Gamification: Engagement and Memory Retention against a

Standard vs. Competition against Others

Sarah E. Bondy

University of Michigan-Dearborn

Abstract

This study examined the element of competition in gamification, specifically if competing against others or against a standard was better for memory retention of material. Participants read a passage and played a board game with questions based on the reading. They were placed in either a condition to compete against others or against a standard. Next, they were asked about their experience and given a test to assess their memory of the material. The type of competition was not found to impact memory retention or engagement; however, immersion was positively correlated with performance. Future research should further examine engagement and learning activities to promote memory retention.

Gamification: Engagement and Memory Retention against a

Standard vs. Competition against Others

The issue of how to best promote student learning has a long history in psychological and educational research, but it is a field that is constantly evolving. Theoretically, researchers have examined tools and learning devices that best promote ideals of learning, and practically researchers have looked to strategies to promote student performance. Engagement and memory retention are two variables researchers have looked at to determine the effectiveness of learning strategies. Engagement refers to student motivation, goals, involvement with the material and the learning process (Skinner, Kindermann, & Furrer, 2009). Memory retention is a measure of how much information students can recall.

Gamification is a relatively new method of teaching that incorporates game-like elements into educational settings for the purpose of increasing student engagement and overall academic performance (Albuquerque, Bittencourt, Coelho, & Silva, 2017; Barata, Gama, Jorge, & Goncalves, 2017; Van Nuland, Roach, Wilson, & Bellieveau, 2015). Research indicates that gamification has been successful in increasing student engagement and achievement. Aldachi and Willoughby (2013) found an indirect positive relationship between strategy-based video game play and academic grades in high school students. They found that students who engaged in strategic video games demonstrated higher levels of problem-solving skills, which in turn predicted higher grades after controlling for students' previous academic history (Aldachi & Willoughby, 2013).

One aspect of gamification that was found to help increase both engagement and achievement was competition. Van Nuland et al. (2015) gamified an online course which had some students participate in tournaments to review material before an exam. They surveyed the students after the course and 87.5% said the experience was engaging, 68.7% said tournament

style reviews helped them to prioritize studying, and 84.3% said they would recommend this sort of exercise in other classes (Van Nuland et al., 2015). The incorporation of competition into gamification may influence its effectiveness. When the evaluation of competition is emphasized, students may experience a rise in anxiety and a decrease in performance and motivation (Keogh, Bond, French, Richards, & Davis, 2004; Owens et al., 2012; Santhanam, Liu, & Milton Shen, 2016). However, if the competition within gamification is presented in a way which does not overemphasize competition, then performance may be increased (Barata et al. 2017, Santhanam, Liu, & Milton Shen, 2016).

While competition has been identified as a key component to gamification, research has produced mixed results on the type of competition that is most effective. Santhanam, Liu, and Milton Shen (2016), found that when participants competed against a low-level competitor, their self-efficacy and overall outcomes were higher because of the feedback they received that they were "winning"; however, when participants competed against a competitor around the same level as the participant engagement was higher. The utility of balanced competition has been supported by previous research that indicates motivation and learning are more efficient when participants are faced with a task slightly more difficult than their current ability (Green & Bavelier, 2008). Other research points to the idea that the level of competition does not matter as much as the notion of competition. For example, informing participants that there is a competitor with whom their scores will be compared, with no other information about the competitor, had an impact on performance. In this study, scores, were not actually compared to others; rather, it was simply the idea of competition that increased participants' motivation (Landers, Collmus, & Williams, 2019).

The purpose of this study is to contribute to the research about how different types of competition in gamification affect motivation and memory retention. The study conducted by Landers et al. (2019), was unique because it suggested the idea of a distal competitor, however it only tested the idea of competition. This study aims to connect various aspects of past gamification studies by examining how competition against a standard (i.e., a more distal and impersonal source of competition) compares with competition against others present in the same location and engaging in the task. I hypothesize that students who utilize gamification against a standard will result in higher performance as shown through memory retention and higher engagement compared to those competing against others present in the same room. This is because in the "standard" condition competition may be less anxiety inducing compared to the "others present" condition while still presenting participants with a balanced level of competition.

Method

Participants

The convenience sample which consisted of 11 male (35.5%) and 20 female (64.5%) participants was obtained at a medium-sized midwestern university. Participant registration was regulated through the Psychology Subject-Pool and participants were compensated through class credits. The only inclusion requirement for participation was that the participant be at least 18 years old. Few participants had prior experience with gamification (6.5%), about half of the participants had no experience with gamification (48.4%), and just under half were unsure if they had prior experience with gamification (45.2%).

Materials

Participants were asked to fill out an informed consent form (Appendix A) and this form was then separated from the rest of the participant data to protect the participant's identity. A brief demographic form (Appendix B) was created by the researcher to measure participant gender and prior experience with gamification. Participants read a selected passage (Appendix C) and took an assessment (Appendix D), both of which were taken from a humanities reading section of a practice ACT test (Martz, Magloire, & Silver, 2009, p.458-459). The assessment was presented in a multiple-choice format.

