

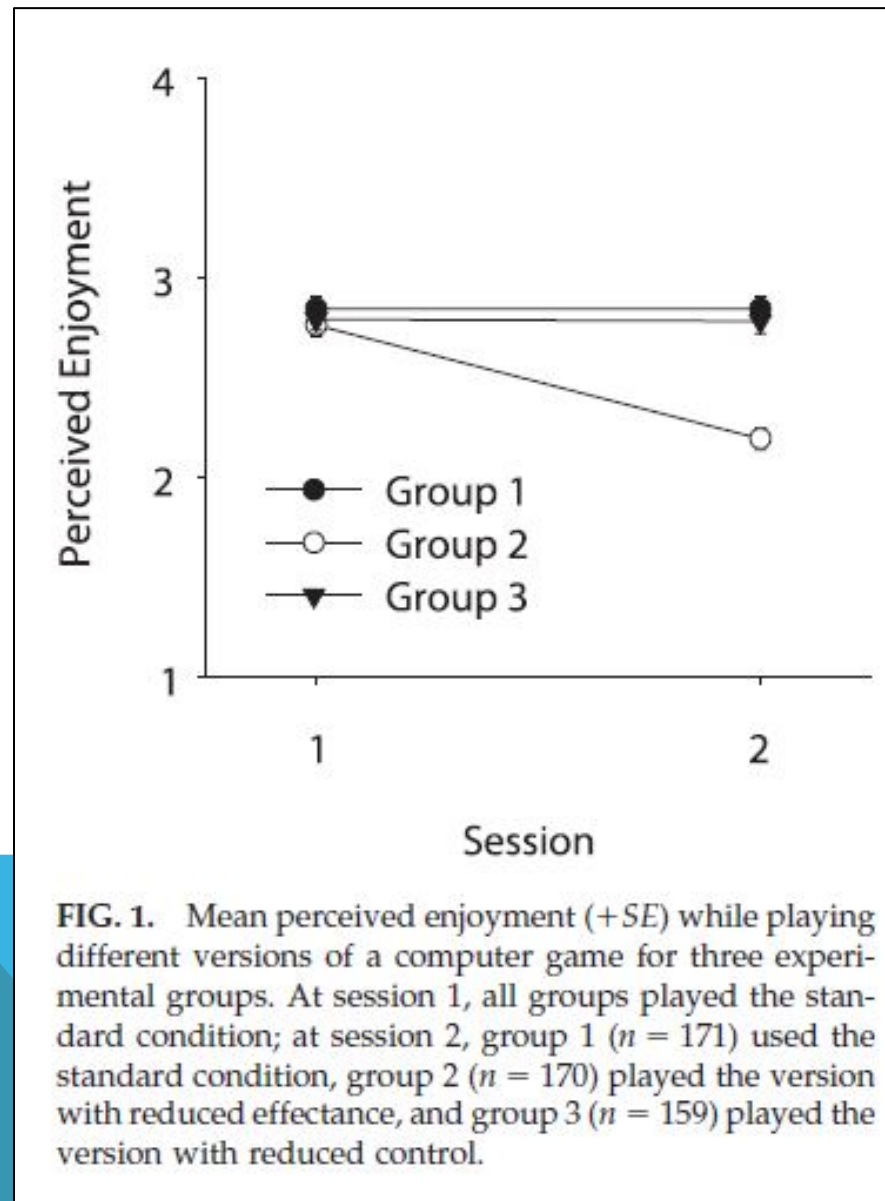
EFFECTANCE AND CONTROL IN VIDEO GAMES

Final Project for CSCE 4250
Spring 2017

PREVIOUS WORK

- Klimmt, Christoph, Tilo Hartmann, and Andreas Frey. "Effectance and Control as Determinants of Video Game Enjoyment." *CyberPsychology & Behavior* 10.6 (2007): 845-48. Web.
 - **Result:** Reducing the player's perceived effectance reduced their enjoyment, but reducing the player's perceived control did not. Therefore, effectance and control are important aspects of video game enjoyment, but they are not the sole determinant of how "fun" a game is.
 - **Justification:** The authors produced 3 versions of a breakout clone: a normal (control) version, a version where the controls did not respond 1/3 of the time (reduced effectance condition), and a version where the ball moved much faster (reduced control condition). 500 volunteers then participated in an online between-subjects research study with 3 groups: a group that played the control twice, a group that played the control followed by the reduced effectance condition, and a group that played the control followed by the reduced control condition. The participants then filled out a questionnaire, which justified their results.

