5/17/2019

A heuristical study on Energy Drinks and the effects they have on Gaming Performance

BSc (Hons) Computer Games Technology

CMP6102 Individual Project UG3 A AYR 2018/9

Researcher: Lewis Farrell
Supervisor: Dr. Carlo Harvey
BIRMINGHAM CITY UNIVERSITY

Contents

Table of Figures

Abstract

Energy Drinks are often associated with Video Games through various marketing techniques such as Product Placement and Influencer Endorsements, which may result in the primary demographic for gaming to be more inclined to consume Energy Drinks, potentially exposing them to the risks involved with Energy Drink consumption. Research has shown the primary demographic for video gaming is adolescent's aged 16-24 which is also the same demographic for Energy Drink consumption. Further research has shown that Product Placement is an effective technique that can influence a person's decision to purchase a particular product and adolescents are unaware of the ingredients as well as the risks involved with Energy Drink consumption. This study aims to provide an insight into how Energy Drink affect a person's performance while playing Video Games and raise awareness to the risks involved with consuming Energy Drinks.

A total of 30 undergraduate participants were asked to complete a short questionnaire in order to identify if they had consumed any Energy Drinks in the past 24 hours, and were then asked to use the benchmark product created for this study which measured their Reaction Time, Accuracy and Eye Fixation patterns. A final product was created which used this data in conjunction with machine learning algorithms to predict a user's Reaction Time and Accuracy as well as providing information on the risks involved with Energy Drink consumption.

Analysis of the data collected showed the participant who consumed at least 1 Energy Drink within a 24 hour period has a statistically significant faster Reactions Times and less eye fixations than those who did not. There was no statistically significant difference in accuracy between the groups. The results indicate Energy Drinks are capable of improving Gaming Performance when used while playing games that fundamentally rely on Reaction Time, however, if used when playing games which fundamentally rely on accuracy, there will not be a notable performance increase.

The findings from this study can be used to benefit the overall research into the effects of Energy Drinks as well as providing Energy Drink users with more insight into how Energy Drinks may affect their performance when used in combination with Video Games. The products created from this study also help provide guidance to Energy Drink users by visually showing the performance difference between the numbers of Energy Drinks consumed while explaining the potential risks involved with Energy Drink Consumption.

Chapter 1: Introduction

1.1 Esports and Advertising

Product placement is “the integration of a product or a brand into a film or televised series” and is a technique that dates back to the 1880’s (Lehu, 2007). A notable example of Product Placement can be seen in the movie E.T where the alien followed a trail of Hershey's Reese's Pieces to his new home. Because of the popularity of the film, and this scene in particular, the total sales of Reese's Pieces increased dramatically (Snyder, 1992; Van Biema, 1982, cited in Jay Newell, 2006). As the Internet and online platforms have become more and more popular, product placing has expanded further than the traditional “Film” or “Televised Series” and can now be seen in many different forms over the Internet. An example of this is the Esports Industry where Energy Drink companies, among others, use it to market their products towards the gaming industry.

Esports, also known as Electronic Sports, is a collection of professionally organised events in which competitions take place using Video Games, and is part of the Video Game Industry. Esports, although not officially labelled as such until recently, has been around for a very long time, dating back to the 80’s with game titles such as Pac-Man being used as the primary platform for competition between Video Game enthusiasts. Over the years, Esports has continued to grow, which has resulted in professionally organised Leagues and tournaments being created where players or teams of players from all around the world compete for cash prizes. Similar to traditional sports such as Football, the players and teams are sponsored by other brands and companies. However, instead of being sponsored by sporting companies such as Nike or Adidas, they are sponsored by Energy Drinks companies such as Red bull or Monster Energy. In return for the benefits these brands and companies provide, the players and teams promote them to their audience while competing on stage or during public appearances, mostly notably through product placement on the clothing they wear. In 2017, there was over 143 million enthusiasts watching esports related events either in person or online (Statista, 2018).

In addition to investing in Esports, Energy Drink companies target their advertising and branding around the latest video game trends. In 2017, Monster Energy produced and sold an Energy Drink can which was entirely branded for the popular video game series Call of Duty. The can offered in-game promotions which could be redeemed by using the code which came with it. Call of Duty: WWII which released in 2017 had over $1 billion in sales for that year (Makuch, 2017) and Monster Energy had a total of $3.4 billion sales for the same year, a 10.5% increase from the previous year which was documented as $3 Billion (Monster Beverage Corp, 2018).

Furthermore, Video Based Social Media websites are also used by Energy Drink companies to further promote their products. Twitch.tv is a livestreaming website where people can stream themselves playing video games which can be watched live by other people all around the world. In December 2018, Twitch.tv had a total of 868 million people visit their site, placing it in the top 52 websites in the world (Similarweb, 2019). In July 2018, Energy Drink Company Red Bull partnered with popular Twitch streamer known as Ninja, who at the time was the number 1 Steamer on the site. From this point onwards, Ninja's future broadcasts featured Red Bull branding and endorsements which could be seen by all of his viewers. In the year 2018, Ninja had a total of 12 million followers and an average of 80,000 Concurrent Viewers on a daily basis (sullygnome, 2019).

1.2 Rationale

The Video Game industry is expanding and growing every year at rapid rates, and is now responsible for more than half of the UK's entertainment industry revenue (Hoggins, 2019). In 2017, the market value for the Video Game Industry was estimated at £5.11bn, which was a 12.4% increase from the previous year which was estimated to be £4.33bn (Ukie, 2018). These figures demonstrate the rapid growth the Video Game Industry is experiencing, and with this growth comes a lot more consumers. The consumers may eventually start becoming more involved with the Video Game Industry by watching Twitch.tv livestreams of their favourite video game, or supporting their favourite team at an Esports event. No matter how they become more involved with the Video Game Industry, the risk of exposure to Energy Drink related marketing will always be there.

In the UK, as of 2018 Q1, 25% of UK gamers are males and females between the ages of 15 - 24 (Ukie, 2018). This directly overlaps with the results concluded from a study conducted in 2012 on behalf of the European Food Safety Authority (EFSA) which showed that 69% of UK adolescents (ages 10-24) consumed an Energy Drink at least once within that year, making them the largest demographic for Energy drink consumption (Nutrition, 2018). This overlap between the Video Game demographic and Energy Drink consumption demographic could be a direct result from the Product Placement being done by Energy Drink companies and the effectiveness of it. A study which explored the consequences of product placement in text, discovered that after participants were finished reading text that included product placement, they were more likely to purchase the placed product over other products that were not placed (Benjamin C. Storm, 2015).

In addition to this, people, and more specifically adolescents, may also be more inclined to consume Energy Drinks over water or other soft drinks without being fully aware of the ingredients or risks involved. A study conducted in 2014 separated a total of 40 adolescents ages 12 – 15 into smaller focus groups of 5 -8 and asked them a series of questions relating to Energy Drinks. The main highlights

of this study conclude that; when asked, adolescents could recognise Energy Drink brands but were unable to mention the Key Ingredients, they consumed Energy Drinks instead of Soft Drinks and they were influenced by parents and advertising (Beth M. Costa, 2014). This demonstrates that the advertising being done by Energy Drink companies creates a lasting impression on adolescents without doing a good enough job of informing them on the ingredients.

The amount of influence adverting Energy Drinks has to a young audience, especially in association with something they are already interested in, such as Video games, can have very serious consequences. In 2014, a 14-year-old boy was put into a coma and hospitalized for 13 days, caused by drinking 4 litres of an Energy Drink over a 16 hour period while playing Call of Duty (TheLocal, 2014). Based on the results from (Benjamin C. Storm, 2015) and (Beth M. Costa, 2014), it is very possible this boy was influenced by the advertising and marketing being done and was not fully aware of the risks involved with consuming Energy Drinks.

In 2014, some guidance on this subject was provided by the UK's National Health Service (NHS) in which they provide an article of information on Energy Drinks, listing their primary ingredients and the potential health concerns involved with consuming them, with supporting evidence from the World health Organization, in an attempt to help with the increasing concern around Energy Drinks (National Health Service, 2014). A year later, in 2015 The Food Safety and Standard authority of India, an official government entity, have prevented companies from manufacturing, selling and distributing Energy Drinks across India (TheTelegraph, 2015). Three years after the Energy Drink ban in India, Major UK supermarkets such as Asda, Waitrose and Tesco also enforced restrictions on Energy Drinks by banning the sale of them to anybody under the age of 16, again due to concerns with the potential risks of these beverages (BBC, 2018). These examples show that action is already being taken to provide guidance on the use of Energy Drinks and to protect young adolescents from risks they are most likely unaware of, however the information being provided is very limited and not readily available. More information needs to be provided on this subject and it needs to be readily available, especially to young adolescents. With 32 Million Gamers in the UK (Ukie, 2018) the hospitalization of the 14 year old boy mentioned above could have happened to anybody and it is important that everybody understands how much influence Energy Drinks have on gaming performance, what ingredients are included and how to consume them safely.