Participants were asked to fill out a questionnaire (Appendix E). The questionnaire measured the participant's experience of the gamification through the constructs of learning, engagement, immersion, challenge, and skill (Hamari, Shernoff, Rowe, Coller, Asbell-Clark, & Edwards, 2015). The questionnaire consisted of statements for the participants to rate how much they agreed with via a 5-point Likert-type scale, and this was changed from the original measure which worded the items as questions. One sample statement from the survey under the learning construct is, "I felt like I was learning" (Hamari, Shernoff, Rowe, Coller, Asbell-Clark, & Edwards, 2015). The original measure was found to be reliable, with the composite reliability for each construct ranging from 0.87 to 0.93 (Hamari, Shernoff, Rowe, Coller, Asbell-Clark, & Edwards, 2015). The original measure was also found to have both convergent and discriminant validity (Hamari, Shernoff, Rowe, Coller, Asbell-Clark, & Edwards, 2015). Participants were also asked to fill out a debriefing form (Appendix F) which was also separated from the rest of the participant data.

Two identical game boards were created for the gamified learning (Appendix G). Questions based on the reading were created (Appendix H) on index cards with the question on one side and the answer on the reverse. Each game box included a game board, set of question

cards, an instruction sheet (Appendix I)(Appendix J), one die, pawn pieces, a blank sheet to use as a scoring card and a pencil.

Research assistants were utilized as confederates and were given a question and answer bank to standardize their participation in the game (Appendix H). A research participant was also utilized as an administrator and was provided with an instruction guide to follow for the administration of the study (Appendix K) and a rubric (Appendix L) for scoring participant responses.

Procedure

Two conditions were created for the study in a between-subjects design: competition against a standard and competition against others. Participants and administrators were initially randomly assigned to either the condition of competing against a standard or against other people by the administrator flipping a coin. Due to time constraints, participants and administrators were later assigned based on convenience. Administrators only ran one participant at a time.

The participant first filled out the consent form, demographic questionnaire, and then was given the reading to read silently. The administrator set up the game and invited in the confederates for the competition against others condition, introducing them as "people familiar with the material and the game who are going to play with you". Participants in the competition against a standard condition were informed of the standard prior to the start of the game and were verbally reminded of the standard at the end of the game. This standard was obtained by averaging the scores of participants who completed the game in the pilot study. The participant score on the game was recorded by the researcher at the conclusion of the game in both conditions. The confederates left the room at the conclusion of the game in condition of competition against others. The participant completed the experience questionnaire immediately

after the game in both conditions and then took the multiple-choice assessment. Participants were

given a debriefing form and verbally debriefed.

Participant anonymity was protected by physically separating participant identifying

information from participant scores. A coding system was created to keep each participant's

scores together without connecting it to identifying information. All the scores, consent forms,

and debriefing forms were always kept on the researcher's person.

Results

Test of Hypotheses

Performance was measured through the assessment participants took upon completion of

the game. Scores on tests were calculated by adding up the number of correct answers using the

key provided by the practice ACT booklet. Potential scores on the test ranged from 0.0,

indicating a low score, to 10.0 points, indicating a high score. Actual scores ranged from 2.0 to

10.0 (*M*=6.3). Scores for participants who competed against others *(M = 6.27; SD = 1.94)* were

compared to scores for participants who competed against a standard *(M = 6.31; SD = 1.96)*, but

no significant differences were found between conditions, *t* (29) = 0.19, *p*=ns.

Engagement was measured through scores on the Gamification Experience

Questionnaire. Scores on the questionnaires were created for the participants by adding up their

score on each question. Several items were reverse-coded and scored so engagement was

measured in one direction. The Gamification Experience Questionnaire broke engagement into

the components: learning, [pure] engagement, immersion, challenge, and skill. Participants did

not receive a total score but did receive a score for each component of engagement (Table 1). No

significant relationship was found between pure engagement and condition (Table 2), *r (29) =*

0.14, p=ns. There was also no significant relationship found between engagement and performance (Table 5), $r(29) = 0.23$, p=ns.

Additional Analyses

The components of engagement were also examined in relation to participant performance. High immersion scores were found to be moderately related to high test scores (Table 4), $r(29) = 0.33$, $p<0.05$. No significant relationship was found between immersion and condition (Table 5), $r(29) = 0.15$, p=ns.

Participants were also asked if they would have rather played against a standard or others given their experience in their assigned condition; 9.7% said they would choose to play against a standard, 22.6% said they were neutral in their preference, and 67.7% said they would choose to play against others.

Discussion

Neither hypothesis was supported. More specifically, significant differences were not found for performance or for engagement by condition. That is, condition (standard or competition) had no effect on the dependent measures. The only relationship found to be statistically significant was between immersion and test score. As Immersion increased so did performance. such that the more "into" the game participants were, the better they performed.

This study was unique in that it compared two different forms of competition within gamification. Prior research had mainly focused on gamified learning versus non-gamified

learning or presenting competition in general into the game. This study supports the notion of a distal competitor (Landers, Collmus, & Williams, 2019), but also suggests that a distal competitor is not necessarily superior to an in-person competitor. The hypotheses of this study assumed that playing against other physical people would be more anxiety-inducing, but that may not have been true as most participants chose to play against others if given the choice. However, no direct measure of anxiety was examined in the study.

Limitations of this study include a small sample size and immediate testing. This study should be replicated with larger sample sizes to determine if the findings hold true. Immediate testing was a limitation because it makes it difficult to look at memory retention. Replications of this study may want to test the participants on the material at different time intervals to see how the gamified learning impacts memory retention over time.

Future research should examine immersion to determine what elements of immersion aid in performance. The use of confederates controlled for the people the participants played against, but future research may want to look at the variable of known competitors versus strangers as competitors. Future research may also want to examine engagement in the context of a full course rather than a single gamified learning experience to determine if immersion is still the most important component of engagement.

