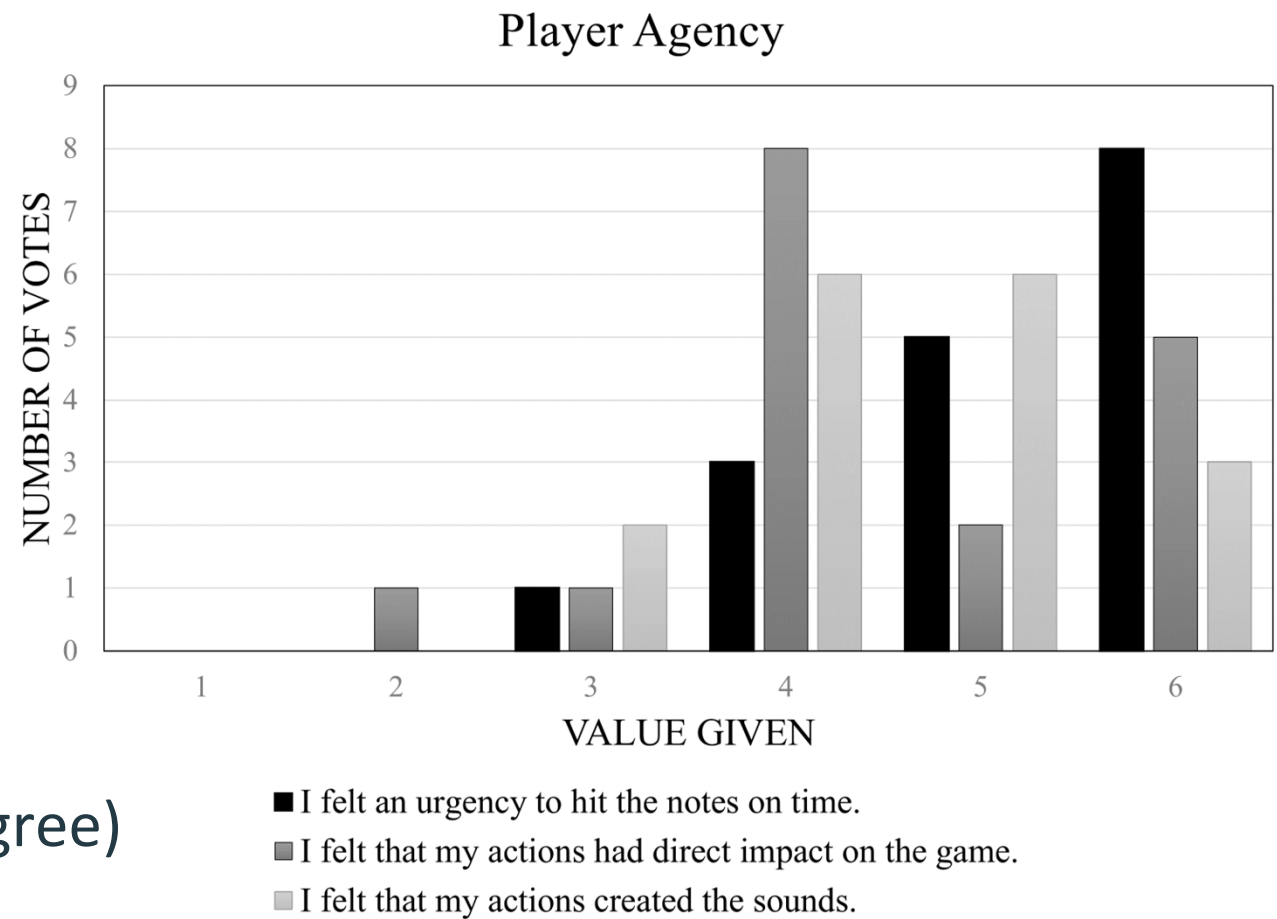
SlowElegance@130bpm_25-01-2024_16-02-48.csv

```
1 layerID,noteID,loopNumber,playerTime,correctTime,classification
2 0,1,1,4.222,3.698,late
3 0,2,1,5.775,5.543,correct
4 0,3,1,7.438,7.387,correct
5 0,4,1,9.252,9.231,correct
6 0,5,1,11.114,11.081,correct
7 0,6,1,-1,12.926,missed
8 0,7,1,14.463,14.77,early
9 0,1,2,18.94,18.465,late
10 0,2,2,20.687,20.309,late
11 0,3,2,22.222,22.159,correct
12 0,4,2,-1,24.003,missed
13 0,5,2,25.898,25.848,correct
14 0,6,2,27.773,27.698,correct
15 0,7,2,29.52,29.542,correct
16 0,1,3,33.324,33.237,correct
17 0,2,3,35.198,35.081,correct
18 0,3,3,37.067,36.925,correct
19 0,4,3,38.814,38.769,correct
20 0,5,3,40.683,40.62,correct
21 0,6,3,42.491,42.464,correct
22 0,7,3,44.22,44.308,correct
23 1,1,1,4.635,4.621,correct
24 1,2,1,6.503,6.465,correct
25 1,3,1,8.839,8.309,late
26 1,4,1,10.186,10.159,correct
27 1,5,1,11.975,12.004,correct
```