1.3 Aims

- The aim of this project is to provide an insight into how energy drinks effect gaming performance and raise awareness of the risks involved with consuming them.

1.4 Objectives

- Create a reaction-based game which is capable of recording key performance elements such as; Reaction time, Accuracy and Eye Fixation Pattern.

- Collect primary data using the created product and evaluate the correlation between Energy Drink use and Gaming Performance

- Research and discuss the advantages and disadvantages of Energy Drink consumption

Chapter 2: Background and Literature

2.2 Background

Energy Drinks are consumable beverages that are typically made using the following ingredients; Caffeine, Sugar, Taurine, Vitamins and herbal extracts. The key ingredient being caffeine which is usually included at a high dosage of 70-140mg per 227ml. Energy drinks are marketed for their ability to Provide Energy, increase alertness and enhance physical performance. (Enriquez, 2017). One example of the effects of energy drinks Is Reaction Time.

Reaction Time is the time it takes for a person to respond to stimuli. This can be broken down into sub sections to help analyse different types of reaction time. The subsections include Simple Reaction Time (SRT), Recognition Reaction Time (RRT), and Cognitive Reaction Time (CRT). SRT measures the time is takes for a person to react to a single stimuli, RRT measures the time it takes a person to select the optimal response from multiple stimuli, and CRT measures the significance of the stimuli. (Dana Badau, 2018)

Gaze points and Eye Fixations are terminology used to describe measurable output data from tracking a person's eye. Gaze points show where and what the eye is looking at. They are recorded every second, multiplied by the sample rate of the eye tracking hardware, for example, if the sampling rate is 144Hz (Hertz) there will be 144 gaze points every second. Eye Fixations rely on gaze points as they are a cluster of gaze points. If there are multiple gaze points in close proximity to each other within a short period of time, this is considered a fixation. (Farnsworth, 2018)

2.3 Literature Review

This section of the report will explore relevant information relating to Energy Drinks and performance factors such as Reaction time and Eye Fixation Patterns. This section will be separated into three main areas; Energy Drinks, Reaction time and Eye Tracking to highlight already existing concepts and ideas on how to effectively measure and evaluate statistics for each section and to perform a critical analysis on the literature being reviewed. A conclusion will be made at the end which discusses how certain practices from various literature will be considered or incorporated into this project.

2.3.1 Energy Drinks and their relationship to Reaction Time

When investigating the effects Energy Drinks have on consumers, a lot of the research is done by administering the key ingredients of the drink individually instead of using an Energy Drink in its final form. This has caused a lot of researchers to claim that caffeine is the core ingredient responsible for improving certain traits such as reaction time. (Reissig, cited in, Amy Peacock, 2013)

A study conducted in 2013 investigated the relationship of Energy Drink ingredients relating to Cognitive performance. In addition to testing the effects of the primary ingredient caffeine, the study also tested the effect that taurine had on performance as well, both by itself and in combination with caffeine. The study used a sample size of 20 female undergraduates and consisted of 4 sessions separated by a minimum 2 day washout period in which the participants consumed no caffeine or taurine. Throughout the sessions, the participants were administered the following; 80mg Caffeine tablet, 1000mg taurine tablet, caffeine and taurine and a matched placebo. 45 minutes after consuming the tablets, the participants were administered two visual based tasks to measure areas such as reaction time. The study concluded that caffeine by itself positively affected reaction time on specific tasks while taurine by itself did not. In addition to this, when caffeine and taurine were used in combination with each other, the positive effects that caffeine was providing were diminished by the taurine. This conclusion was drawn by analysing the mean of the recorded results. (Amy Peacock, 2013)

This study demonstrates that Energy Drinks, due to their ingredients, do improve performance of the consumer. They independently tested caffeine and taurine as well as a combination of both, including a matched placebo to obtain conclusive evidence on the effects that the ingredients have by themselves and in combination with each other. Multiple tests were used to measure different areas of performance that may have been effected by the ingredients which overall resulted in a very thorough results gathering phase. However, the study showed bias in the participants used. Since all the participants were females, the study showed no evidence of caffeine or taurine having the same effects on males. Moreover, the study administered the ingredients through tablets which does not accurately reflect how the ingredients would be digested as the tablets were consumed instantly, whereas an Energy Drink may take several minutes to fully consume. This may have had an influence on the results obtained.

Another study conducted in 2012 also investigated the relationship energy drinks have on cognitive performance. Similar to (Amy Peacock, 2013), this study also tested the ingredients of Energy Drinks independently and in combination with each other. The study used a sample size of 48 participants (18 male, 30 female) and consisted of 4 sessions that were separated by a 3 day wash out period. The length of the washout period was determined by using research done on the half-life of caffeine and taurine. On each of the four sessions, participants were administered one of four treatments (200 mg caffeine/0 mg taurine, 0 mg caffeine/2000 mg taurine, 200 mg caffeine/2000 mg taurine, 0 mg caffeine/0 mg taurine). A 50g glucose placebo drink was also given in-between administrations. After the administration was complete, two tasks were given to the participants which consisted of an attention based exercise and a reaction based exercise. The attention based exercise was always given

first and began 30 minutes post administration, followed by the reaction based exercise which began 60 minutes post administration. (Grace E Giles, 2012). The study concluded a lot of different results relating to the independent and combined effects of all the ingredients, however, some noteworthy results of the study are; Caffeine reduced fatigue and improved attention, working memory and reaction time. Taurine increased choice based reaction time but reduced working memory reaction time and glucose slowed choice based reaction time (RRT).

This study, similar to (Amy Peacock, 2013), also demonstrates that Energy Drinks, due to their ingredients, improved performance of the consumer. In addition to testing the common ingredients such as caffeine, this study also tested the effects of glucose which provides a deeper and better understanding of the true effects of Energy Drinks. There was also no demographic bias in this study as there was a mix between males and females. However, Similar to (Amy Peacock, 2013), this study also does not accurately reflect consumption habits as the ingredients were administered individually and not consumed from an off the shelf Energy Drink.

2.3.2 Effectively Measuring Reaction Time

A study conducted in 2018 (Dana Badau, 2018) measured three types of reaction time using visual computer tests with a sample size of 332 students and athletes. The study used three tests available online. The first test used was the “Human Benchmark Test” which measures the participants SRT by having them click a button as fast as possible when it changes colour. The average of 5 executions was used for the final score. The Second test used was “Hit-The-Dots”, which measured the participants RRT by having the participants click as many black dots as possible in 30 seconds. The dots were mixed with 60 white dots, arranged in 6 lines of 10. The final test used was the “Trail Making Test” which measured the participants CRT by having them click the 25 randomly arranged circles in chronological order while still having to maintain accuracy. This study ultimately concluded that the hand laterality of the participants effected the reaction time in all three categories and the complexity of the tests also effected reaction time.

This study demonstrates that using a variety of tests, different areas of Reaction Times can be successfully measured and evaluated. The use of multiple tests allowed the study to obtain conclusive results for each area of reaction time and differentiate the effect hand laterality had on the participant’s reaction time. However, some areas of the study were not considered. For example, as all the tests were done using a computer, the study did not take any consideration into the DPI of the input device they were using. This could have potentially effected the results of the study if the DPI was not controlled throughout the testing. In Addition to this, the refresh rate of the monitor could have also impacted the results. If the refresh rate was not controlled throughout the testing, some

participant's reaction time would be slower than others depending on the refresh rate of the display device as the information being shown on the screen would come at a delayed rate.

Another study conducted in 2015 also measured reaction time through a variety of tests but took extra consideration to analyse and manage all the factors that could potentially influence the latency of SRT. The results were obtained by using a 30 minute test that was comprised of four other tests from the California Cognitive Assessment Battery (CCAB) and specific criteria was required for this test to be effective, such as ensuring the stimuli were large and of high contrast as well as the input device being capable of registering input with minimal force. In addition to this criteria, further measures were taken to ensure the data being obtained was as precise as possible. The study measured the delay of the hardware they were using which could potentially be effected by delays. This was mainly the monitor and the input device which was a mouse. The monitor delay was measured by using a photodiode which calculated the average delay of the monitor and the mouse delay was measured by disassembling the mouse and simulating the button closure with an electronic relay. Both delays were factored into the final analysis for the results obtained. With a sample size of 1469 males and females between the ages of 18 – 65, this study concluded that mean SRT latencies were on average 231ms and increased significantly with age at a rate of 0.55ms/year. Gender and education did not have an effect on SRT. (David L. Woods, 2015)

This study highlights the considerations that need to be taken in order to effectively measure reaction time with precision. Hardware delays were calculated and factored into the final results as well as ensuring that all the hardware was correctly calibrated and consistent through the entire results gathering phase, allowing for accurate and reliable results. A large number of participants were used that were an even mix between males and females of all ages resulting in no demographic bias.