In addition to driving further research on gamification, the implications of this study may be utilized in a learning setting. For individual studying, one might try and find the most immersive study strategies based on personal preference. For larger groups, teachers may decide to poll their students as to the types of competition and games those students find most immersing.

References

Albuquerque, J., Bittencourt, I., Coelho, J. & Silva, A. (2017). Does gender stereotype threat in

    gamified educational environments cause anxiety? An experimental study. *Computers*

    and Education, 115, 161-170. Doi: 10.1016/j.compedu.2017.08.005

Aldachi, P. J. C. & Willoughby, T. (2013). More than just fun and games: The longitudinal

    relationships between strategic video games, self-reported problem solving skills, and

    academic grades. *Journal of Youth and Adolescence, 42(7)*, 1041-1052. Doi:

    10.1007/s10964-013-9913-9

Barata, G., Gama, S., Jorge, J. & Goncalves, D. (2017). Studying student differentiation in

    gamified education: A long-term study. *Computers in Human Behavior, 71,* 550-585.

    Doi: 10.1016/j.chb.2016.08.049

Hamari, J., Shernoff, D. J., Rowe, E., Coller, B., Asbell-Clark, J., & Edwards, T. (2015).

    Challenging games help students learn: An empirical study on engagement, flow and

    immersion in game-based learning. *Computers in Human Behavior, 54*, 170-179. Doi:

    10.1016/j.chb.2015.07.045

Keogh, E., Bondy, F. W., French, C.C., Richards, A. & Davis, R. E. (2004). Test anxiety,

    susceptibility to distraction and examination performance. *Anxiety, Stress & Coping: An*

    International Journal, 17(3), 241-252. Doi: 10.1080/10615300410001703472

Landers, R.N., Collmus, A.B., & Williams, H. (2019). The greatest battle is within ourselves: An

    experiment on the effects of competition alone on task performance. *International*

    Journal of Human-Computer Studies, 127, 51-61.

McCabe, J. A. & Lummis, S. N. (2018). Why and how do undergraduates study in

groups. *Scholarship of Teaching and Learning in Psychology, 4(1),* 27-42. Doi:

10.1037/stl0000099

Micari, M. & Pazos, P. (2014). Worrying about what others think: A social-comparison

intervention in small learning groups. *Active Learning in Higher Education, 15(3),* 249-

262. Doi: 10.1177/1469787414544874

Owens, M., Stevenson, J., Hawdin, J. & Norgate, R. (2012). Anxiety and depression in academic

performance: An exploration of the mediating factors of worry and working memory.

School Psychology International, 33(4), 433-449. Doi: 10.1177/0143034311427433

Santhanam, R., Liu, D., & Milton Shen, W. (2016) Gamification of technology-mediated

training:

Not all competitions are the same. *Information Systems Research, 27(2),* 453-465.

Skinner, E.A., Kindermann, T.A. & Furrer C. J. (2009). A motivational perspective on

engagement and disaffection: Conceptualization and assessment of children's behavior

and emotional participation in academic activities in the classroom. *Educational and*

Psychological Measurement, 69(3), 493-525. Doi: 10.1177/0013164408323233

Sung, H., Hwang, G., Lin, C., Hong, T. (2017). Experiencing the analects of confucius: An

experimental game-based learning approach to promoting students' motivation and

conception of learning. *Computers and Education, 110,* 143-153. Doi:

10.1016/j.compedu.2017.03.014

Van Nuland, S., Roach, V., Wilson, T. & Belliveau D. (2015). Head to head: The role of

academic competition in undergraduate anatomical education. *Anatomical Sciences*

Education, 8(5), 404-412. Doi: 10.1002/ase.1498

Table 1: Engagement Component Scores

				NGE	SKILL
N					31
					0
Mean					4.8710
Std. Error of					.39004
Median					5.0000
Mode	12.00	30.00	10.00	7.00	2.00a
Std. Deviation	1.13970	3.54540	1.68994	1.69693	2.17167
Variance	1.299	12.570	2.856	2.880	4.716
Skewness	-.367	-.563	-.376	-.168	.260
Std. Error of Skewness	.421	.421	.421	.421	.421
Kurtosis	.749	.409	.838	-.465	-.604
Std. Error of Kurtosis	.821	.821	.821	.821	.821
Range	5.00	16.00	8.00	7.00	8.00
Minimum	9.00	21.00	6.00	3.00	2.00
Maximum	14.00	37.00	14.00	10.00	10.00
Sum	371.00	941.00	324.00	208.00	151.00

Table 2: Correlation of Condition and Engagement

		S'S CONDITION	ENGAGEMENT
S'S CONDITION	Pearson Correlation	1	.136
	Sig. (2-tailed)		.467
	N	31	31
ENGAGEMENT	Pearson Correlation	.136	1
	Sig. (2-tailed)	.467	
	N	31	31

Table 3: Correlation of Test Score and Engagement

		TPOINTS	ENGAGEMENT
TPOINTS	Pearson Correlation	1	.225
	Sig. (2-tailed)		.225
	N	31	31
ENGAGEMENT	Pearson Correlation	.225	1
	Sig. (2-tailed)	.225	
	N	31	31

Table 4: Correlation of Test Scores and Immersion

		TPOINTS	IMMERSION
TPOINTS	Pearson Correlation	1	.328[*]
	Sig. (1-tailed)		.036
	N	31	31
IMMERSION	Pearson Correlation	.328[*]	1
	Sig. (1-tailed)	.036	
	N	31	31

*. Correlation is significant at the 0.05 level (1-tailed).