Playtest results

- player agency

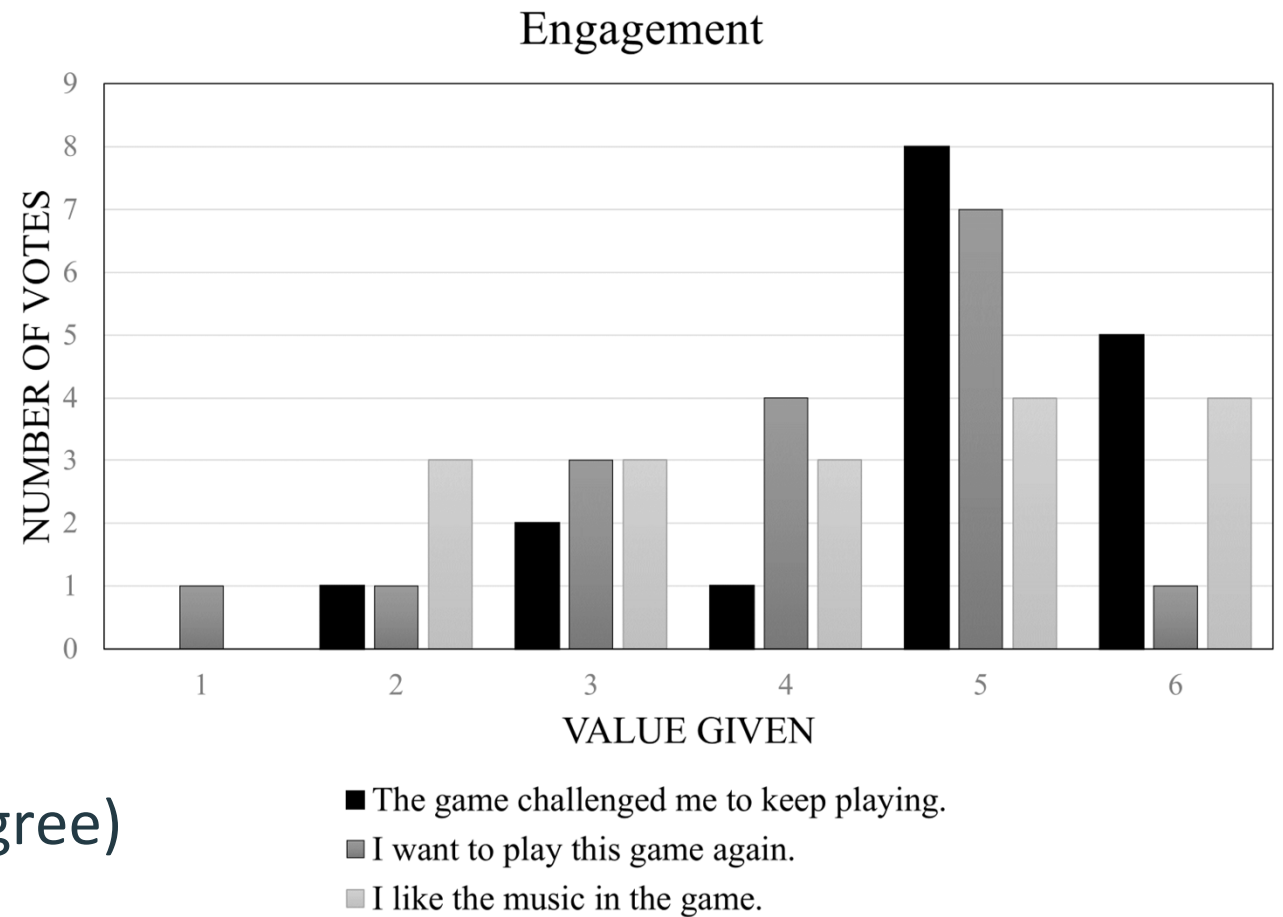
6-point Likert scale
(1-Strongly disagree ... 6-Strongly agree)