2.3.3 Effectively measuring Gaze Points and Eye Fixations

A study conducted in 2015 investigated hand-eye coordination patterns while playing two different virtual reality games with a sample size of 21 participants, consisting of 11 children (6 males & 5 females) and 10 adults (3 males & 7 females). The study used an ASL mobile Eye (Eye Tracking hardware) with a sampling rate of 60Hz to record and track each participants Gaze Data while playing video games. Gaze Tracker 7.0 software was used to process this data at a later date to evaluate more details such as Eye Fixations. For this study, an eye fixation was calculated when any number of gaze points were retained for more than 150ms within a 40 pixel radius circle. To ensure the correct data was being obtained, all participants passed an eye tracking calibration test before playing the video games. (Yuping Chen, 2015). This study ultimately concluded that children have longer latencies between gaze initiation and shorter fixation durations than adults.

This study demonstrates that by using Eye Tracking hardware to monitor Gaze points on participants playing video games, it is possible to obtain usable data to evaluate how a person responds to stimuli. The study used a controlled sampling rate to ensure all the data was consistent as well setting a baseline for what would be considered as a fixation. However, the study was a little vague on the participants. Firstly, the study had a sample size of 21, which by itself it quite a small number. If more participants were used the reliability of the study may have increased. Secondly, although the study did have an even spread of males and females they did not measure this information. The study's results were condensed to be presented as Children and adults, which still leaves the question if there is a notable difference in Fixation patterns between males and females.

2.3.4 Conclusion

Throughout this section, various ideas and designs have been learned which will be incorporated and or considered for the final design of this project. For example, as mentioned in (Amy Peacock, 2013) and (Grace E Giles, 2012), a washout period was required in order to identify a participant as "Sober" before continuing the experiment to ensure no substances remained, this was done to avoid any false results. For this project, a washout period will not be necessary as there will be no direct administration of substances to the participants, however, when formulating the questions for the preliminary questionnaire, participants will be asked if they have consumed any caffeine related beverages prior to filling in the questionnaire. This will be used to distinguish participants as "Sober" or "Not Sober".

In addition to this, (Dana Badau, 2018) made use of a variety of tests to measure reaction time effectively. Some of the tests will be adapted and certain elements will be incorporated into the data gathering product of this project. It is also important to note that this study pointed out hand laterality does have an effect on reaction time. Because of this, the questionnaire will ask the hand laterality of the participant which will be taken into consideration when analysing the results for this project. Furthermore, it is important certain criteria is met to ensure the product will be effective, this includes making sure the stimuli is of high contrast and is large enough on the screen to be seen easily. Other factors to consider for the product will be input delay from the hardware being used as this can negatively affect the final results. (David L. Woods, 2015).

Moreover, as outlined in (Yuping Chen, 2015), when measuring Eye Gaze and Fixation patterns, it is important to control certain elements such as refresh rate and set solid baselines ahead of time to be consistent when determining aspects such as eye fixations. This will be considered and implemented into this project.

Chapter 3: Performance Benchmark Product

The product created to gather data for this project was inspired by the Reaction Time test included in the Cambridge Neuropsychological Test Automated Battery (CANTAB) and was capable of recording Simple Reaction Time, Accuracy and Eye Fixation patterns. (Cambridge Cognition, n.d.). The purpose of the product was to represent mouse movement and interaction somebody may experience when playing a Video Game on the PC platform. The product required the participants to hold their mouse cursor in a box located in the centre of the screen and after a short delay, a new box would appear randomly in a circular radius around the centre box. The objective of the participant was to click the new box as fast as possible, using as little mouse clicks as possible. In total, there were 10 clickable boxes throughout the test and only one box was ever displayed at any given time. No box in the same position was shown more than once.

3.1 Design

The product was designed to be very minimalistic to maximize the reliability of the data being collected. For example, the colour scheme of the product was limited to 2 colours, Black and White. The background of the product was completely black while the objects the participant was required to click on were white. This improved reliability when capturing Eye Fixation patterns as the stimuli was of high contrast, ensuring it could be seen easily by the participants (David L. Woods, 2015). In addition to this, the visual elements displayed on the screen at any given time during the benchmark was limited to two (The centre box and the target clickable box). It was crucial that anything displayed on the screen was something meaningful and was something the participant should be looking at, as adding more stimuli can have a negative effect on eye movement and fixations (Rosa Angela Fabio, 2015), therefore any potential distracting visuals were removed.

Moreover, as the product required the user to position their mouse in the centre of the screen before a clickable box appeared, it was important to incorporate a randomized delay from the moment the participant positioned their mouse in the centre box and the new clickable box appeared on the screen. This was to ensure the participant reacted to the visual stimuli change and not instincts as this is a mandatory requirement to consider the time it takes to respond as Simple Reaction Time. (Dana Badau, 2018).

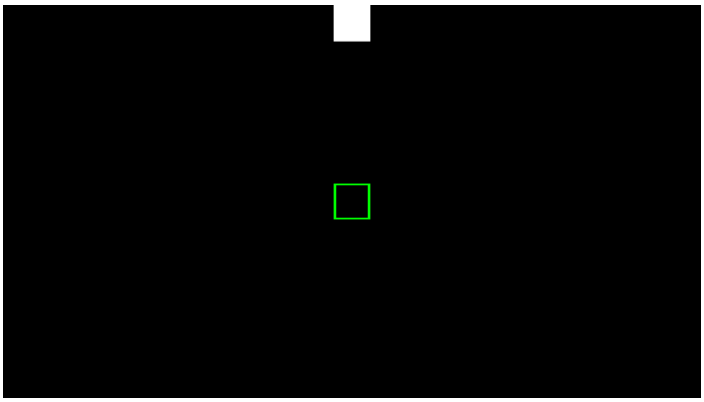

Figure 1: Image showing the benchmark product in progress. Note: Mouse Cursor is not shown in this image

Furthermore, the locations of the clickable boxes were shown in a circular radius around the centre box. The CANTAB Reaction Time test had the clickable boxes positioned in an arched row in the upper hemisphere of the screen, however this does not accurately represent a Video Game environment as it fails to utilize the lower hemisphere of the screen. In order for the product to be fit for purpose, the clickable boxes were positioned in a circular radius around the center box, all of which were a fixed distance from the centre of the screen. This made the product more closely resemble the motions when playing a Video Game on the PC platform.

3.2 Implementation

3.2.1 Simple Reaction Time

Simple Reaction Time (SRT) outputted by the product was calculated by averaging the SRT of each box click throughout the test (total of 10 box clicks). By utilising the Tick Count of the product, which measured how long it had been running on the PC in milliseconds, it was possible to store this value when the box was displayed and when the box was clicked. The value of these two numbers when subtracted from each other was the time in milliseconds it took the participant to click on the target box, resulting in SRT. This process was repeated for each box click and the average was calculated at the end which was the final SRT.

3.2.2 Accuracy

Accuracy for this product was calculated by dividing the total number of boxes displayed (10) by the total number of clicks made by the participant. This value represented how accurate the participant was when reacting to the stimuli, for example as there was 10 clickable boxes in total, the minimum amount of clicks required to complete the test by the participant was 10. This would result in an accuracy of 100% ($Accuracy = \frac{Total\ Number\ of\ Boxes}{Total\ Number\ of\ Clicks} \times 100$). If the participant missed any boxes, their total clicks would increase, resulting in a lower accuracy score. For example, a participant who had 12 total clicks would have an accuracy of 83%.

It was important to ensure the total number of clicks only incremented when the participant was required to click on the box. If the value increased during any other time throughout the test, the final

accuracy score would be inaccurate. Because of this, if there was no boxes being displayed on the screen, any clicks made by the participant were not taken into account for the final calculation.

3.2.3 Eye Fixation Patterns

As eye fixations are a cluster of Gaze Points, it was important to record each gaze point and its location on the screen so the data could be visualised later through the use of a heatmap. This was achieved by creating an invisible grid that ran in the background while the participant completed the test. Each frame, the eye tracker recorded a gaze point from the participant as well as its two dimensional location on the screen. By using the location, each gaze point was allocated a cell on the grid, and if the gaze point's location was in the same grid cell for longer than the specified fixation time, the value of that cell was incremented by 1. The fixation time for this product was set to 50ms based of the fixation fact sheet provided by Tobii. (Tobii, n.d.)