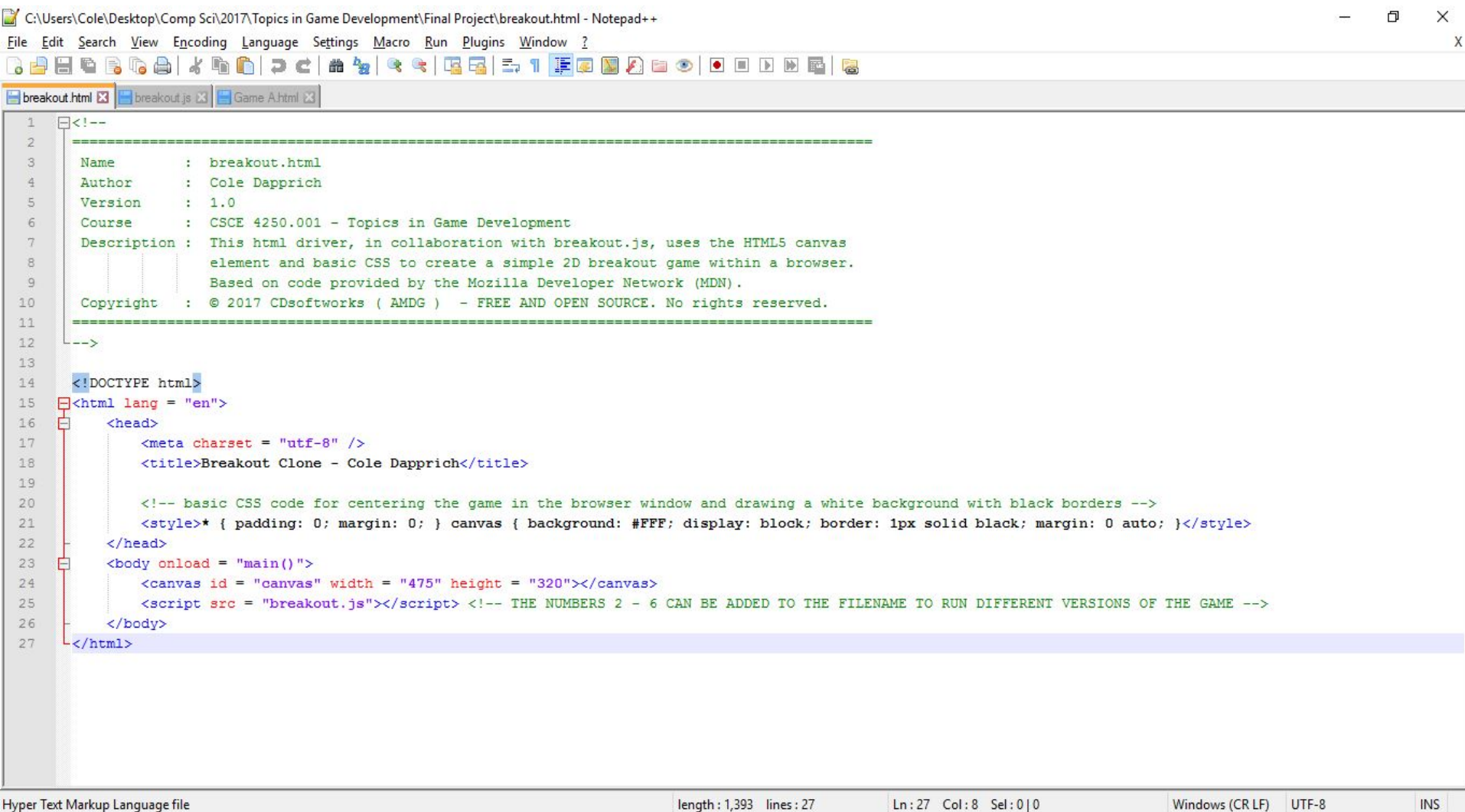
PREVIOUS WORK



IMPLEMENTATION

- I designed and implemented 5 different versions of a Breakout clone
 - Written in HTML5, CSS, and JavaScript
 - Reasons: portability, simplicity, and ease of distribution
 - Version 1: Experimental control (standard version)
 - Version 2: Mouse controls
 - Increased control and effectance conditions
 - Version 3: Increased ball speed and decreased paddle speed
 - Decreased control condition
 - Version 4: Controls respond only 75% of the time
 - Decreased effectance condition
 - Version 5: Paddle moves automatically, user controls its speed
 - Decreased control and effectance conditions
 - Randomized
 - First game (Game A) is not the control, etc.

IMPLEMENTATION

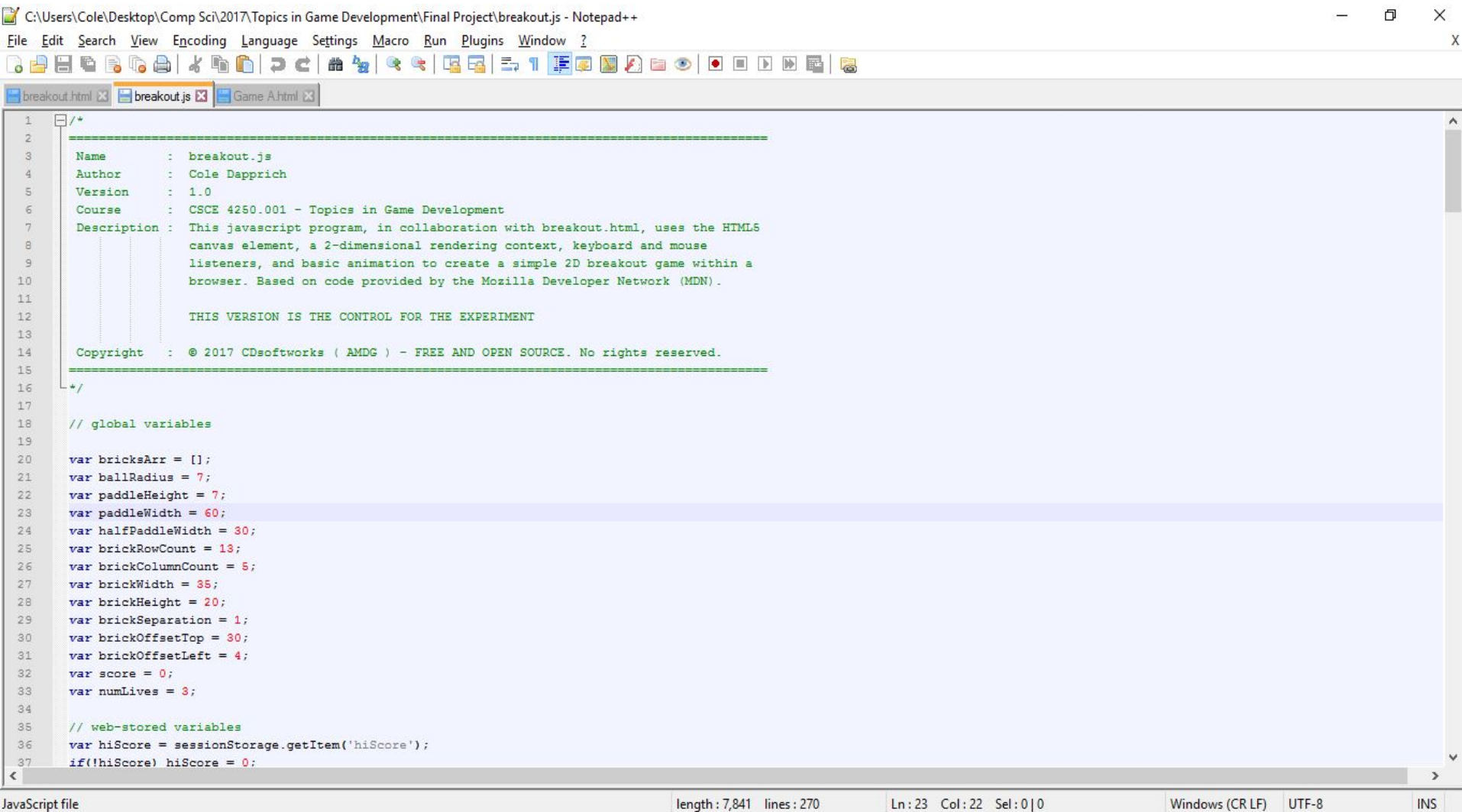


The screenshot shows a Notepad++ window with the file path `C:\Users\Cole\Desktop\Comp Sci\2017\Topics in Game Development\Final Project\breakout.html`. The window displays the HTML code for a Breakout game. The code includes a multi-line comment at the top with metadata such as Name, Author, Version, Course, Description, and Copyright. Below the comment is the HTML boilerplate, including the DOCTYPE declaration, the `<html>` tag with language set to English, and the `<head>` section. The `<head>` section contains a meta charset declaration, a title "Breakout Clone - Cole Dapprich", and a CSS style block for centering the game canvas. The `<body>` section includes an `onload` event that calls a `main()` function, a canvas element with dimensions 475x320, and a script tag for `breakout.js`. A comment at the end of the script tag indicates that numbers 2-6 in the filename can be used to run different versions of the game.

```
1  <!--
2  =====
3  Name       : breakout.html
4  Author     : Cole Dapprich
5  Version    : 1.0
6  Course     : CSCE 4250.001 - Topics in Game Development
7  Description : This html driver, in collaboration with breakout.js, uses the HTML5 canvas
8                element and basic CSS to create a simple 2D breakout game within a browser.
9                Based on code provided by the Mozilla Developer Network (MDN).
10 Copyright  : © 2017 CDsoftworks ( AMDG ) - FREE AND OPEN SOURCE. No rights reserved.
11  =====
12  -->
13
14  <!DOCTYPE html>
15  <html lang = "en">
16  <head>
17      <meta charset = "utf-8" />
18      <title>Breakout Clone - Cole Dapprich</title>
19
20      <!-- basic CSS code for centering the game in the browser window and drawing a white background with black borders -->
21      <style>* { padding: 0; margin: 0; } canvas { background: #FFF; display: block; border: 1px solid black; margin: 0 auto; }</style>
22  </head>
23  <body onload = "main()">
24      <canvas id = "canvas" width = "475" height = "320"></canvas>
25      <script src = "breakout.js"></script> <!-- THE NUMBERS 2 - 6 CAN BE ADDED TO THE FILENAME TO RUN DIFFERENT VERSIONS OF THE GAME -->
26  </body>
27  </html>
```

Hyper Text Markup Language file length : 1,393 lines : 27 Ln : 27 Col : 8 Sel : 0 | 0 Windows (CR LF) UTF-8 INS

