Music Video Games...Beyond Fun and Games

Patrick Richardson • patrickr@drexel.edu • Advisor: Dr. Youngmoo E. Kim
Electrical & Computer Engineering • Drexel University

Abstract

Music-driven video games (e.g. Guitar Hero, Rock Band) have proven popular for recreational game-play, but their value in music education and training has yet to be investigated directly. This project held a supervised gaming study of "gamer" (N_e=17) and "non-gamer" (N_c=7) cohorts of Drexel freshman in a nine-week gaming study. Pre- and post-assessments were taken using musical skills tests and surveys of music- and gaming experience. Quantitative data analysis suggests learning advantages in gamers over non-gamers only among certain aural- and visual-processing tasks of music imitation and interpretation. Qualitative surveys indicate demographically balanced experimental allocation, and survey data bolsters evidence of predominantly visual learning from these games.

The Games

Our study is motivated by interest in the basic elements common to these "rhythm games."

- Gamers "play" songs using microphones or pseudo-instrument controllers (drum-pads, buttoned-guitars, microphones).
- Play follows "time-line"-notated melodies and rhythms scrolling at a constant rate.
- Game scores are based on how accurately such notation was followed or matched (in timing or "pitching") by player input.
- Game notation and difficulty are based on arbitrary interpretations and/or reductions of vocal and instrumental performances.
- These visual- and motor-skill abstractions are central to questions of the games' validity and utility for use in conventional music education or music skill training .

Left: game notation within "RockBand 2" showing time-line notations

References:
[1] Grassi, M., Soranzo, A. MLP: a MATLAB toolbox for rapid and reliable auditory threshold estimations. Behavioral Research Methods, 41(1), pp. 20-28. 2009
[2] Gordon, E. The Musical Aptitude Profile. Music Educators Journal, 53(6), pp. 52-54. 1967.
[3] Crawford, T. et al. "String Matching Techniques for Musical Similarity and Melodic Recognition." Computing in Musicology, 11, pp. 71-100. 1998

Musical Skills Tests

Max.-Likelihood Psychometrics (MLP)[1]**:** Discrimination tasks for timing, pitch, order and intonation of tone sequences.

Musical Aptitude Profile (MAP)[2]**:** Melody and rhythm fitting.

R3 Notation Test (R3NT): Our "time line" notation (Fig. 1) represent (like in-game graphics) motifs for performance of Keyboard Melody, Vocal melody, or Dual Key/Voice rhythm.

R3 Aural Skills Assessment (R3ASA): Repetition of heard-only rhythms and melodies by voice and MIDI keyboard.

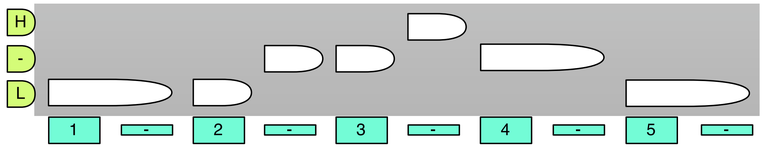
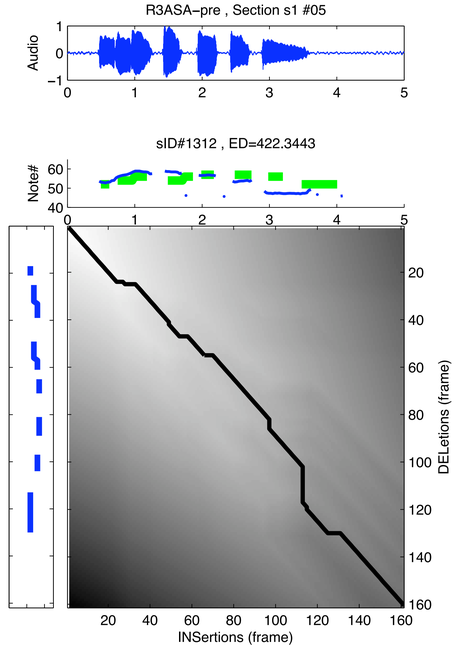


Figure 1: R3NT: time-line melody exercise with 3 tones over 5 beats

For R3ASA and R3NT, full audio and MIDI performance recordings are processed in MATLAB for segmentation, pitch/timing analysis, interpretation and statistical analysis.

Performance Analysis by Computer



Above: single-exercise ED scorings of a pitch-tracked voice melody response.

R3- "musical responses" are analyzed by a Dynamic Time Warping algorithm [3], rating pitch- and time-matching/congruence in "melody lines" between the MIDI target/prompt and human effort (MIDI or pitch-tracked voice). This edit-distance (ED) error metric provides a consistent and automatic *quantitative* measure of qualitative performance accuracy in terms of these pitching and timing properties.

Results and Conclusions

- 1-way ANOVA of MLP show *global improvement* (test habituation effect) among all auditory tests (Fig. 2).
- 1-way ANOVA of MAP show *no significant learning-effects* for music-listening tests, per section or as a whole.
- Among R3NT keyboard sight-reading, while non-gamers had lower average error, only the *gamers showed significant learning over time* (Fig. 3).
- The R3ASA shows *significant gamer learning advantage* across the whole test (Fig. 4), with strongest difference in keyboard melody skills(Fig. 5).

Figure 2
MLP global time-effects
(standardized scores)

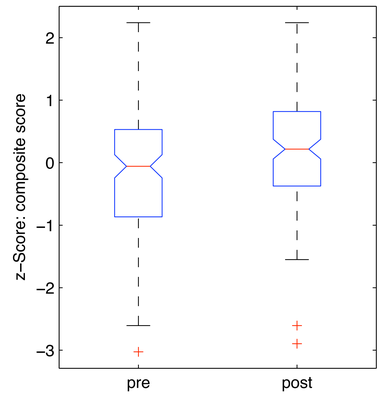


Figure 3
R3NT error-scores for key-melody sight-reading

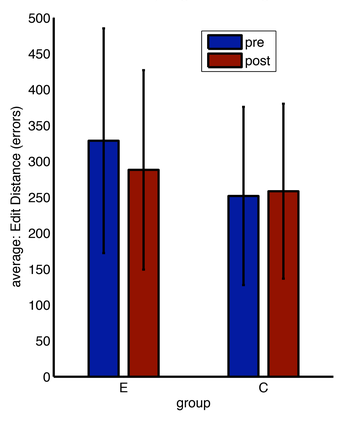


Figure 4
R3ASA standardized ED
scores across all aural skills

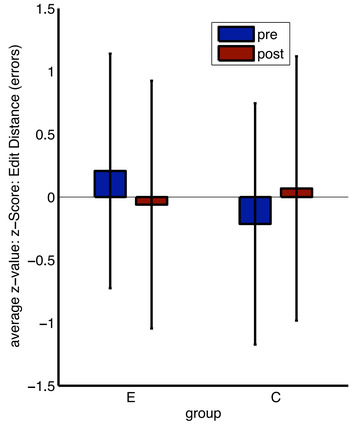
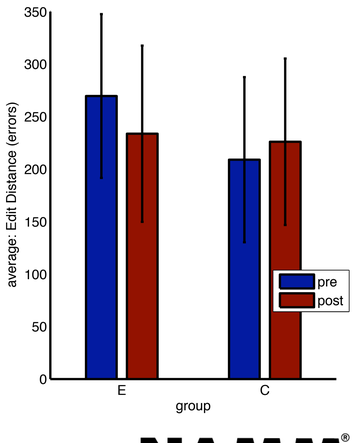


Figure 5
R3ASA raw ED scores for
keyboard skills



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