Chapter 4: Methodology

4.1 Participants

The target demographic for this project was anybody between the ages of 18 – 24 as this; was the largest demographic for Energy Drink consumption, was the largest demographic for video gamers in the UK, and abided by the ethical standards set by Birmingham City University. The estimated population for video gamers in the UK that fit within this demographic was 5.77m. When the required sample size was being calculated to have 95% confidence and 5% margin of error, this was the population size used, which resulted in a projected sample size of 385.

The final sample size for this project was 30 undergraduate students from Birmingham City University, ranging from 18 – 32 years old (μ = 21.4, σ = 3.4). This was 7.79% of the projected sample size. Participants were selected at random, and were asked if they would like to participate in the project. An information leaflet was provided that outlined the details of the project, and any questions they had were answered. If they agreed to participate, signed consent was provided prior to participation.

4.2 Data Collection

The data collected came from two sources, the performance benchmark (discussed in chapter 3) and a questionnaire, both of which collected quantitative data.

The questionnaire had three main questions and potentially two additional questions depending on how the participant responded to the first three. All the questions were closed ended except for the first question which asked for the participants' age. The questionnaire also required a unique ID number to be entered, which was provided by the benchmark test after completion. This was used to link the questionnaire data with benchmark data for each participant while still keeping them anonymous to comply with the General Data Protection Regulation 2018 (GDPR). The main three questions of the questionnaire were;

1) What is your age?
2) Are you left or right handed?
3) Have you consumed an Energy Drink within the past 24 hours?

And the additional questions were:

4) When was the last time you consumed an Energy Drink?
5) How many Energy Drinks were consumed in the period of time answered in question 4?

The primary purpose of the questionnaire was to establish if the participant was under the influence of any Energy Drinks and to what extent they were influenced. This was achieved through questions

4 and 5. The secondary purpose of the questionnaire was to control other factors which may influence the results obtained by the benchmark product. This was achieved through questions 1 and 2 as both age and hand laterality are known to have an effect on Simple Reaction Time (Dana Badau, 2018) and (David L. Woods, 2015). Additional questions were considered such as, asking the participants if they had consumed any other caffeinated beverages other than Energy Drinks. This information would have been useful to establish the true effects that Energy Drinks had on each participant, as any external factors that may have influenced the results could have been taken into consideration, and minimized. However, asking such questions was considered to be unreliable for this project, as it would require the participant to recall; how many caffeinated beverages they had, the caffeine content of each beverage, and how much of it they consumed for any meaningful data to be collected and used, which is data that may be difficult to recall or, not readily available depending on the origin of the drink. For this reason, such questions were not included into the questionnaire.

4.3 Apparatus and Software

A Laptop with a refresh rate of 60Hz and a native 16:9 aspect ratio was used to run the benchmark product. A mouse was connected to the laptop via USB 2.0 and was configured to run at 1000 DPI (Dots per inch) and 125 MHz polling rate. The Refresh rate, DPI and Polling rate were not changed for any of the participants as this may have gave an unfair advantage. A Tobii EyeX Eye Tracker was used to record the participant's eye fixation patterns and was synced with the refresh rate to have a sampling rate of 60Hz. The Tobii eye calibration software was ran for each participant prior to them using the benchmark product.

The Benchmark product was ran in exclusive full screen mode at a screen resolution of 1600x1200 (4:3 aspect ratio) to ensure the stretching and distance of the stimuli being displayed was kept to a minimum while still blocking out any distracting stimuli from background applications on the laptop.

4.4 Procedures

After signed consent was obtained from the participants, they were asked to complete the questionnaire. If any of the participants were ambidextrous they were instructed to choose their preferred hand of choice when answering question 2 of the questionnaire (see section 4.2 for questionnaire questions). After the questionnaire was completed, participants were guided through the Tobii eye calibration software through on screen instructions and verbal confirmation of these instructions. Once the questionnaire had been completed, and the eye tracker was calibrated, participants were ready to use the benchmarking product.

The basic mechanics of the benchmark product were explained to the participants and were instructed to be as fast as possible and as accurate as possible when reacting to the visual stimuli. Two practice

attempts were given to each participant, based on (Yuping Chen, 2015) and the data from the third attempt was included in the research. The data was then exported to CSV format by using the created functionality of the benchmark test. Heat maps were also created for 14 of the participants by using an online heatmap generator.

4.5 Data Analysis

As the data came from two sources, it was important to combine this data into one file to not only make it more manageable, but to easily compare and perform analysis on the data. The data was copied from their original source and placed into a blank Microsoft Excel spreadsheet, making use of the unique ID number to match the data for each entry. After the data had been combined, each entry was separated into one of two groups, Sober and not sober. This distinguished participants who had an Energy Drinks from those who did not, and allowed for analysis to be performed separately for each group so the data could be compared later.

As the expected result were an average for each group, it was crucial that any outliers were identified and removed from the calculation to ensure the data was not influenced in a negative way. This was done by calculating the Inter Quartile Range (IQR) for each group and flagging any entry points that fell outside of the IQR.

After all the outliers were identified, the average Simple Reaction Time and Accuracy was calculated for each group with any outliers excluded from the calculation. In addition to this, as the non-sober group had additional information in the form of when the Energy Drink was consumed, the average reaction time and accuracy for each period of time was also calculated to identify when Energy Drinks were most effective.

Chapter 5: Results

Not all of the participant data was used for this chapter as those who were identified to be outliers as mentioned in chapter 4.5, were removed. In addition to this, Eye Tracking data was recorded only for a total of 14 participants, 2 of which were removed due to the data being incomplete.

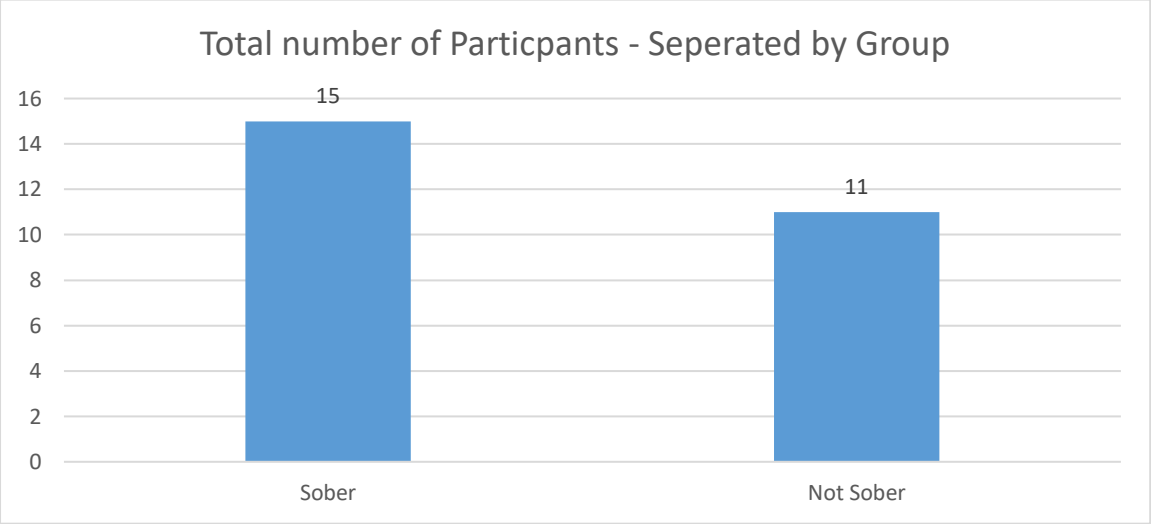

Figure 2: Chart showing the total number of participants within each primary group after the identified outliers were removed

The overall results from this project show that on average, participants who consumed Energy Drinks within a 24 hour period (n = 11, μ = 794.45ms, σ = 46.77) had faster reaction time than those who did not (n = 15, μ = 859.60ms, σ = 75.88) (See Figure 4). However, participants that did not consume any Energy Drinks within a 24 hour period (n = 15, μ = 95.96%, σ = 6.32) had better accuracy than those who did (n = 11, μ = 92.15%, σ = 10.21) (See Figure 5). In addition to this, in some cases, the total amount of eye fixations the participant had when reacting to the stimuli while under the influence of Energy Drinks(n = 7, μ = 11446, σ = 8258.10), was also lower than other participants who were not under the influence of Energy Drinks (n = 5, μ = 22891, σ = 9949.17).