Table 5: Correlation of Condition and Immersion

		S'S CONDITION	IMMERSION
S'S CONDITION	Pearson Correlation	1	.147
	Sig. (2-tailed)		.431
	N	31	31
IMMERSION	Pearson Correlation	.147	1
	Sig. (2-tailed)	.431	
	N	31	31

Appendix A

Consent to be Part of a Research Study

Title of the Project: Differences in Engagement and Memory Retention in Competition
 Against a Standard Versus Competition Against Others in Gamification
Principal Investigator: Sarah Bondy, member of psychology honors program, U of M Dearborn
Faculty Advisor: Dr. Arlo Clark-Foos, Ph. D., University of Michigan Dearborn

Invitation to be Part of a Research Study

The psychology faculty considers participation in experimental research by subjects to be an educational experience for the students as well as an important service to the research of the University. Participation is voluntary, if you choose not to participate as a research subject you may participate in another research-related activity at no expense to your academic record or standing.

Important Information about the Research Study

Things you should know:

- The purpose of the study is to compare competition against a standard with competition against others in terms of memory retention and engagement. If you choose to participate, you will be asked to participate in gamification activities, complete short material based assessments and answer a questionnaire. This will take approximately one hour.
- Risks or discomforts from this research include eye strain, fatigue, paper cuts, boredom, or embarrassment from losing the game.
- The study will expose participants to various contexts of gamification.
- Taking part in this research project is voluntary. You don't have to participate and you can stop at any time.

Please take time to read this entire form and ask questions before deciding whether to take part in this research project.

What is the study about and why are we doing it?

The purpose of the study is to examine the relationship between competition and gamification. This study will look at competition against a standard and competition against others in terms of memory retention of material and engagement.

What will happen if you take part in this study?

If you agree to take part in this study, you will be asked to participate in individual and group based gamification activities, complete two material based assessments and fill out a questionnaire, on date of study, room 4051 CB. We expect this to take about one hour.

How could you benefit from this study?

You might benefit from being in this study by learning more about different study techniques and your preference for learning contexts.

What risks might result from being in this study?

There are some risks you might experience from being in this study. They are boredom, eye strain, paper cuts, fatigue, and embarrassment from losing the game. I will minimize these risks by allowing participants to work at their own pace during the activity time frames and allowing participants to take breaks if necessary.

How will we protect your information?

I plan to publish the results of this study. To protect your privacy, I will not include any information that could directly identify you.

I will protect the confidentiality of your research records by keeping the data anonymous.

It is possible that other people may need to see the information we collect about you. These people work for the University of Michigan and government offices that are responsible for making sure the research is done safely and properly.

What will happen to the information we collect about you after the study is over?

I will not keep your research data to use for future research. Your information will be kept secure and stored separately from the research data collected as part of the project.

I may share your research data with other investigators without asking for your consent again, but it will not contain information that could directly identify you.

How will we compensate you for being part of the study?

As a part of your participation in an Introductory Psychology course at the University of Michigan- Dearborn, you agree to serve as a research subject for this experiment. You will receive _____subject pool credits for your participation in today's study. You may withdraw at any time from today's study without penalty or loss of research participation credit.

As part of your participation in an upper-level psychology course at the University of Michigan-Dearborn, you agree to serve as a research subject for this experiment. You will receive _____extra credit for your participation. You may withdraw at any time from today's study without penalty or loss of extra credit.

Your Participation in this Study is Voluntary

It is totally up to you to decide to be in this research study. Participating in this study is voluntary. Even if you decide to be part of the study now, you may change your mind and stop at any time. You do not have to answer any questions you do not want to answer. If you decide to withdraw before this study is completed, your data will not be used in the study. Your participation may be terminated by the PI without your consent if you exhibit violent behaviors, such as hitting or kicking, as a result of losing a game.

Contact Information for the Study Team and Questions about the Research

If you have questions about this research, you may contact **Sarah Bondy, sebondy@umich.edu, 734-6644086 and Dr. Clark-Foos, acfoos@umich.edu**

Contact Information for Questions about Your Rights as a Research Participant

If you have questions about your rights as a research participant or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the following:

University of Michigan
Health Sciences and Behavioral Sciences Institutional Review Board
2800 Plymouth Road
Building 520, Room 1169
Ann Arbor, MI 48109-2800
Phone: (734) 936-0933 or toll free, (866) 936-0933
Email: irbhsbs@umich.edu

Your Consent

By signing this document, you are agreeing to be in this study. Make sure you understand what the study is about before you sign. I/We will give you a copy of this document for your records. I/We will keep a copy with the study records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above. If you would like to learn the findings of this study, please email me at [PI email] and I will be happy to forward that information to you. Thank you for your participation in this study.

I understand what the study is about and my questions so far have been answered. I agree to take part in this study.

Signature:_____

Date: _____

Printed Subject Name: _____

Address: _____

Enrolled in: Psychology: _____

Psychology Instructor:_____

To be filled by experimenter:

Experiment: _____

Date: _____

Appendix B

Demographic Questionnaire

Please Respond to the Following Questions. Do not write your name on this.

1. I identify as **circle one of the following** (male, female, prefer not to say)

2. Do you have prior experience with gamification? **Circle one of the following** (Yes, No, I'm not sure)

   If you circled 'Yes' or 'I'm not sure' Please Explain:

   _____

   _____

Appendix C

Reading

Directions: Please read the following story. You will have _____ minutes to complete the

reading. You will be asked questions later on this material later on in the study.

