

# Investigating the effects of juiciness on flow and its ability to foster a state of flow in players.

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## **Abstract**

Gaming as an industry is ever-growing and with it, research into providing a deeper understanding of how players interact with them has developed, offering knowledge of how to better design and create games that produce more intrinsic experiences for players through the application of psychological theorems and varying design models. This study aims to contribute to this area through the application of the Juicy Framework (K.hicks. Et al, 2008) to a game and studying for connections between juiciness, player experience and flow.

Based upon a review of literature an artefact was created that encompasses 3 versions of a single game each with varying amounts of juice being applied, an online study was then carried out in which participants played each version of the game while answering several surveys relating to each version, as to allow for the measurement of players experience with the game & flow when playing the game each survey contained the Player Experience Inventory Scale (Abeele, V.V. Et al, 2020) and Activity Flow Scale (Payne, B.R. Et al, 2011). Responses were broken into different dimensions of each scale and averages between all participants were created per dimension per bracket. Analysis of the responses produced no significant value and therefore no proof of affect thus not allowing to create any comparisons between each bracket, nor allowing to define whether or not juiciness does affect the ability to foster flow in players.

The results of asking players to rank each version, however. does produce a means of how often each bracket was ranked 1st, 2nd and 3rd and therefore a preference could be taken finding that version 2 with the average amount of juicy features present was rated the highest the most often. Further research applying a study with a larger sample size is needed to produce significant data that can show comparisons between games with varying amounts of juiciness and their relationship with flow.

<b>Abstract</b>	<b>2</b>
<b>Introduction</b>	<b>6</b>
Rationale & Benefits	6
Aims, Objectives & Hypothesis	6
Background	7
Report Structure	8
<b>Literature Review</b>	<b>8</b>
Player Experience:	9
Flow:	11
Juiciness:	14
<b>Methodology</b>	<b>15</b>

Project Management	15
Software Development	17
Toolset's & Machine Environments	18
Datasets/knowledgebase and statistical analysis	19
Research Methods	22
<b>Design and Development</b>	<b>24</b>
Requirements	24
Design and Implementation	25
Win Conditions:	25
Level Structure:	26
Lose Conditions:	26
Breakdown of juicy elements:	28
"On-Click" Sound Effect	28
"Wrong Move" Sound Effect	29
"Match" Sound Effect	29
Hint Effect:	29
"Mouse Click" Visual Effect:	30
"Match Made" Animation	30
"Hover Ripple Effect"	31
"Animated Explosion Type Indicators"	31
"Colour Explosion Animation"	32
"Static Row/ Column Explosion Indicator"	32
"Animated Row/Column Explosion Indicator"	33
"Static Adjacent Explosion Indicator"	33
"Animated Adjacent Explosion Indicator"	34
"Wrong Move Screen Shake"	34
"On Dot Mouse Tracking Arrows"	34
"Dot Shattering Effect on Match"	35
"Confetti Win Screen"	36
<b>Experiments and Evaluation</b>	<b>37</b>
Player Experience Inventory:	37
Meaning:	37
Mastery:	38
Immersion:	39
Autonomy:	40
Activity Flow Scale:	46
Player Metrics & Bracket Rankings and Qualitative Data:	56
Participant 1:	56
Bracket 1:	56
Bracket 2:	56
Bracket 3:	56

Ranking:	56
Statements:	56
Participant 2:	57
Bracket 1:	57
Bracket 2:	57
Bracket 3:	57
Ranking:	57
Statements:	58
Participant 3:	58
Bracket 1:	58
Bracket 2:	58
Bracket 3:	58
Ranking:	59
Statements:	59
Participant 4:	59
Bracket 1:	59
Bracket 2:	59
Bracket 3:	60
Ranking:	60
Statements:	60
Participant 5:	60
Bracket 1:	60
Bracket 2:	61
Bracket 3:	61
Ranking:Statements:	61
Participant 6:	62
Bracket 1:	62
Bracket 2:	62
Bracket 3:	62
Ranking:	62
Statements:	62
Participant 7:	63
Bracket 1:	63
Bracket 2:	63
Bracket 3:	63
Rankings:	63
Statements:	64
Participant 8:	64
Bracket 1:	64
Bracket 2:	64
Bracket 3:	64
Rankings:	65

Statements:	65
Participant 9:	65
Bracket 1:	65
Bracket 2:	65
Bracket 3:	66
Ranking:	66
Statement:	66
Participant 11:	66
Bracket 1:	66
Bracket 2:	67
Bracket 3:	67
Ranking:	67
Statements:	68
Participant 12:	68
Bracket 1:	68
Bracket 2:	68
Bracket 3:	68
Ranking:	69
Statements:	69
Participant 13:	69
Bracket 1:	69
Bracket 2:	69
Bracket 3:	69
Rankings:	70
Statements:	70
Participant 14:	70
Bracket 1:	70
Bracket 2:	71
Bracket 3:	71
Ranking:	71
Statements:	71
<b>Discussions &amp; Analysis</b>	<b>71</b>
<b>Reflective Analysis:</b>	<b>74</b>
<b>Conclusion</b>	<b>76</b>
<b>References</b>	<b>77</b>
<b>Acknowledgements</b>	<b>80</b>
<b>Appendix</b>	<b>80</b>
Appendix Item 1: Exploring Flow & Juiciness Recruitment info	80
Appendix Item 2: Flow and Juiciness User Study Information	80

Appendix Item 3: Expert Validation of Brackets	84
Expert One:	84
Expert Two:	87
Expert Three:	89

## Introduction

### Rationale & Benefits

Applying psychology into game design has in the past led to positive new outcomes, advantages and therefore may have led to the creation of better polished and designed game's or at least framework's on how to do so (K.Hicks, Et al. 2008), (Sweetser, P., Et al. 2005), (Abeele, V.V. Et al, 2020). Theories and Models can be applied throughout the entire design process of a game, or be applied to specific areas, seeing this application of psychology in games design in the same vain led way to investigating how the flow theory can be applied to game design, flow theory has already been investigated in video games limited at applying and measuring flow based upon balancing of a game (Jenova, C. 2007). However, it seems flow has yet to be measured or applied to other game design area's, hence this project looking to see whether or not it can be applied to or if there is a connection between flow and a more abstract game design concept, juiciness.