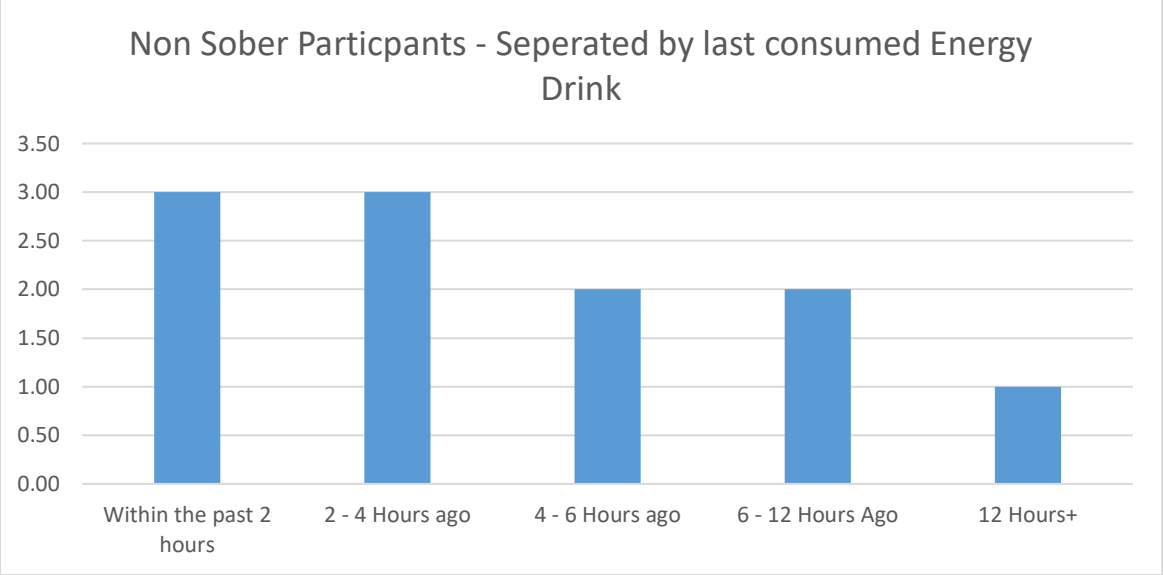

Figure 3: Chart showing the total number of non-sober participants separated by time of consumption after the identified outliers were removed

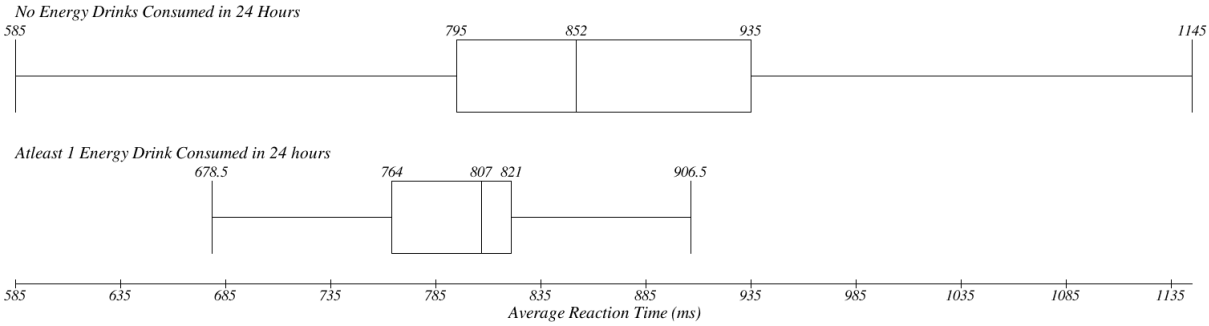

Figure 4: Diagram comparing the average reaction time of participants who consumed an Energy Drink vs those who did not

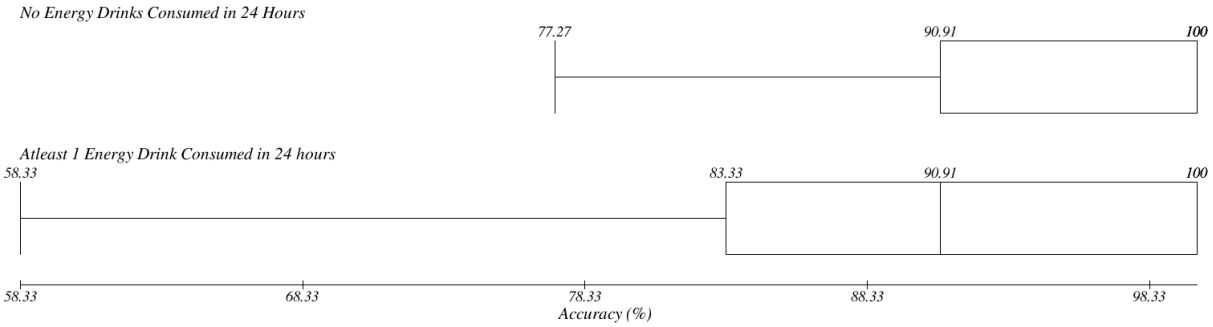

Figure 5: Diagram comparing the accuracy of participants who consumed an Energy Drink vs those who did not

There was a statistically significant difference between Sober and Non Sober groups for Reaction Time as determined by a one-way ANOVA (F (1, 24) = 6.306, p = .02). A Tukey post hoc test revealed that the average Reaction Time was statistically significantly lower after consuming at least 1 Energy Drink (794.45 ± 46.77) compared to consuming no Energy Drinks (859.60 ± 75.89). This rejects the null hypothesis. (See Figure 6)

Dependent Variable: Reaction Time

Groups	*Count*	*Sum*	*Average*	*Variance*	*SD*
Sober	15.00	12894.00	859.60	5758.97	75.89
Not Sober	11.00	8739.00	794.45	2187.47	46.77

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	26932.63	1.00	26932.63	6.31	0.02	4.26
Within Groups	102500.33	24.00	4270.85			
Total	129432.96	25.00				

Figure 6: ANOVA table showing the significant difference between Sober and Non Sober Reaction Times

There was statistically no significant difference between Sober and Non Sober groups for accuracy as determined by a one-way ANOVA (F (1, 24) = 1.38, p = 0.25). A Tukey post hoc test revealed that the average accuracy score was statistically significantly the same after consuming at least 1 Energy Drink (92.15 ± 10.20) compared to consuming no Energy Drinks (95.96 ± 6.32). This accepts the null hypothesis. (See Figure 7)

Dependent Variable: Accuracy

Groups	*Count*	*Sum*	*Average*	*Variance*	*SD*
Sober	15.00	1439.39	95.96	39.90	6.32
Not Sober	11.00	1013.64	92.15	104.14	10.20

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	92.16	1.00	92.16	1.38	0.25	4.26
Within Groups	1600.02	24.00	66.67			
Total	1692.18	25.00				

Figure 7: ANOVA table showing the significant difference between Sober and Non Sober Accuracy scores

5.1 Reaction Time

Participants who consumed at least 1 Energy Drink within 2 – 4 hours of using the benchmark product (n = 3, μ = 762.67ms) had the fastest reaction time when compared with the data for other periods of time. This group had an average faster reaction time than those who did not consume any Energy

Drinks within a 24 hour period by 12.7%. The period of time with the slowest reaction time that consumed at least 1 Energy Drink, was those who consumed more than 12 hours before using the benchmark product (n = 1, μ = 889ms). This group's average reaction time was 3.5% slower than those who did not consume any Energy Drinks, and 16.6% slower than those who consumed within 2 – 4 hours.

5.2 Accuracy

Participants who consumed at least 1 Energy Drink within 6 – 12 hours of using the benchmark product (n = 2, μ = 100.00) had the best accuracy when compared with the data for other periods of time. This group's had a better average accuracy than those who did not consume any Energy Drinks within a 24 hour period by 4.04%. The period of time with the worst accuracy, that consumed at least 1 Energy Drink, was those who consumed within 4 – 6 hours before using the benchmark product (n = 2, μ = 78.79). This group's average accuracy was 17.17% worse than those who did not consume any Energy Drinks, and 21.21% worse than those who consumed within 6 – 12 hours.