Humanities: the following passage is adapted from the article "Conquering Jazz" by Patrick

Tyrrell

From the time I started playing instruments, I have been intrigued and slightly mystified

by the world of jazz. I'm not talking about adventurous, atonal, confusing jazz that normal music

listeners have a hard time following. I'm talking about the lively, accessible, beautiful jazz that

came of age in the swinging 1920s and 1930s: the simultaneously hip and regal symphonic

swing of Duke Ellington and Count Basie; the carnival of contrapuntal melodies that

inexplicably harmonize with each other in New Orleans' jazz; the buoyant, atmosphere-touching

saxophone solos of Charlie Parker and the young John Coltrane.

The one thing I had always heard about jazz but could never accept was that jazz was an

improvised form of music. How could this be?

The trademark of beautiful jazz is the complexity of the music. All the instrumentalists

are capable of dizzying arrays of notes and rhythms. The soloists find seemingly impossible

transitions from one phrase to the next that are so perfect one would think they had spent weeks

trying to devise *just* the right route to conduct safe passage. To think they spontaneously craft

these ideas seems preposterous.

My first nervous jabs into the world of jazz came during college. I was in a rock band, but my fellow guitarist and bandmate, Victor, also played in a jazz ensemble. At our practices, I would sometimes show off a new chord I had just "invented" only to have him calmly and confidently name it, "Oh, you mean C-sharp diminshed?" Often, in between our band's simplistic rock songs, I would look over and see him playing chord shapes on his guitar I had never seen before. Were we playing the same instrument?

Of course, rock music, as well as most early classical music, operates within a much simpler harmonic world than does jazz. There are 12 tones in Western music: A-flat, A, B-flat, B, C, D-flat, D, E-flat, E, F, G-flat, and G. There are major chords, which sound happy, and minor chords, which sound sad. Essentially, rock music requires only that you learn the major and minor chord for each of the 12 tones. If you do, you can play 99 percent of all the popular radio songs from the 1950s onward.

Jazz uses the same twelve tones as do rock and classical, but it employs a much more robust variety of chords. Major sevenths, augmented fifths, flat ninths, and diminished chords all add to the depth and detail of the music. These often bizarre-sounding chords toss in subtle hints of chaos and imbalance, adding a worldly imperfection to otherwise standard chord values. Jazz starts sounding better the older you get, just as candy starts tasting too sweet and a bit of bitterness makes for a more appealing flavor.

For the most part, Victor's elliptical personality prevented him from ever giving me straightforward explanations when I asked him to divulge the "magician's secrets" of jazz. But I did learn that jazz is only *partly* improvised. The musicians aren't inventing the structure of songs spontaneously, just the specific details and embellishments. A sheet of jazz music doesn't

look like a sheet of classical music. There aren't notes all over the page dictating the "ideas" There are just chord names spaced out over time, dictating the "topic of conversation".

There's a legendary book in the jazz world known as "The Real Book." It's a collection of a few hundred classic songs. Open it up in any room full of jazz musicians, and they could play in synchrony for a week. For years, I wanted my own copy, but I had always been too afraid to buy it, afraid that I wouldn't know how to use the book once I had it. Then, at age 30, more than a decade since Victor and I had gone our separate ways, I bought myself a copy. I resolved to learn how to play all the chords on guitar and piano. For the next few months, I quietly plucked away at these strange, new combinations. F-sharp minor-7 flat-5? Each chord was a cryptic message I had to decode and then understand. It felt like being dropped off alone in a country where I didn't speak the language.

But I made progress. Chords that initially took me twenty seconds to figure out started to take only a few. My left hand was becoming comfortable in its role of supplying my right hand with a steady bass line. Meanwhile, to my amazement, my right hand began to improvise melodies that sounded undeniably *jazzy*.

It seemed like the hard work of figuring out the exotic jazz chords had sent new melodic understanding straight to my hand, bypassing my brain entirely. I felt like a witness to performances by detached hands; I couldn't believe that I was the one creating these sounds. I'm sure this feeling will not last, but for now I'm enjoying the rare and miraculous feeling of improvising music that I still consider beyond my abilities.

Appendix D

Reading 1 Assessment

Directions: Read each question and answer choice carefully and circle the ONE best answer. Try to answer all questions.

1. Which chord, if any, does the author eventually conclude is the most confusing jazz chord to play?
   a. **The passage does not indicate any such chord**
   b. C-sharp diminished
   c. Major sevenths
   d. F-sharp minor-7 flat-5

2. As it is used in the text, "magician's secrets" most nearly means:
   a. **Information on how to play jazz**
   b. Forbidden bits of knowledge
   c. Instances of harmless trickery
   d. The true nature of a private person

3. As portrayed by the author, Victor responds to the author's *invented* chord with what is best described as:
   a. Amazement
   b. Jealousy
   c. Confusion
   d. **Nonchalance**
4. The author states that "The Real Book" was something he explored for a few:
   a. Years
   b. **Months**
   c. Weeks
   d. Days

5. The details in the following lines primarily serve to suggest the:

   These often bizarre-sounding chords toss in subtle hints of chaos and imbalance, adding a worldly imperfection to otherwise standard chord values. Jazz starts sounding better the older you get, just as candy starts tasting too sweet and a bit of bitterness makes for a more appealing flavor.

   a. **Aspects of jazz's complexity that more mature listeners enjoy**

       b.   Lack of depth and detail found in rock and classical music
       c.   Confusion and awkwardness of standard jazz chord values
       d.   Unpleasantly bitter taste of candy that develops with age