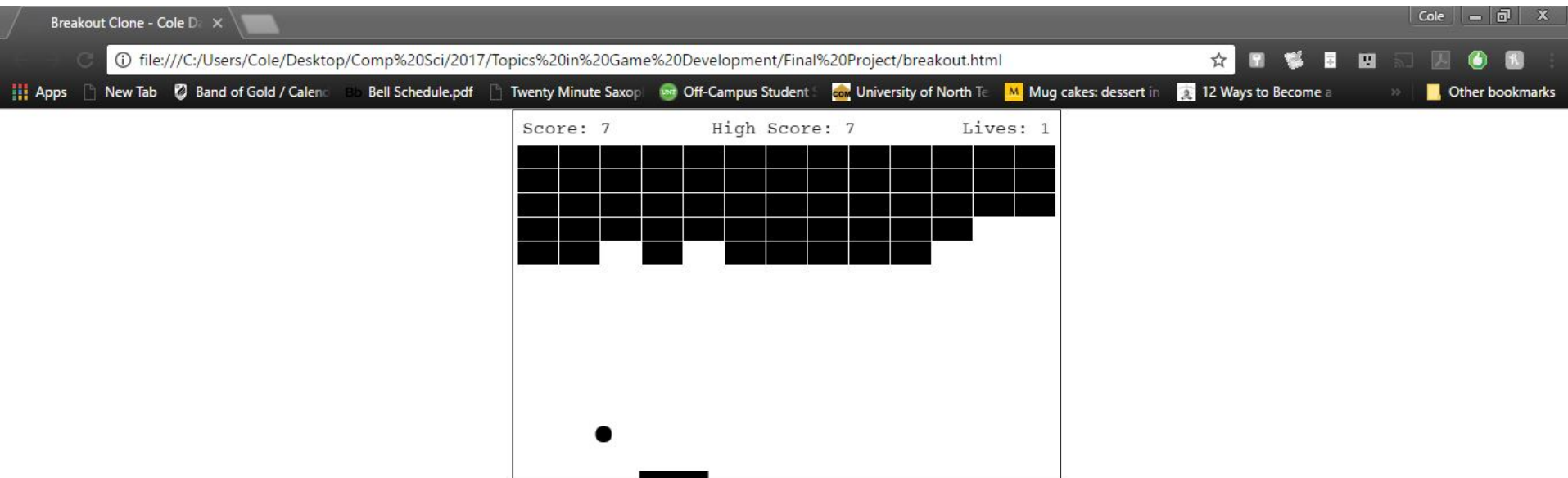
IMPLEMENTATION



```
1  /*
2  =====
3  Name       : breakout.js
4  Author      : Cole Dapprich
5  Version     : 1.0
6  Course      : CSCE 4250.001 - Topics in Game Development
7  Description  : This javascript program, in collaboration with breakout.html, uses the HTML5
8                  canvas element, a 2-dimensional rendering context, keyboard and mouse
9                  listeners, and basic animation to create a simple 2D breakout game within a
10                 browser. Based on code provided by the Mozilla Developer Network (MDN) .
11
12                 THIS VERSION IS THE CONTROL FOR THE EXPERIMENT
13
14  Copyright   : © 2017 CDsoftworks ( AMDG ) - FREE AND OPEN SOURCE. No rights reserved.
15  =====
16  */
17
18  // global variables
19
20  var bricksArr = [];
21  var ballRadius = 7;
22  var paddleHeight = 7;
23  var paddleWidth = 60;
24  var halfPaddleWidth = 30;
25  var brickRowCount = 13;
26  var brickColumnCount = 5;
27  var brickWidth = 35;
28  var brickHeight = 20;
29  var brickSeparation = 1;
30  var brickOffsetTop = 30;
31  var brickOffsetLeft = 4;
32  var score = 0;
33  var numLives = 3;
34
35  // web-stored variables
36  var hiScore = sessionStorage.getItem('hiScore');
37  if(!hiScore) hiScore = 0;
```

JavaScript file length : 7,841 lines : 270 Ln : 23 Col : 22 Sel : 0 | 0 Windows (CR LF) UTF-8 INS

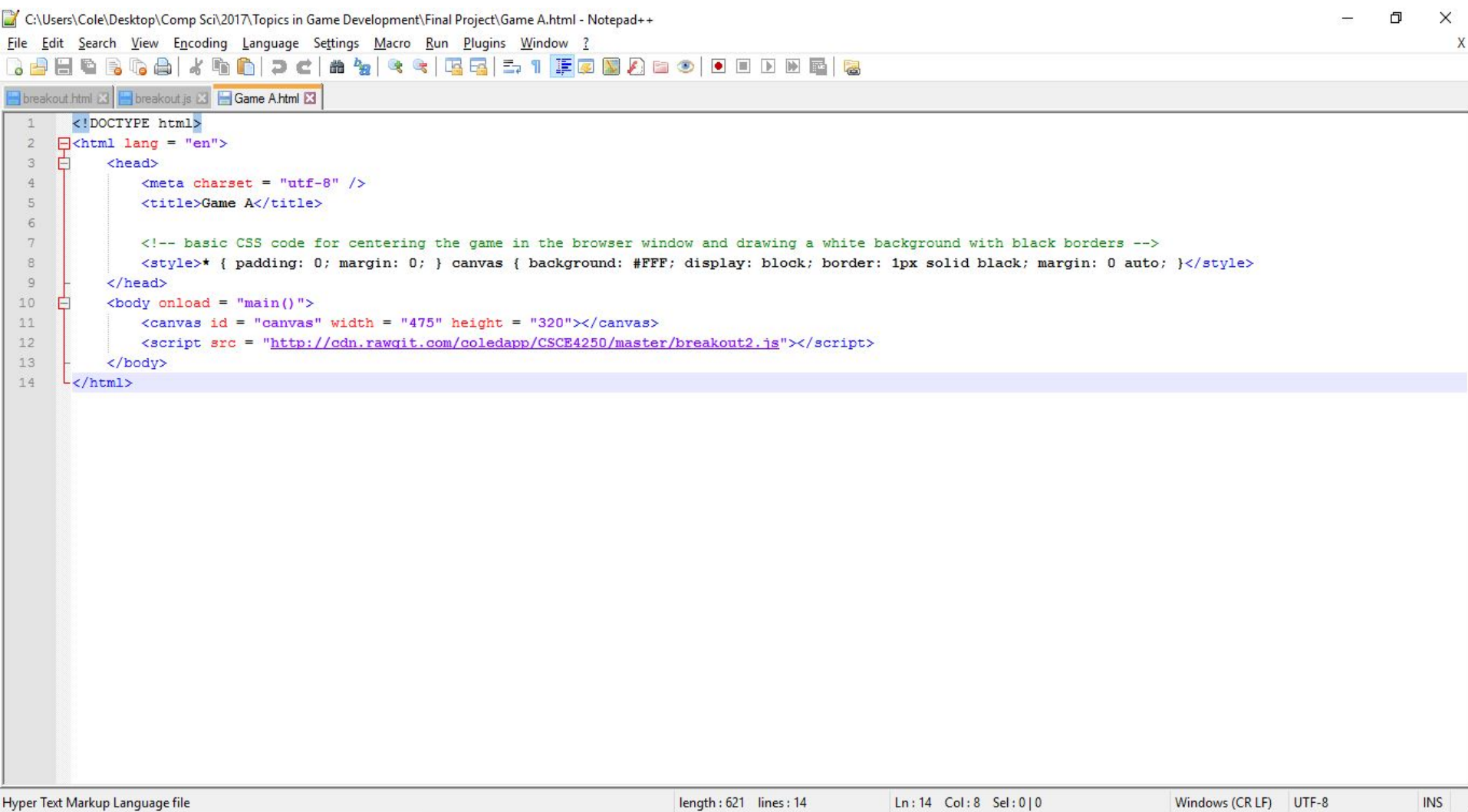
IMPLEMENTATION



EXPERIMENTATION

- I designed a within-subjects research study that had each participant play the 5 versions of Breakout in random order, in an attempt to reduce the effects of ordering and fatigue
 - Reasons: time and numbers limitations
 - Using random.org, a “true” RNG that uses atmospheric noise
 - 29 participants in total
 - Were told to play each version as many times as they liked
- The participants were then asked to complete a survey about their experience
 - Using SurveyMonkey