5.3 Eye Tracking

On average, participants who were under the influence of at least 1 Energy Drink within the past 24 hours had 100% less fixation points than those who did not. A one-way ANOVA test (F (1, 10) = 4.74, p = .05) revealed that the average number of eye fixations was statistically significantly lower after consuming at least 1 Energy Drink (11446.57 ± 8258.10) compared to consuming no Energy Drinks (22891.00 ± 9949.17). This rejects the null hypothesis. (See Figure 8)

Dependent Variable: Eye Fixations

Groups	*Count*	*Sum*	*Average*	*Variance*	*SD*
Sober	5.00	114455.00	22891.00	98985932.00	9949.17
Not Sober	7.00	80126.00	11446.57	68196213.62	8258.10

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	382010257	1.00	382010257.20	4.74	0.05	4.96
Within Groups	805121010	10.00	80512100.97			
Total	1.187E+09	11.00				

Figure 8: ANOVA table showing the significant difference between Sober and Non Sober Eye Fixations

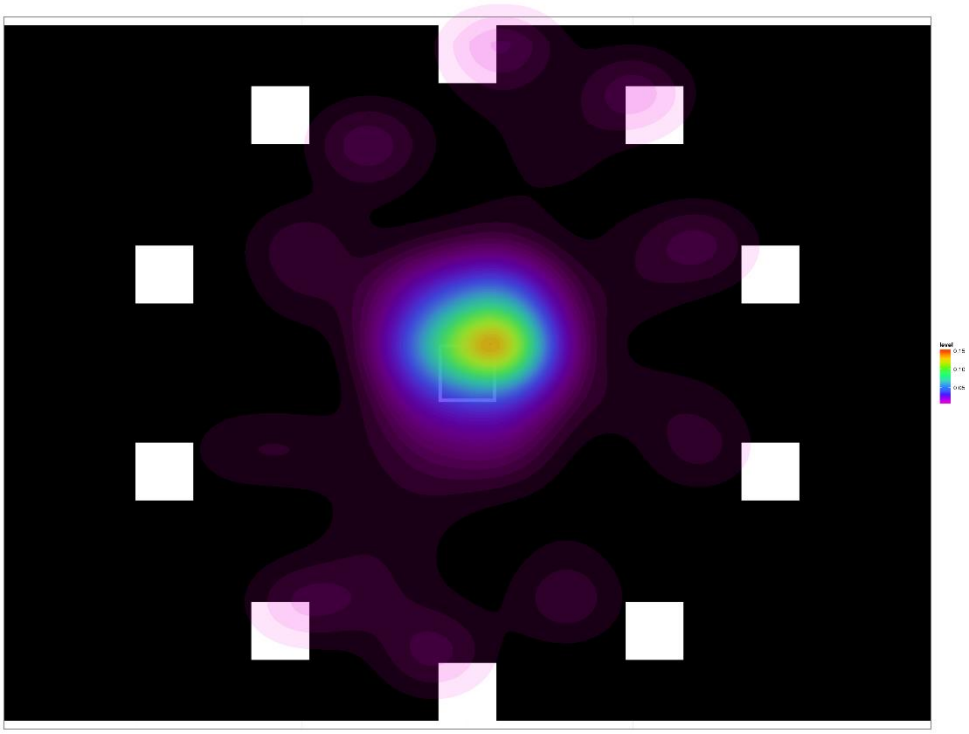

Figure 9: Example Heatmap displaying the eye fixations of a participant who was under the influence of an Energy Drink

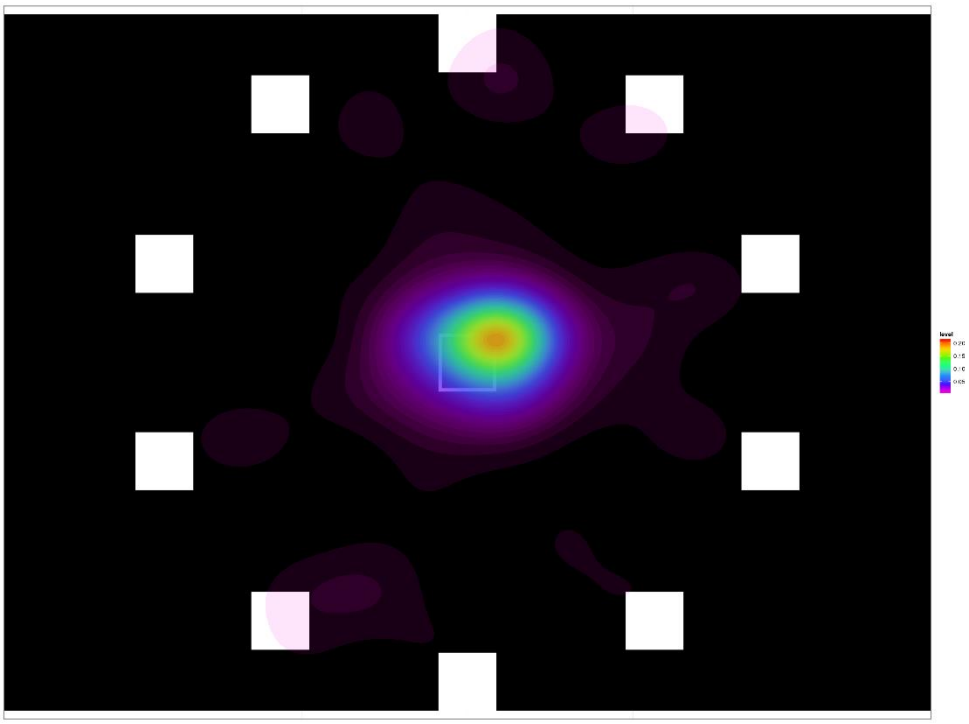

Figure 10: Example Heatmap displaying the eye fixations of a participant who was not under the influence of an Energy Drink

Chapter 6: Performance Calculator Product

The product created to meet the aims of this project was a prediction calculator, inspired by the BMI calculator provided by the National Health Service (NHS). (National Health Service, 2018). It was capable of predicting Simple Reaction Time (SRT) and Accuracy based off the inputted parameters, and displayed a table of results of similar parameters. The main purpose of this was to provide the user with an insight into their current performance metrics, and show them how their performance compared with others, allowing them to decide if the difference in performance they may get from consuming Energy Drinks would be in their best interest. The risks of consuming Energy Drinks were also briefly outlined and a hyperlink to the NHS website was provided for full in depth information.

6.1 Product Design

The calculator ran on the PC platform and was created in Python, using the Kivy framework (Kivy, n.d.) To create a Graphical User Interface that the user could interact with. When the calculator was first ran, the user was presented with a screen asking three questions (Questions 1, 4 and 5) adapted from the questionnaire discussed in chapter 4 (See Figure 11). The questions were used to collect data from the user, which was then cross referenced with the data collected from the questionnaire and benchmark product, to predict the user's performance using machine learning.

Once the user entered all the required information and clicked confirm, the machine learning algorithm predicted the users SRT and accuracy and displayed it back to the user. A table consisting of SRT's and accuracy's with each row having a different number of Energy Drinks was also displayed below the users performance, allowing them to compare their current performance with what could be expected if they were to have more or less Energy Drinks. Underneath the table was a brief warning

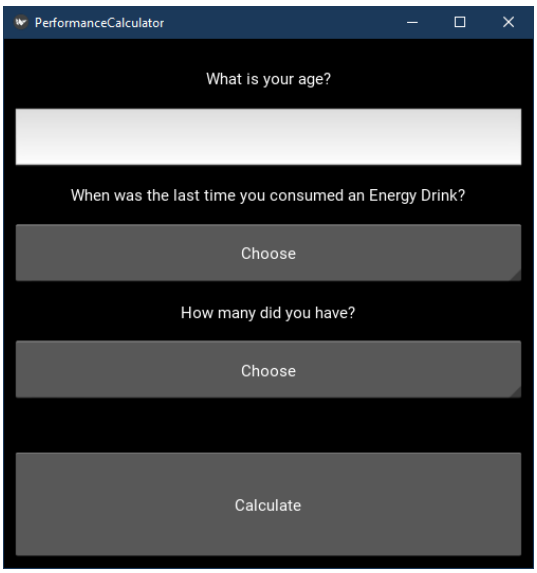

Figure 11: Image showing the calculator product's initial screen

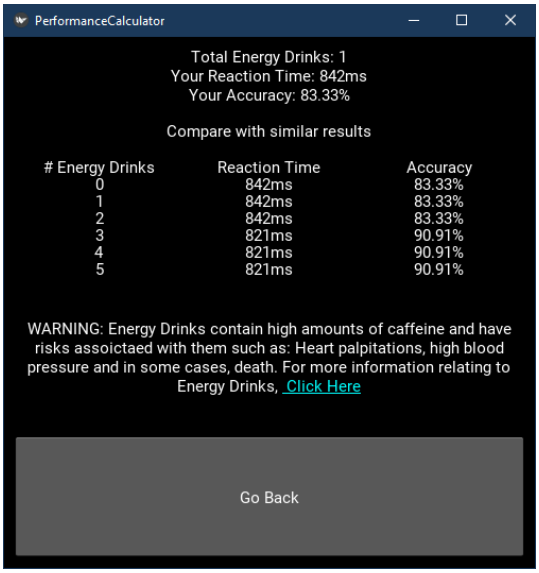

Figure 12: Image showing the calculator product's final screen

sentence, outlining some of the risks involved with Energy Drink consumption and hyperlink that would direct the user to a NHS article that contained a full list of all the risks involved with Energy Drink consumption. (See Figure 12)

6.2 Product Implementation

The machine learning models were provided by Scikit-Learn (Scikit-Learn, n.d.) And the chosen model for this product was Linear Regression, as this produced the best results when used with the provided data set compared to other models. The data set provided to the algorithm, was a combined CSV file using the data collected from the questionnaire and benchmark product. The columns labelled as; Age, Time of last consumed Energy Drink and number of Energy Drinks consumed were used as features for the algorithm, and the columns labelled as; average SRT and accuracy were used as the targets.