Playtest results

- engagement

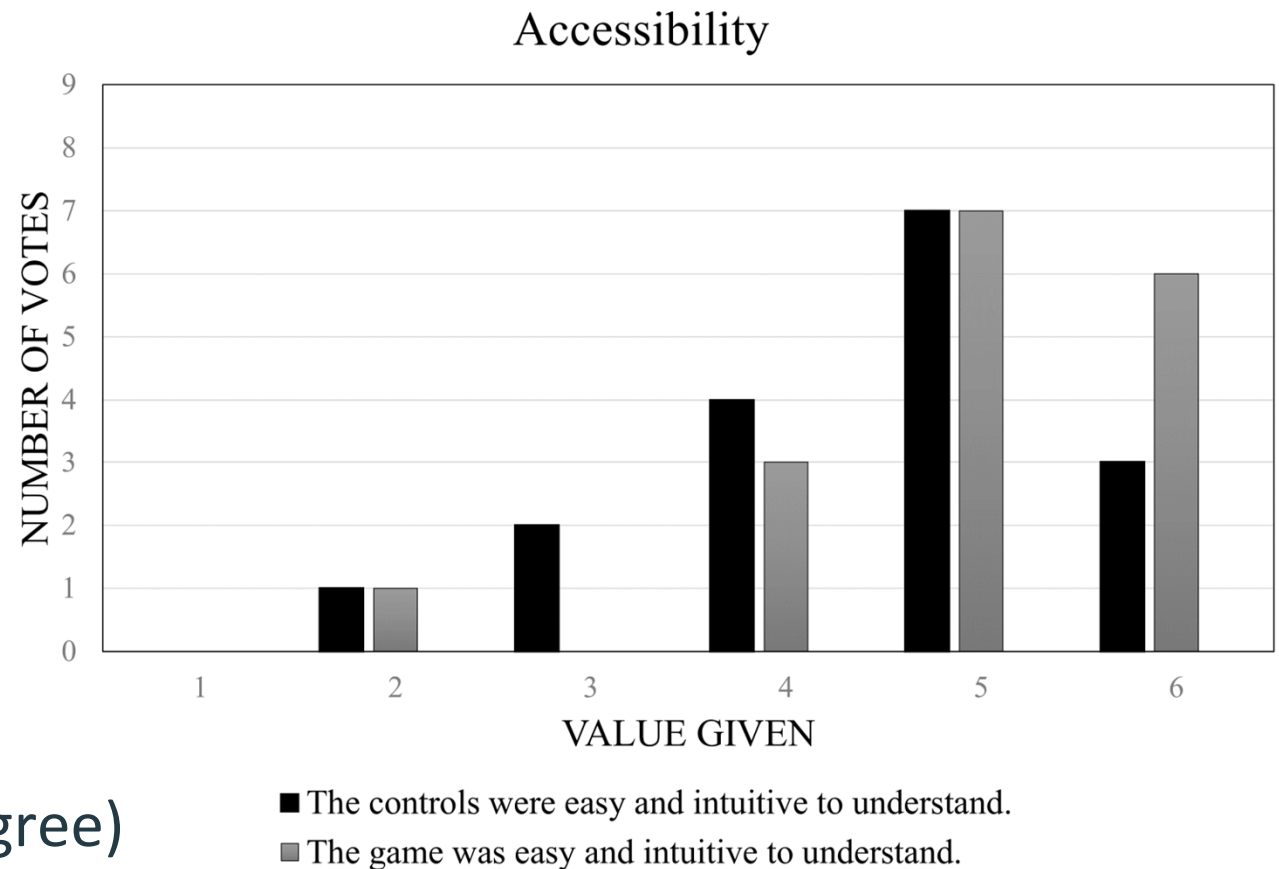
6-point Likert scale
(1-Strongly disagree ... 6-Strongly agree)



Playtest results

- accessibility

6-point Likert scale
(1-Strongly disagree ... 6-Strongly agree)



Conclusion

- Pizzicato is a very accessible and engaging game
- solves the main drawbacks of current methods
 - agency and flexibility
 - data collection
- presently deployed in several evaluation experiments

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<https://pizzicato-game.github.io/>

project done in collaboration with our neuropsychology colleagues
Rebecca Schaefer and Marijn Coers, from Leiden University