EXPERIMENTATION



```
1 <!DOCTYPE html>
2 <html lang = "en">
3   <head>
4     <meta charset = "utf-8" />
5     <title>Game A</title>
6
7     <!-- basic CSS code for centering the game in the browser window and drawing a white background with black borders -->
8     <style>* { padding: 0; margin: 0; } canvas { background: #FFF; display: block; border: 1px solid black; margin: 0 auto; }</style>
9   </head>
10  <body onload = "main()">
11    <canvas id = "canvas" width = "475" height = "320"></canvas>
12    <script src = "http://odn.rawgit.com/coledapp/CSCE4250/master/breakout2.js"></script>
13  </body>
14 </html>
```

Hyper Text Markup Language file length : 621 lines : 14 Ln: 14 Col: 8 Sel: 0 | 0 Windows (CR LF) UTF-8 INS

EXPERIMENTATION

[Home](#) [Games](#) [Numbers](#) [Lists & More](#) [Drawings](#) [Web Tools](#) [Statistics](#) [Testimonials](#) [Learn More](#) [Login](#)

RANDOM.ORG

Google Custom Search

True Random Number Service

Do you own an iOS or Android device? [Check out our app!](#)

List Randomizer

There were 5 items in your list. Here they are in random order:

1. B
2. C
3. E
4. A
5. D

IP: 71.12.46.221
Timestamp: 2017-04-24 18:51:12 UTC

You have randomized this list 13 times.

Again!

Go Back

Follow @RandomOrg

4,613 followers

Like 1.1M

Share

Follow

22k

© 1998-2017 RANDOM.ORG

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EXPERIMENTATION

[SURVEY PREVIEW MODE] x

Secure | https://www.surveymonkey.com/r/Preview/?sm=7YBUr0bOWCJQbP9C4rbfxWSD_2BF7_2FMyM9B20ZeOHwkBMVY4Wlb2wcr5svbz01_2Foia

Apps New Tab Band of Gold / Calenc Bb Bell Schedule.pdf Twenty Minute Saxop Off-Campus Student University of North Te Mug cakes: dessert in 12 Ways to Become a Other bookmarks

SurveyMonkey® Preview & Test

CSCE 4250 Final Project - Cole Dapprich

1. What is your age?

- ☐ 18 to 24
- ☐ 25 to 34
- ☐ 35 to 44
- ☐ 45 to 54
- ☐ 55 to 64
- ☐ 65 to 74
- ☐ 75 or older

2. What is your gender?

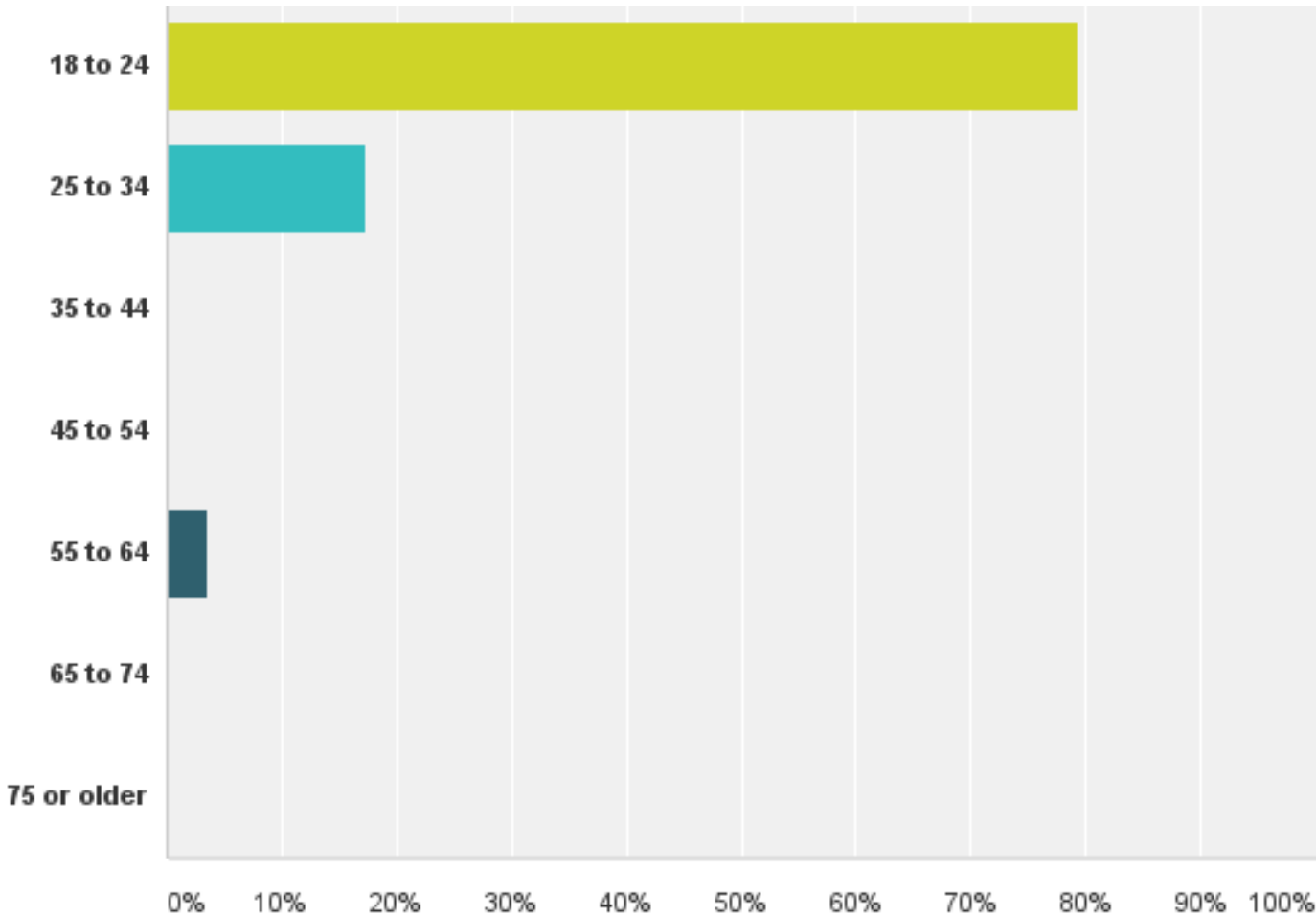
- ☐ Female

Desktop Tablet Phone

RESULTS

Q1: What is your age?