The model was trained using 50% of the data provided and tested with the remaining 50%, as well using K-fold cross validation, allowing for different entries of data to be used for training, resulting in more dynamic results. After the model was trained, it was instructed to make two predictions, using the answers from the three questions, as input. The first predication made was for SRT and the second was for accuracy, both of which were provided back to the user.

6.3 Evaluation

Even though the product was capable of predicting a user's Reaction time and accuracy, it was often times inaccurate due to the limited number of samples provided to the model (N = 30) which prevented it from making an informed decision. The solution to this would have been to oversample the data to artificially create entries, which would allow the machine learning model to learn more, ultimately allowing for a more informed decision to be made. However, due to technical limitations, this was not implemented into this product.

Chapter 7: Discussion

7.1 Summary

In this project, participants were asked to use a custom created benchmark test to examine how their Simple Reaction Time (SRT), Accuracy and Eye Fixation Patterns were effected by Energy Drink use. The results of this suggested that Energy Drinks can improve SRT by as much as 12.7% however, this came at the expense of reducing accuracy, as those with improved SRT also had their accuracy reduced by as much as 17.17%. In addition to this, the results also suggested that Energy Drinks reduce the number of eye fixation by up to 100% when calculated as an average. However, when evaluated on a case by case basis, there appears to be inconsistences with Energy Drink use and Eye fixations, as some participants who had not consumed any Energy Drinks had less fixations than those who had, but in some cases had more fixations. Furthermore, it is unknown if hand laterality has any effect on Reaction Times or accuracy as this was not analysed in this project, due to insufficient amounts of variety in the data collected relating to hand laterality.

7.2 Conclusion

Based on the results of this project, Energy Drinks provide an advantage when used to play certain types of games, and a disadvantage when used to play others. For example, if Energy Drinks are used while playing a Video Game in the puzzle genre, such as Tetris, the results of this study suggested that overall performance should increase, as Tetris generally does not require point click accuracy but does require Simple Reaction Time. On the other hand, if Energy Drinks are used while playing Video Games that belong to the First Person Shooter genre, such as Call of Duty, the results of this study suggested that overall performance should decrease, as games of this nature usually fundamentally rely on point click accuracy.

The conclusion drawn, based on the results of this project, relating to how Energy Drinks effect Simple Reaction Time (SRT) are consistent with the results shown in, (Amy Peacock, 2013) and (Grace E Giles, 2012), as the results from both of these studies also conclude that Energy Drinks improve SRT. However, the effects that Energy Drinks have on accuracy are still debatable as the results demonstrated in this project cannot be reinforced by the results of another project, as no similar project in which accuracy was tested against Energy Drinks could be found.

7.3 Limitations

The one and only limitation this project encountered, was the restrictions put in place by the Ethics Board of Birmingham City University. It was considered unethical to administer Energy Drinks to participants directly, which resulted in this project having to rely on participant honesty for most of

the data collection. This took a lot of control away from the researchers in this project as important variables such as the number of Energy Drinks consumed, and how long ago they were consumed could not be controlled, which resulted in a wide variety of results and very limited samples for specific data groups.

7.4 Recommendations for future research

To improve this project, if ethical approval allows, Energy Drinks should be provided to the participants directly and then have them use the benchmark product in set intervals of time after consumption E.G 1 hour, 2 hour etc. This allows for a lot more variables to be controlled such as the amount of Energy Drink consumed measured in millilitres and the amount of caffeine that was consumed measured in milligrams, which would increases the reliability of the data being collected.

By administering the Energy Drinks directly, this would also allow for a more robust approach to collecting data as instead of using two sample groups and comparing the data, it would be possible to have sober participant use the benchmark product, store the results, and then have them use the product again after consuming an Energy Drink and evaluate if there was a noticeable performance increase or decrease.

References

Amy Peacock, F. H. M. A. C., 2013. Energy drink ingredients. Contribution of caffeine and taurine to performance outcomes. *Appetite,* Volume 64, pp. 1-4.

BBC, 2018. *Energy drinks: UK supermarkets ban sales to under-16s.* [Online]
Available at: https://www.bbc.co.uk/news/uk-43287125
[Accessed 15 February 2019].

Benjamin C. Storm, E. S., 2015. Exposure to Product Placement in Text Can Influence Consumer Judgments. *Applied Cognitive Psychology,* 29(1), pp. 20-31.

Beth M. Costa, A. H. P. M., 2014. Young adolescents' perceptions, patterns, and contexts of energy drink use. A focus group study. *Appetite,* Volume 80, pp. 183-189.

Cambridge Cognition, n.d. *Cantab - The most sensitive and validated cognitive research software available.* [Online]
Available at: https://www.cambridgecognition.com/cantab/
[Accessed 14 April 2019].

Dana Badau, B. b. A. B., 2018. Differences among Three Measures of Reaction Time Based on Hand Laterality in Individual Sports. *Sports,* 6(2), p. 45.

David L. Woods, J. M. W. E. Y. T. J. H. B. R., 2015. Factors influencing the latency of simple reaction time. *Frontiers in Human Neuroscience,* Volume 9, p. 131.

Enriquez, A., 2017. Arrhythmogenic effects of energy drinks. *Journal of cardiovascular electrophysiology,* 28(6), pp. 711-717.

Farnsworth, B., 2018. *10 Most Used Eye Tracking Metrics and Terms.* [Online]
Available at: https://imotions.com/blog/7-terms-metrics-eye-tracking/
[Accessed 24 February 2019].

Grace E Giles, C. M. T. B. A. G. H. T. R. K., 2012. Differential cognitive effects of energy drink ingredients: Caffeine, taurine, and glucose. *Pharmacology Biochemistry and Behavior,* 102(4), pp. 569-577.

Hoggins, T., 2019. *Gaming worth more than video and music combined in record UK entertainment revenues.* [Online]
Available at: https://www.telegraph.co.uk/technology/2019/01/03/video-games-make-half-record-

uk-entertainment-revenues/
[Accessed 15 February 2019].

Jay Newell, C. T. S. S. C., 2006. The hidden history of product placement. *Journal of Broadcasting & Electronic Media.,* Volume 50.4, pp. 575-594.

Kivy, n.d. *Kivy - Open source Python library for rapid development of applications.* [Online]
Available at: https://kivy.org/#home
[Accessed 17 April 2019].

Lehu, J.-m., 2007. Branded Entertainment . In: *Product Placement and Brand Strategy in the Entertainment Business .* s.l.:Kogan Page, pp. 1, 18.

Makuch, E., 2017. *Call Of Duty: WW 2 Passes $1 Billion In Worldwide Sales.* [Online]
Available at: https://www.gamespot.com/articles/call-of-duty-ww-2-passes-1-billion-in-worldwide-sa/1100-6455775/
[Accessed 15 February 2019].

Monster Beverage Corp, 2018. *Monster Beverage Reports 2017 Fourth Quarter and Full Year Financial Results.* [Online]
Available at: http://investors.monsterbevcorp.com/news-releases/news-release-details/monster-beverage-reports-2017-fourth-quarter-and-full-year
[Accessed 15 February 2019].

National Health Service, 2014. *Warnings issued over energy drinks.* [Online]
Available at: https://www.nhs.uk/news/food-and-diet/warnings-issued-over-energy-drinks/
[Accessed 15 February 2019].

National Health Service, 2018. *BMI healthy weight calculator.* [Online]
Available at: https://www.nhs.uk/live-well/healthy-weight/bmi-calculator/
[Accessed 14 April 2019].

Nutrition, 2018. *Should children be drinking energy drinks?.* [Online]
Available at: https://www.nutrition.org.uk/nutritioninthenews/headlines/childrenenergydrinks.html
[Accessed 15 February 2019].