6.   In the context of the passage, the author's following statement most nearly means that: These often bizarre-sounding chords toss in subtle hints of chaos and imbalance, adding a worldly imperfection to otherwise standard chord values. Jazz starts sounding better the older you get, just as candy starts tasting too sweet and a bit of bitterness makes for a more appealing flavor.

       a.   He was so overworked that his hands could still move, but his thoughts were turned off
       b.   He had accidentally trained his hands to resist being controlled by his brain
       c.   It was easier to decode the exotic jazz chords by pointing at them with his hands
       d.   His hand was capable of playing music that his mind was incapable of fully comprehending

7.   The author implies that F-sharp minor-7 flat-5 is an example of a chord that he:
       a.   Had little trouble decoding now that he had "The Real Book"
       b.   Had previously only seen during his travels abroad
       c.   Knew how to play on guitar but not on a piano
       d.   Initially found confusing and struggled to understand

8.   The passage supports which one of the following conclusions about Victor?
       a.   He played music with the author until the author turned 30 years old
       b.   He gave his copy of "The Real Book" to the author as a gift
       c.   He was at one time a member of multiple musical groups
       d.   He invented a chord and named it C-sharp diminished

9.   The passage is best described as being told from the point of view of someone who is:
       a.   Reviewing the chain of events that led to his career in jazz
       b.   Discussing reasons why jazz is less complicated than it seems
       c.   Relating his impressions of jazz music and his attempts to play it
       d.   Highlighting an important friendship that he had in college

10. Assessing his early and later experiences. with "The Real Book," the author most strongly implies that it was:
       a.   Pleasantly strange to begin with but annoyingly familiar by the end

b. Initially difficult to decipher, but ultimately manageable following diligent practice

c. Almost impossible to understand because its pages didn't look like sheets of classical music

d. Very useful as a learning tool, but not useful for more profound study

Appendix E
Gamification Experience Questionnaire

Please read each numbered statement and circle the response that best fits you.

1. I felt like I was learning

1	2	3	4	5
Strongly disagree	disagree	neutral	agree	Strongly agree

2. Playing the game increased my understanding of the material (amended for clarity)

1	2	3	4	5
Strongly disagree	disagree	neutral	agree	Strongly agree

3. This game helped me learn

1	2	3	4	5
Strongly disagree	disagree	neutral	agree	Strongly agree

4. I was concentrating hard (amended for clarity)

1	2	3	4	5
Strongly disagree	disagree	neutral	agree	Strongly agree

5. It provided content that focused my attention

1	2	3	4	5
Strongly disagree	disagree	neutral	agree	Strongly agree

6. I enjoyed what I was doing

1	2	3	4	5
Strongly disagree	disagree	neutral	agree	Strongly agree

7. Interacting with the game was entertaining (amended for clarity)

1	2	3	4	5
Strongly disagree	disagree	neutral	agree	Strongly agree

8. Interacting with the game was fun (amended for clarity)

1	2	3	4	5
Strongly disagree	disagree	neutral	agree	Strongly agree

9. The game was interesting (amended for clarity)

1	2	3	4	5
Strongly disagree	disagree	neutral	agree	Strongly agree

10. I felt bored while playing the game

1	2	3	4	5
Strongly disagree	disagree	neutral	agree	Strongly agree

11. I wish I was doing something else

1	2	3	4	5
Strongly disagree	disagree	neutral	agree	Strongly agree

12. I was immersed in the game (amended for clarity)

1	2	3	4	5
Strongly disagree	disagree	neutral	agree	Strongly agree

13. I lost track of time while playing it

1	2	3	4	5
Strongly disagree	disagree	neutral	agree	Strongly agree

14. I became very involved in the game, forgetting about other things

1	2	3	4	5
Strongly disagree	disagree	neutral	agree	Strongly agree

15. It was challenging

1	2	3	4	5
Strongly disagree	disagree	neutral	agree	Strongly agree

16. Playing it stretched my capabilities to the limit

1	2	3	4	5
Strongly disagree	disagree	neutral	agree	Strongly agree

17. I was not very good at the game

1	2	3	4	5
Strongly disagree	disagree	neutral	agree	Strongly agree

18. I was very skilled at the game

1	2	3	4	5
Strongly disagree	disagree	neutral	agree	Strongly agree

19. I enjoyed playing against (please circle one) [a standard/others]

1	2	3	4	5
Strongly disagree	disagree	neutral	agree	Strongly agree

20. I would have rather played against (please circle one) [a standard/others]

1	2	3	4	5

Strongly disagree	disagree	neutral	agree	Strongly agree

Appendix F
Debriefing Form

Thank you for participating in this study! We hope you enjoyed the experience. This form provides background about our research to help you learn more about why we are doing this study. Please feel free to ask any questions or to comment on any aspect of the study.

You have just participated in a research study conducted by Sarah Bondy, email sebondy@umich.edu

You were told that the purpose of this study was to see how well you remembered information after playing a game about it. In actuality, we were interested in whether competition against a standard or against others is better at increasing memory retention and engagement. To protect the integrity of this research, we could not fully divulge all the details of this study at the start of the procedure.

As you know, your participation in this study is voluntary. If you so wish, you may withdraw after reading this debriefing form, at which point all records of your participation will be destroyed. You will not be penalized if you withdraw. If you would like to seek counseling, resources are available at 2157 University Center, phone number: 313-593-5430, email: umdearborncaps@umich.edu.