Answered: 29 Skipped: 0



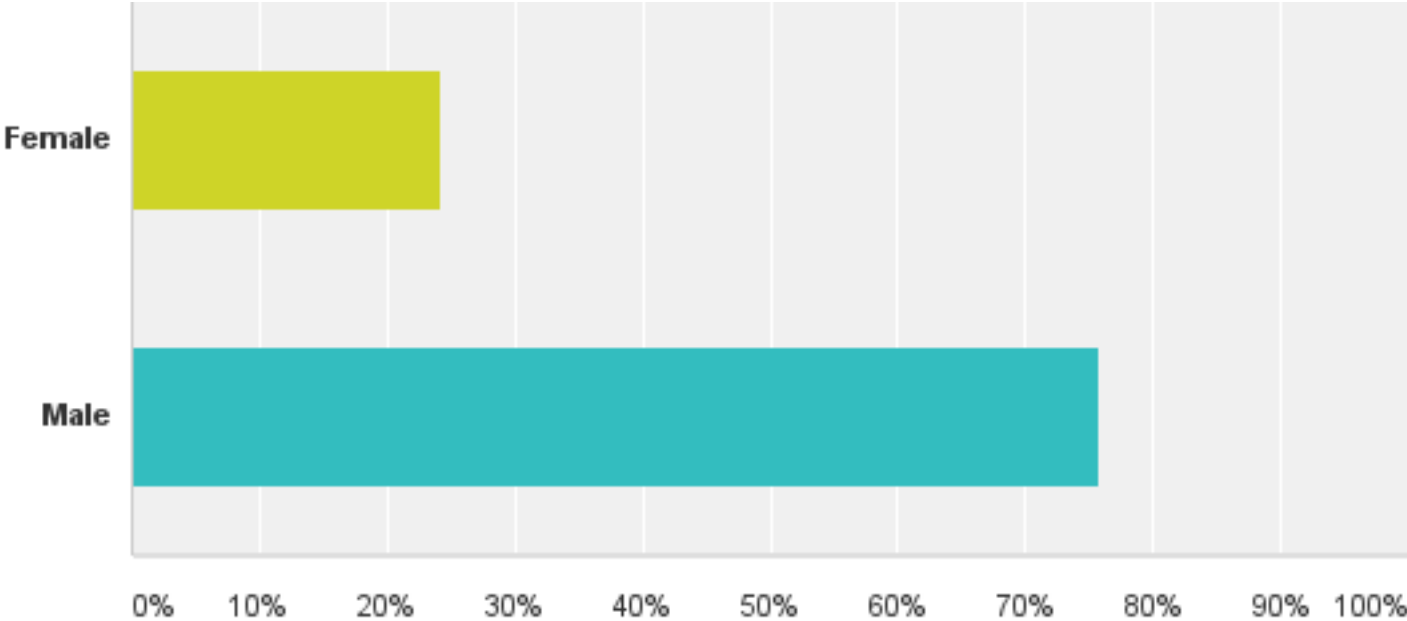
Q1: What is your age?

Answered: 29 Skipped: 0

Answer Choices	Responses	
18 to 24	79.31%	23
25 to 34	17.24%	5
35 to 44	0.00%	0
45 to 54	0.00%	0
55 to 64	3.45%	1
65 to 74	0.00%	0
75 or older	0.00%	0
Total		29

Q2: What is your gender?

Answered: 29 Skipped: 0



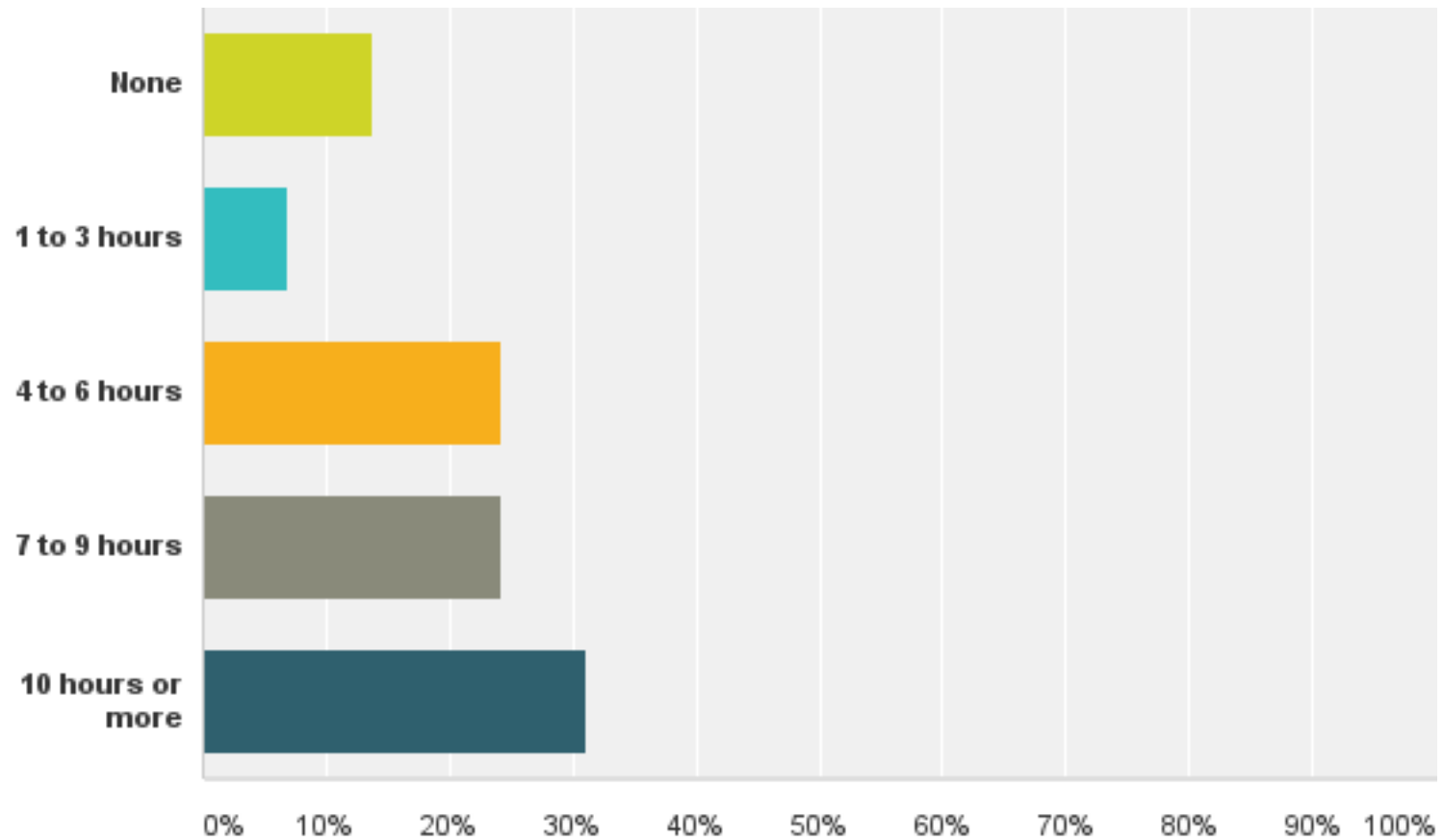
Q2: What is your gender?

Answered: 29 Skipped: 0

Answer Choices	Responses	
Female	24.14%	7
Male	75.86%	22
Total		29

Q3: In the past 7 days, roughly how many hours have you spent playing video games (e.g. gaming consoles, mobile phones, computers, etc.)?