Rosa Angela Fabio, C. I. A. E. N. M. T. C. C. C. S. D. S. A. F., 2015. The Influence of Cognitive Load and Amount of Stimuli on Entropy through Eye Tracking Measures. *EAPCogSci.*

Scikit-Learn, n.d. *scikit-learn - Machine Learning in Python.* [Online]
Available at: https://scikit-learn.org/stable/
[Accessed 17 April 2019].

Similarweb, 2019. *Twitch.tv Traffic Statistics.* [Online]
Available at: https://www.similarweb.com/website/twitch.tv
[Accessed 15 February 2019].

Statista, 2018. *eSports audience size worldwide from 2012 to 2021, by type of viewers (in millions).* [Online]
Available at: https://www.statista.com/statistics/490480/global-esports-audience-size-viewer-type/
[Accessed 15 February 2019].

sullygnome, 2019. *ninja - Twitch statistics, analysis and predictions.* [Online]
Available at: https://sullygnome.com/channel/ninja/365
[Accessed 15 February 2019].

TheLocal, 2014. *Caffeine-fuelled game binge puts boy in coma.* [Online]
Available at: https://www.thelocal.no/20140320/boy-hospitalised-after-energy-drink-fuelled-gaming-binge
[Accessed 15 February 2019].

TheTelegraph, 2015. *Ban on 'irrational' energy drinks.* [Online]
Available at: https://www.telegraphindia.com/india/ban-on-irrational-energy-drinks/cid/1477178#.Vg1_h8uqqko
[Accessed 15 February 2019].

Tobii, n.d. *Tobii Pro.* [Online]
Available at: https://www.tobiipro.com
[Accessed 10 April 2019].

Ukie, 2018. *The games industry in numbers.* [Online]
Available at: https://ukie.org.uk/research#demographics
[Accessed 15 February 2019].

Yuping Chen, M.-J. T., 2015. Eye-hand coordination strategies during active video game playing: An eye-tracking study. *Computers in Human Behavior,* Volume 51, pp. 8-14.

Appendices

Appendix A – Participant Information Leaflet

BIRMINGHAM CITY University

Energy Drinks and their effects on gaming performance - Participant Information Sheet

Invitation

You are being invited to take part in a research project. Before you decide if you wish to take part, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us (the researchers) if there is anything that is not clear or if you would like more information.

Project Purpose

The purpose of this project is to identify if Energy Drinks have an impact on performance factors that contribute to a person's ability to play video games and provide information for optimal and safe use of such products. Performance factors include Reaction Time, Accuracy and Eye Fixation Patterns.

Why have I been chosen?

Based on research that identified the primary demographics for Energy Drink consumption, people ages 16 – 24 were highlighted as the largest single demographic which is a range your current age is included in. You will be 1 of the projected 385 participants for this project

Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a participant agreement form. You can withdraw at any time, up to the point outlined in the participant agreement form without it affecting any benefits that you are entitled to in any way. You do not have to give a reason. Deciding to take part or not will not impact upon/adversely affect your treatment/care /education or studies at BCU (or that of others).

What would taking part involve?

Taking part will require 5 – 10 Minutes of your time, this includes becoming familiar with the data collection product and using it to obtain data. Repeat participation for this project is not necessary.

During participation, you will first be required to fill in a preliminary questionnaire which establishes basic information about yourself and your personal use of Energy Drinks. Following the questionnaire, you will be required to use a computer to play through a benchmark test which will measure your Reaction Time, Accuracy and Eye Fixation Patterns.

As a participant, you are expected to:

- Be truthful, to the best of your knowledge, when answering questions on the questionnaire.
- Not intentionally modify any of the hardware or software being used during your participation.

Page 1 of 2

BIRMINGHAM CITY University

What are the advantages and possible disadvantages or risks of taking part?

Whilst there are no immediate benefits for those participating in this project, it is hoped that this work will provide more information to gamers around the world on how to consume Energy Drinks optimally and safely.

There are no immediate disadvantages or risks involved with participating in this project.

Will my taking part in this project be confidential?

Any information you provide during your participation on this project will be anonymised and only shared with the people on the research team. You will not be able to be identified with the information you provide. After this project has concluded, any information you provided will be permanently deleted as it will no longer be required, as in accordance with the Data Protection Act 2018.

What type of information will be sought from me and why is the collection of this information relevant for achieving the research project's objectives?

Basic information will be collected such as your Age and Hand laterality. This information will be used to categorize participants into distinguishable groups to evaluate how Energy Drinks effect different people.

In addition to this, your personal use of Energy Drinks will be asked of you and this will be used to determine how different uses of Energy Drinks can effect a person's performance.

No protected characteristics will be asked of you, or be used in this project.

Will I be recorded, and how will the recorded media be used?

You will not be recorded during your participation for this project.

Contact details for further information

If you require further information please contact any member of the research team listed below:

Name: Lewis Farrell
Title: Researcher
Email: Lewis.Farrell@Mail.bcu.ac.uk

Name: Dr. Carlo Harvey
Title: Supervisor
Email: carlo.harvey@bcu.ac.uk

In case of complaints

If you have any complaints please contact any of the people listed below.

Name: Ofonime Udoudo
Email: Ofonime.Udoudo@bcu.ac.uk

This copy of the information sheet is for you to keep and you will also receive a signed copy of the participant agreement form if you choose to participate in this project.

Thank you for taking the time to read through the information

Appendix B – Participant Agreement Form

Participant Agreement Form

Project Title:
Energy Drinks and their effects on gaming performance

Researcher Details:
Lewis Farrell,
Final Year Student
Lewis.Farrell@Mail.bcu.ac.uk

Supervisor Details:
Dr. Carlo Harvey
Senior Lecturer
carlo.harvey@bcu.ac.uk

	Please Initial or Tick Here
I have read and understood the participant information sheet for the above research project	
I confirm that I have had the opportunity to ask questions.	
I understand that my participation is voluntary.	
I understand that I am free to withdraw at any time before the collected data has been saved and anonymised	
I understand that during the task/experiment, I am free to withdraw without giving a reason, and without there being any negative consequences.	
I understand that if I do not wish to answer any particular question(s), complete a test or give a sample, I am free to decline without there being any negative consequences	
I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the outputs that result from the research.	
I agree to take part in the above research project.	

Name of Participant	Date	Signature
Name of Researcher	Date	Signature

This form should be signed and dated by all parties after the participant receives a copy of the participant information sheet and any other written information provided to the participants. A copy of the signed and dated participant agreement form should be kept with the project's main documents which must be kept in a secure location.

Appendix C – Preliminary Questionnaire

Data Collection Preliminary Questionnaire

* Required

What is your age? *

Your answer

Are you left or right handed? *

- ◯ Left Handed
- ◯ Right Handed

Have you consumed an Energy Drink within the past 24 hours? *

- ◯ Yes
- ◯ No

NEXT

Never submit passwords through Google Forms.

Data Collection Preliminary Questionnaire

* Required

Energy Drink consumption data

When was the last time you consumed an Energy Drink *

- ◯ Within the past 2 hours
- ◯ 2 - 4 Hours ago
- ◯ 4 - 6 Hours ago
- ◯ 6 - 12 Hours Ago
- ◯ 12 Hours+

How many Energy Drinks were consumed in the period of time chosen above? *

Choose

BACK NEXT

Never submit passwords through Google Forms.

Appendix D – Copyright Waiver Form

UCEEL Copyright Waiver

Student Name: Lewis Farrell

Project/Thesis Title A heuristical study on Energy Drinks and the effects they have on Gaming Performance

Course: Computer Games Technology

Student Agreement

1. I confirm that Birmingham City University can electronically archive and make accessible the project / thesis described above via the UCEEL Electronic Library system. I retain all other ownership rights to the copyright of the document / project work described above.

2. I confirm the above project / thesis is a true and unaltered representation of the project / thesis as submitted to Birmingham City University course tutors and examiners.

3. I confirm that the above project / thesis ~~**includes**~~ / **does not include** *(please delete as appropriate)* material copied from a source (e.g. a book) where ownership of the copyright does not belong to myself.

If the **project / thesis includes** such material please supply the following details:

a) **Page reference / item reference:**

b) **I have** obtained and attached a written permission statement from the owner(s) of each third party copyrighted matter included in my project / thesis

Yes No (please circle)

*(**If No,** I understand the electronic copy of my project / thesis available on UCEEL will omit these sections from view)*

Signature: L Farrell

Print Name: Lewis Farrell

Date: 17/05/2019

N.B. If you are at anytime in consultation with a publisher regarding this work you will need to declare the copy held on UCEEL. Some publishers may regard the UCEEL copy as constituting prior publication. The copy can be removed from UCEEL if it becomes an obstacle to future commercial publication.

Official Use only

ORION unique number: _____ Date added to the system: _____

IS228a/Oct07