I expect to do follow-up experiments with other participants. Because of this, it is important that you do NOT talk (or write or e-mail, etc.) about this project. The main reason for this is that YOUR COMMENTS could influence the expectations, and therefore, performance of a future participant, which would bias our data. Failure to comply with this request may have severe repercussions with regard to the accuracy of the data. YOUR COMMENTS could compromise months of hard work preparing this experiment. We hope you will support our research by keeping your knowledge of this study confidential.

You may keep a copy of this debriefing for your records.

If you have questions now about the research, please ask. If you have questions later, please e-mail Sarah Bondy, sebondy@umich.edu.
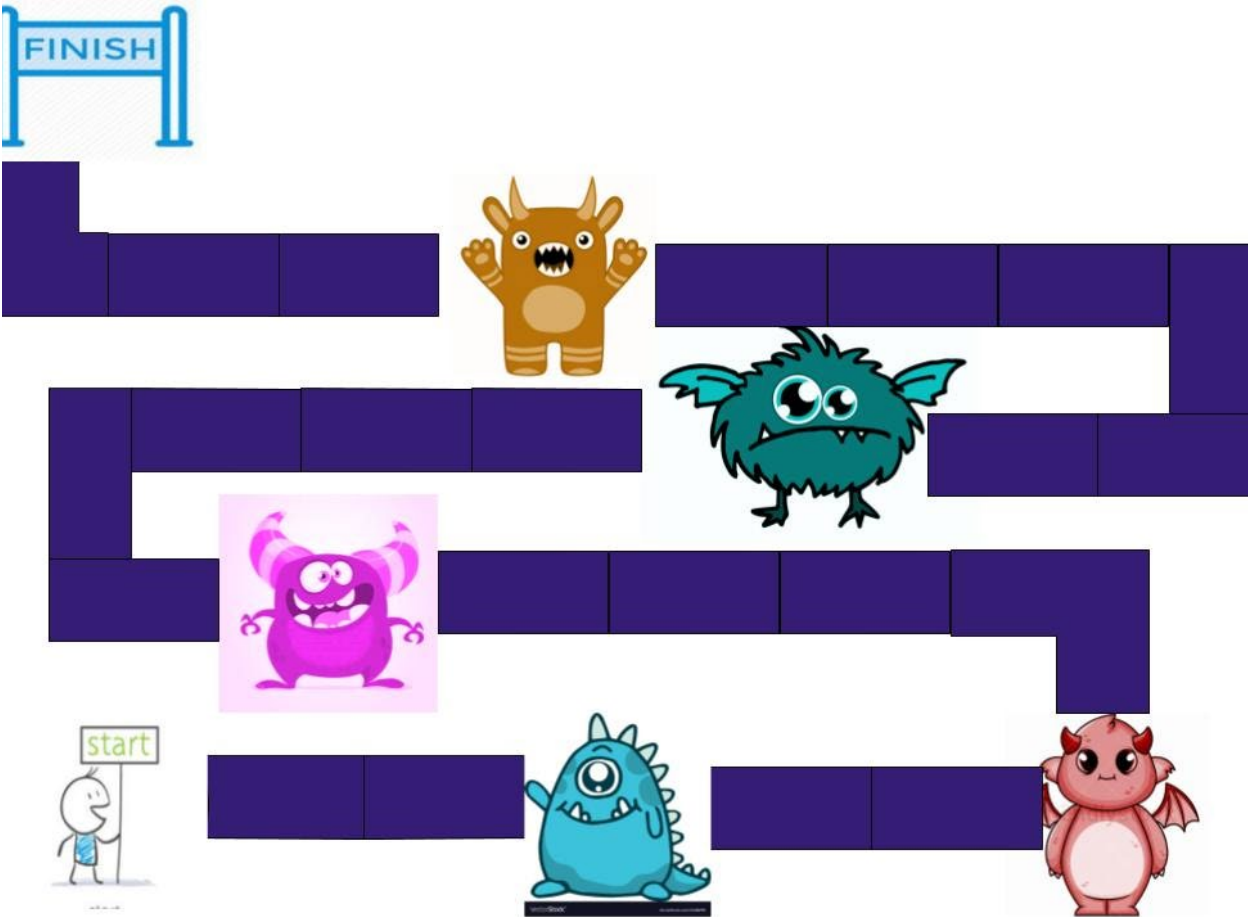
I have read and understand the contents of this debriefing form. I agree to take part in this study.

Signature: _____

Date: _____

Printed Subject Name: _____

Appendix G

Appendix H

Question Cards and Key

Key: <mark style="background-color: #00ff00">gets correct</mark>
         <mark style="background-color: #ff0000">incorrect</mark>

Normal Cards
Q: What two decades of jazz music does the author like best?
A: 1920s and 1930s

Brittany:
Q: What is the trademark of beautiful jazz?
A: <mark style="background-color: #ff0000">the complexity of the music</mark>   **will say**: how well the musician improvises

Zenon:
Q: When did the author first start to play jazz?
<mark style="background-color: #ff0000">A: during college</mark>   **will say:** after meeting Victor

Q: What is the author referring to when he said a part of jazz is the "topic of conversation"?
A: Chord names on the sheet music

Brittany:
Q: What instrument did the author play?
<mark style="background-color: #00ff00">A: guitar</mark>

Zenon:
Q: Who was Victor?
<mark style="background-color: #00ff00">A: the author's bandmate</mark>