Answered: 29 Skipped: 0



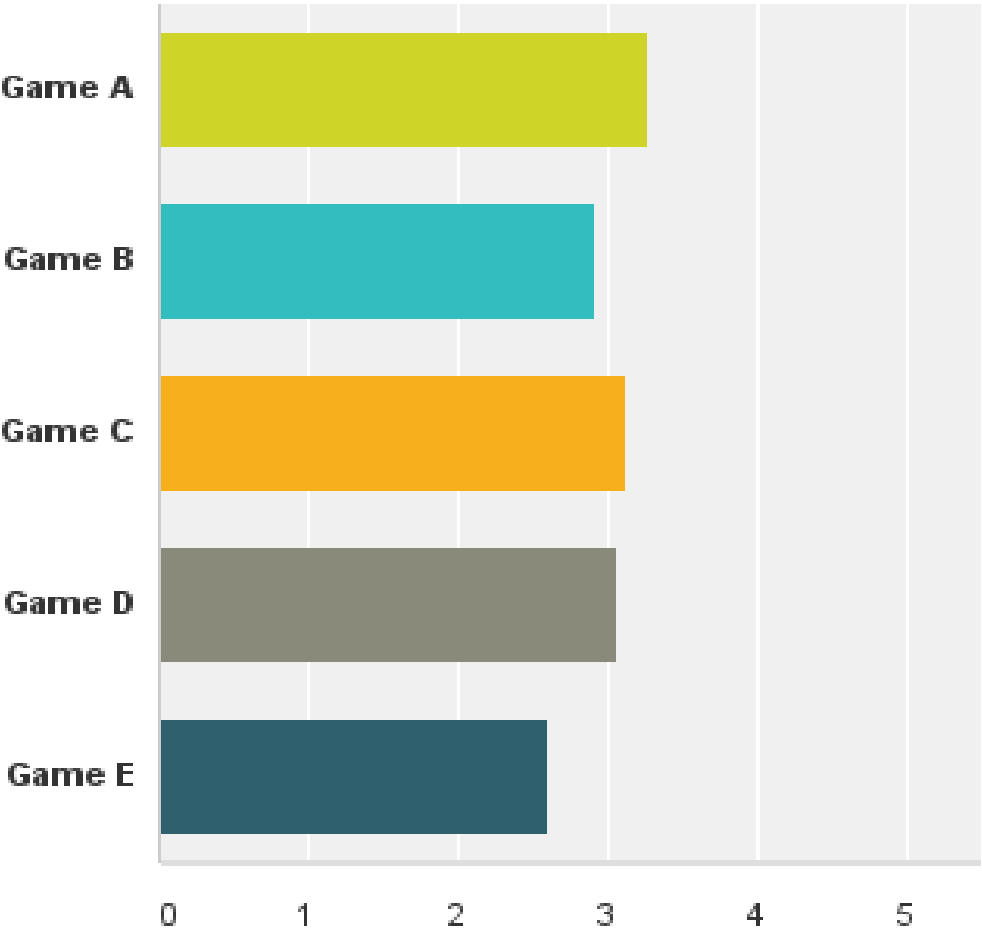
Q3: In the past 7 days, roughly how many hours have you spent playing video games (e.g. gaming consoles, mobile phones, computers, etc.)?

Answered: 29 Skipped: 0

Answer Choices	Responses	
None	13.79%	4
1 to 3 hours	6.90%	2
4 to 6 hours	24.14%	7
7 to 9 hours	24.14%	7
10 hours or more	31.03%	9
Total	29	

Q4: Please indicate the order in which you played the games.

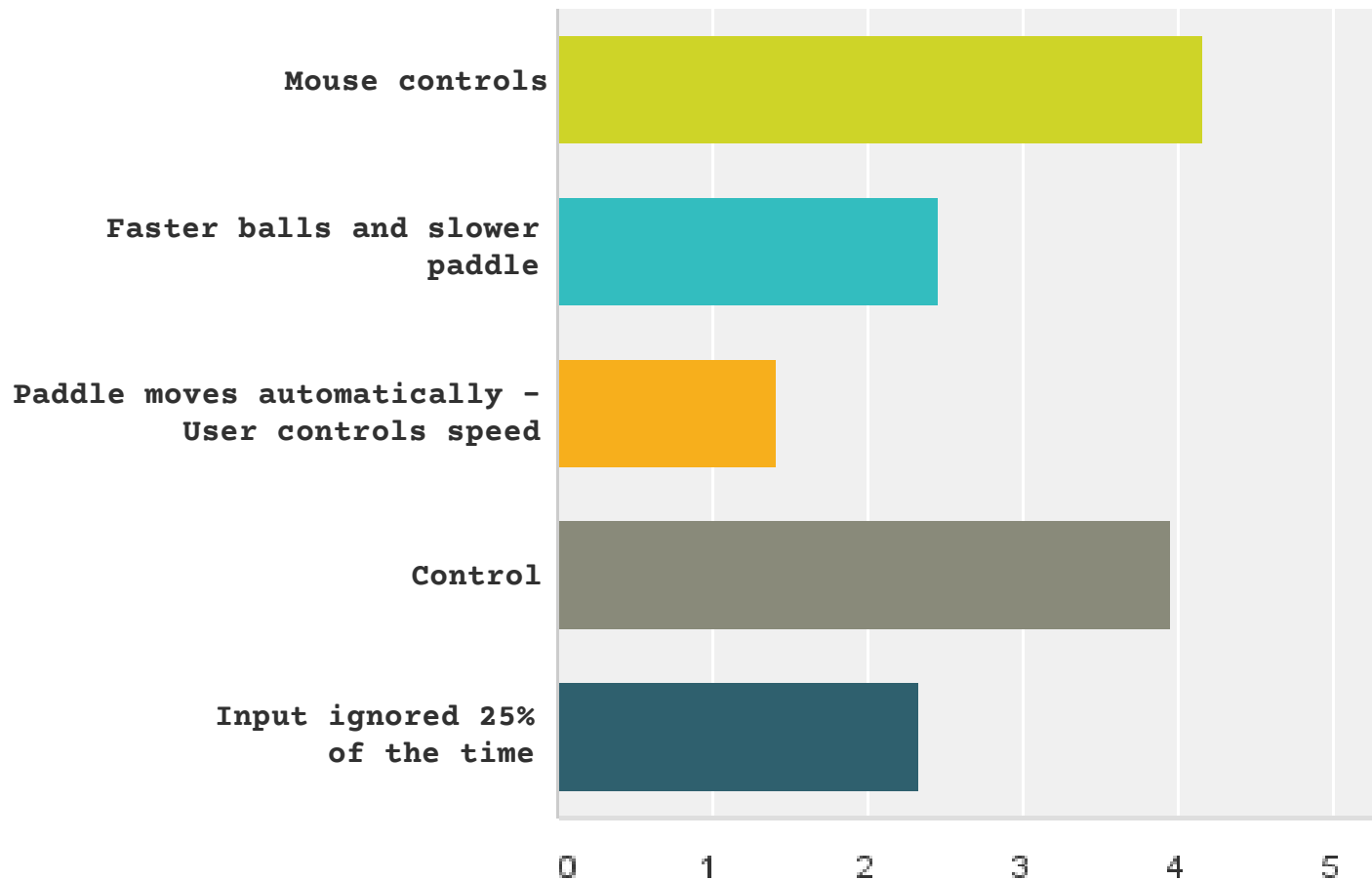
Answered: 29 Skipped: 0



Q5: Please indicate the level of effectance (your ability to affect the game environment) you felt during each game.

Answered: 29

Skipped: 0



Q5: Please indicate the level of effectance (your ability to affect the game environment) you felt during each game.

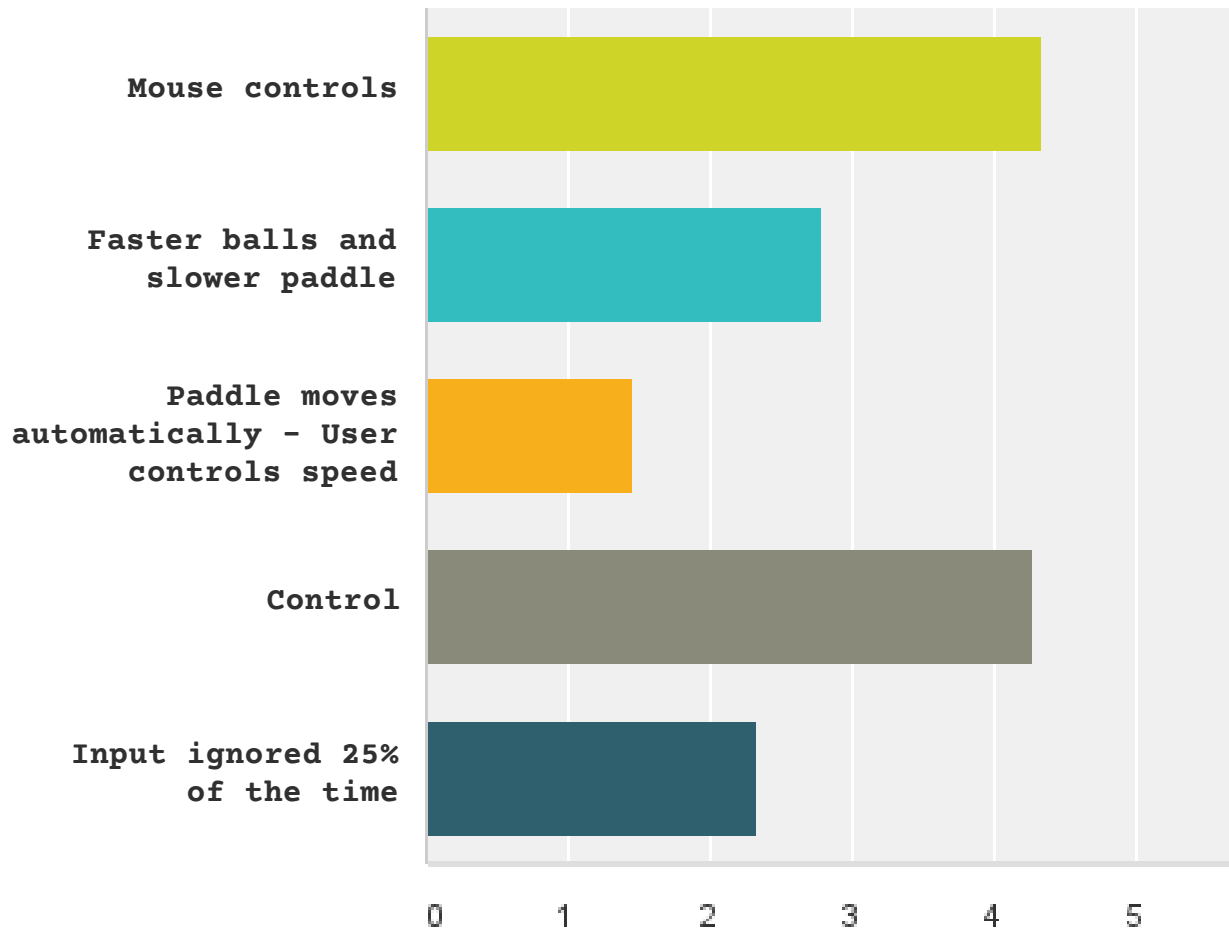
Answered: 29 Skipped: 0

	No effectance felt	Slight amount of effectance felt	Moderate amount of effectance felt	Fair amount of effectance felt	Extreme amount of effectance felt	Total	Weighted Average
Mouse controls	6.90% 2	10.34% 3	3.45% 1	17.24% 5	62.07% 18	29	4.17
Faster balls and slower paddle	10.71% 3	50.00% 14	25.00% 7	10.71% 3	3.57% 1	28	2.46
Paddle moves automatically - User controls speed	71.43% 20	17.86% 5	7.14% 2	3.57% 1	0.00% 0	28	1.43
Control	0.00% 0	10.71% 3	14.29% 4	42.86% 12	32.14% 9	28	3.96
Input ignored 25% of the time	20.69% 6	44.83% 13	20.69% 6	6.90% 2	6.90% 2	29	2.34

Q6: Please indicate the level of control (your ability to anticipate and influence the game in order to achieve your goal) that you felt during each game.

Answered: 29

Skipped: 0



Q6: Please indicate the level of control (your ability to anticipate and influence the game in order to achieve your goal) that you felt during each game.

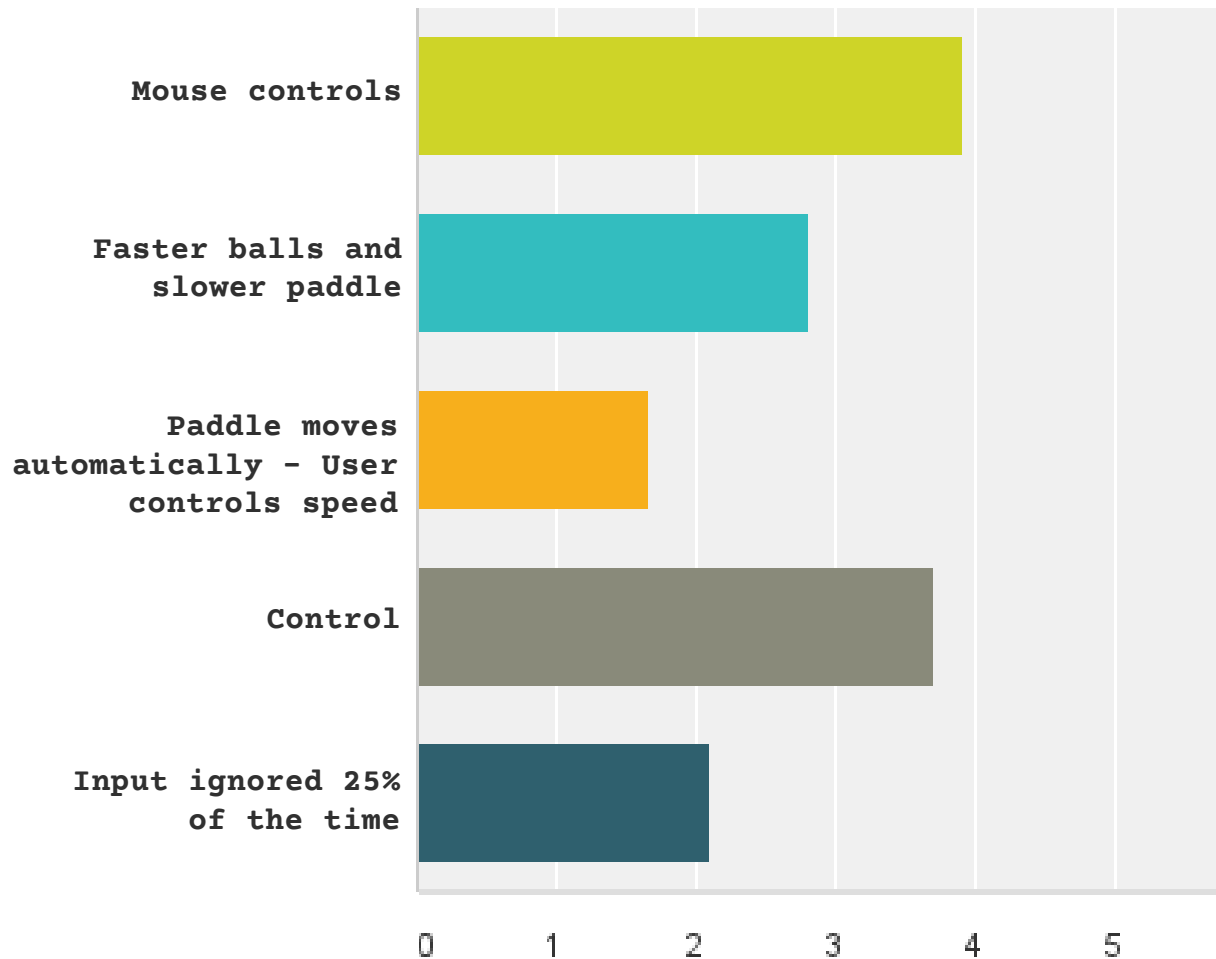
Answered: 29 Skipped: 0

	No control felt	Slight control felt	Moderate control felt	Fair control felt	Extreme control felt	Total	Weighted Average
Mouse controls	6.90% 2	3.45% 1	3.45% 1	20.69% 6	65.52% 19	29	4.34
Faster balls and slower paddle	10.71% 3	32.14% 9	35.71% 10	10.71% 3	10.71% 3	28	2.79
Paddle moves automatically - User controls speed	67.86% 19	25.00% 7	3.57% 1	0.00% 0	3.57% 1	28	1.46
Control	0.00% 0	0.00% 0	14.29% 4	42.86% 12	42.86% 12	28	4.29
Input ignored 25% of the time	24.14% 7	37.93% 11	24.14% 7	6.90% 2	6.90% 2	29	2.34

Q7: Please indicate the level of enjoyment (the amount of fun and desire to keep playing) that you felt during each game.