Q: T/F jazz is completely improvised
A: F. Jazz is only partly improvised

Brittany
Q: T/F jazz uses more tones than rock music
<mark style="background-color: #00ff00">A: F. Jazz uses the same number of tones but has more chords</mark>

Zenon:
Q: What types of music does the author say operate under a much simpler harmonic than jazz?
A: <mark style="background-color: #ff0000">rock and (early) classical;</mark> **will say**: rock and roll

Q: What is "The Real Book"?
A: a book containing a few hundred classic (jazz) songs

Brittany:
Q: T/F Victor taught the author how to use "The Real Book"
<mark style="background-color: #00ff00">A: F. The author didn't buy a copy of the book until a decade after he and Victor separated</mark>

Zenon:

Q: Which hand does the author describe as making music that sounded undeniably jazzy?
A: right hand

Q: How do musicians improvise while playing jazz?
A: They improvise the embellishments and details while keeping the sheet music's structure

Brittany
Q: What are the two instruments the author wants to learn to play songs on using "The Real Book"?
A: guitar and piano

Zenon
Q: T/F by the end of the passage, the author feels like their brain finally comprehends how to play jazz
A: F (they felt like their brain was being bypassed while hands played)

Monster Cards
Q: What could the author never accept about jazz?
A: that it was improvised → Brittany get right; Zenon → that it was so complex

Q: What emotion best captures the way the author feels about jazz music being improvised?
A: awe/bewilderment/amazement/wonder → both get right

Q: What kept the author from buying "The Real Book" earlier?
A: He was afraid he wouldn't know how to use it → Both;

Q: How does the author feel about their jazz playing abilities by the end of the passage?
A: ecstatic/in wonder/ that it was miraculous/ astonished → Brittany (confident); Zenon (surprised but excited)

Q: What is the title of the article the passage was taken from?
A: Conquering Jazz → Both say idk

Appendix I

Instructions for Competition Against a Standard Condition

Please read the informational material provided. You can revisit the instructions at any

time during the gamification exercise.

Directions for the board game: Choose a game piece and place it on start. To begin your

turn, roll the die and pick up a question card. Without reading the answer, attempt to

answer the question silently. If you got the answer correct, you may move the number of

spaces shown on the die and you receive 1 point. If you answer incorrectly, you do not

move and do not collect any points. Then roll again to begin the next turn.

You will be given 20 minutes to complete this activity. If you have any questions, please

raise your hand. NOTE: When you reach a monster space you must stop. You will get to

answer a monster question your next turn. If you are on a monster space, draw a card

from the monster deck and read the question without looking at the answer. If you get the

answer correct, you get 3 points and can roll and move the number of spaces shown on

the die. If you get the answer incorrect, you may not move forward and get 1 point

subtracted from your point total. Then on your next turn, you may face off the boss again.

The game ends when you reach the finish line. Keep track of how many points you get

throughout the game. The average points most players get is _____.

You will have 20 minutes to complete the game. Raise your hand if you have any

questions.

Appendix J

Instructions for Competition Against Others Condition

Please read the material provided. You can revisit the material at any time during the

gamification exercise.

Directions for the board game: Place each player's game piece on the start square. Players will

roll to see who goes first, the player who rolls the highest gets to start. To start your turn, have

the person to your left read you a question card, if you get the answer wrong you cannot move

and you don't get any points (and the player who read the card must read the correct answer). If

you get the answer correct, you get 1 point and get to roll the die and move that number of

spaces. NOTE: When you reach a monster space you must stop. You will get to answer a

monster question your next turn. If you are on a monster space, have the player to your left

draw a card from the monster deck and read you the question. If you get the answer correct,

you get 3 points and can roll and move the number of spaces shown on the die. If you get the

answer incorrect, you may not move forward and get 1 point subtracted from your point total.

Then on your next turn, you may face off the boss again. The game ends when the first player

reaches the finish line. Once the game ends, each player must count up their points, and the

player with the most points wins!

You will have 20 minutes to complete this activity. If you have any questions, please raise your

hand

Appendix K

Order of Administration Guide

- Random assignment of administrators
    - Researchers will take turns flipping a coin (every time switch who flips it)
        - If it lands on heads, the flipper is in the competition against a group condition and if it lands on tails, the flipper will be in the individual condition
- Random assignment of participants
    - Flip a coin
- Have the participant fill out the informed consent form
    - Have 2 copies: one for us and one for their records
- Have the participant fill out the demographic questionnaire
    - Have them turn it into you when they are done
    - Write participant ID at the top
        - You will write this ID on top of all of the papers they hand in
        - Coding system:
            - 1 (if they are in the individual condition)
            - 0 (if they are competing against others)
            - And the number of participant they are in that condition (with 2 digits)
                - Ex. the first person tested in the individual condition would be coded as 101 and the first person tested in the group condition would be 001
- Have the participant complete the reading
- Run the game
    - Invite the confederates in at this point
        - "These are the people who are participating in this study who you will be playing the game with"
    - When it is over, record the score of the participant
        - For partipant score = percentage based for both conditions
- Have the participant fill out the questionnaire
    - When they are done, have them hand it to researcher
- Have the participant take the multiple-choice test
    - Hand it into researcher
- Debrief the participant and thank them for their participation
    - Give them the debriefing form
    - 2 copies, one for their records and one to hand into you

Appendix L

Rubric for Awarding Points in the Game

In order to award points for a participant's response, at least **2** out of the following criteria should be met:

- Participant's answer was at least 80% factually correct
- The participant got the essence of the question correct, even if they did not say the exact answer
- The participant thinks they got it correct