Answered: 29

Skipped: 0



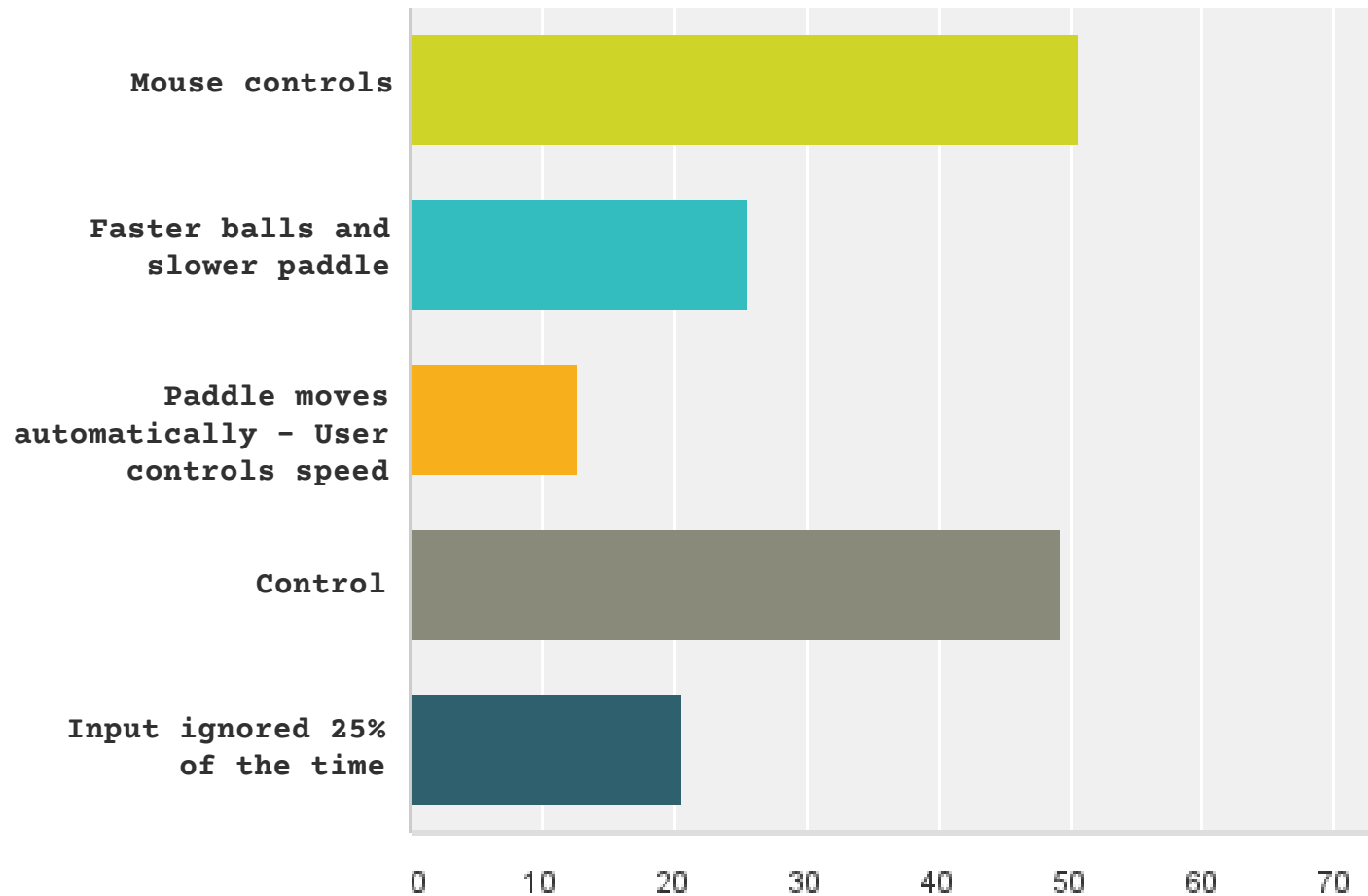
Q7: Please indicate the level of enjoyment (the amount of fun and desire to keep playing) that you felt during each game.

Answered: 29 Skipped: 0

	No enjoyment felt	Slight enjoyment felt	Moderate enjoyment felt	Fair enjoyment felt	Extreme enjoyment felt	Total	Weighted Average
Mouse controls	7.14% 2	7.14% 2	7.14% 2	42.86% 12	35.71% 10	28	3.93
Faster balls and slower paddle	14.29% 4	32.14% 9	21.43% 6	21.43% 6	10.71% 3	28	2.82
Paddle moves automatically - User controls speed	71.43% 20	7.14% 2	10.71% 3	3.57% 1	7.14% 2	28	1.68
Control	0.00% 0	10.71% 3	17.86% 5	60.71% 17	10.71% 3	28	3.71
Input ignored 25% of the time	34.48% 10	37.93% 11	10.34% 3	17.24% 5	0.00% 0	29	2.10

Q8: Please enter the highest score you were able to achieve in each game.

Answered: 29 Skipped: 0



Q8: Please enter the highest score you were able to achieve in each game.

Answered: 29 Skipped: 0

Answer Choices	Average Number	Total Number	Responses
Mouse controls	51	1,469	29
Faster balls and slower paddle	26	744	29
Paddle moves automatically - User controls speed	13	371	29
Control	49	1,429	29
Input ignored 25% of the time	21	600	29
Total Respondents: 29			

VALIDATION

- I was able to validate Klimmt Et Al.'s result that reduced effectance directly leads to decreased enjoyment for the player (Game E / Ignoring random inputs).
 - Additionally, I was able to expand on this result by showing that *increased* effectance and control led to increased enjoyment (Game A / Mouse controls) **and** even less effectance and control led to even less enjoyment (Game C / Automatic paddle movement, user-controlled paddle speed).
 - Not only did the participants find the higher effectance and control conditions more enjoyable, but they also were able to achieve a significantly higher score in those conditions.
- However, while the original paper found that decreased control did not lead to decreased enjoyment, my study did. The difference was smaller than decreased effectance, but it was still significant (Game B / Faster ball and slower paddle).
 - Possible reasons: different sample sizes, different numbers of "hardcore" gamers, relative extremity of my reduced control condition, order effects

LINKS

- Original paper:
 - <https://drive.google.com/file/d/0BzbGO6AAs4pPanBMQ21MR1VhbjqO/view?usp=sharing>
- Full source code:
 - **Version 1**
 - <https://www.dropbox.com/s/dfmuc5ofrm3552y/breakout.js?dl=0>
 - **Version 2**
 - <https://www.dropbox.com/s/nuua6orf207iy78/breakout2.js?dl=0>
 - **Version 3**
 - <https://www.dropbox.com/s/0nvzmdzljsftsfa/breakout3.js?dl=0>
 - **Version 4**
 - <https://www.dropbox.com/s/e755czohmzo7h7n/breakout4.js?dl=0>
 - **Version 5**
 - <https://www.dropbox.com/s/ozf0dmzfapukf5l/breakout5.js?dl=0>
 - **HTML**
 - <https://drive.google.com/file/d/0BzbGO6AAs4pPdmp6dDZQWmlYOGc/view?usp=sharing>
- Raw data:
 - https://docs.google.com/spreadsheets/d/1HcRCxwVvSJWk_19fNiU3QGtzKPUFBtB68c0xgZ1S7EA/edit?usp=sharing