Juiciness is the use of positive feedback to create positive, rewarding and “feel-good” outcomes when carrying out tasks in a game (K.Hicks, Et al. 2008), & flow is a specific positive and intrinsic experience in which a person enters when carrying out a truly engaging and balanced task (Csikszentmihalyi, M. 1990), therefore there is a noticeable connection between the outcomes of juiciness and what leads to people entering a “flow state”. This study hopes to allow for new means of producing a higher level of game design, allowing to apply new knowledge into game design and allowing for an overall better-produced gaming experience in both industry and academic projects. If successful, intrinsic positive experiences will be allowed to be designed for simply using juicy features in a known systematic or bracketed manner allowing for easier implementation of design features known to foster flow.

The project may also aid in finding any limitation of juiciness in regards to inflicting flow allowing to get closer to answering such a question as; whether there is such a thing as too much or too little juice, in doing so creating a higher understanding of what may be, such a thing as “optimal” juiciness in regards to a player’s general experience with a game and more specifically concerning fostering flow. Both of these concepts revolve around positive user experience therefore perhaps allowing them to support one another will allow for an extremely positive player experience.

## Aims, Objectives & Hypothesis

Aims:

- To investigate the relationship between state of flow and juiciness
- To deduce the optimal amount of juicy features needed to help invoke flow
- Deduce if Juiciness induced flow creates a better experience for players

Objectives:

- Research and develop an advanced understanding of the flow theory and current work in its area
- Discovering what are the known parameters of inducing flow, both in and outside of games means
- Discovering and understanding how flow is measured
- Study games that practice or highlight juiciness
- Research and apply means of employing juiciness to a game
- Discovering and understanding juiciness
- Applying the juiciness framework to the game design of the artefact
- Produce a game that showcases a range of different amounts of juiciness
- Produce several versions or builds of the same game each having a different bracket of juiciness.
- Ensure the core game is well designed and built with polish.
- Craft a suitable measuring instrument able to measure the state of flow of players in regards to juicy features.
- User studies and data collection will be carried out using the aforementioned measuring instrument
- Carry out data analysis on data from measuring instrument

Hypothesis; the concepts Juiciness and Flow are connected

- This project's hypothesis presents the theory that the game design term, frame and methods under the guise of juiciness can be used to foster a "flow state" derived from the psychology theorem of Flow, that they share similarities that can bolster one another and simply that they are in some way connected, more specifically that juiciness can support flow because of these similarities. We also theorize that there is such a thing as too much, too little and the optimal amount of juicy features and design that can be applied to a game in regards to player experience but also in affecting the level of flow participants enter

## Background

A short introduction on prevalent topics this project looks to work under is provided, explaining what flow is, how it's known to be measured and where it stemmed from, along with a definition of juiciness provided by a review of past work in the area and a handful of examples of juicy features.

Flow is a concept that stems from psychology and was founded in 1990 by psychologist Mihaly Csikszentmihalyi (Csikszentmihalyi, M. 1990), its definition states the abstract phenomenon of humans entering a state of mind while carrying out an activity in which they are so invested they are able to achieve their goals easier and happier, the fact that the participant of a task has become intrinsic with the participant, solely focusing on the task at hand, in a rather optimal manner to the point where the participant loses track of their surroundings.

Since flows existence different means of measuring a person's flow state were developed, originally applied to people participating in sport's activities to measure a sports person's experience with flow while playing said sport (Jackson, S.A. Et al, 1999), the application of these scales are often always carried out immediately after completing the task (Csikszentmihalyi, M. 1990), some known and pre-existing measuring models are FFS (Jackson, S.A. Et al, 2008) & ESM (Larson, R. Et al, 2014) , some measuring instruments have been looked at and slightly adapted to fit measuring flow in people playing games rather than sports such instruments as DFS/ DFS-2 (Jackson, S.A. Et al, 2008) and several self developed instruments have also been created by experts in the field of psychology.

Flow in games for its majority has been studied in regards to game balancing with studies assessing the optimal difficulty for a specific player to the optimal amount of reward for players and how these 2 topics can affect flow, simply put findings found a game too difficult simply does not allow a person to enter flow as they can never achieve the level of dexterity the game needed and if a game is to easy flow may not be achieved due to players having no reason of becoming invested enough into the game for the experience to be intrinsic (Jenova, C. 2007) outside of this little research into invoking flow in video games and the means of doing so has been carried out leaving open several areas of games design that can be studied in tandem with the flow theorem.

Juiciness's meaning slightly differs between different designers, games developing teams and academia studying games design (K.Hicks, Et al. 2008). The term however has a concrete definition being the concept that prevalent audiovisual feedback can enhance a players experience (K.Hicks, Et al. 2008), since then academia has studied juiciness and has now produced a concrete definition of juiciness, this being on a high-level, positive audio-visual player feedback, as an example of this feedback take a simple button for example, to make the button feel nicer to press or to make it a positive experience juiciness can be applied, a sound could be played on every click, it's colour could change, it could wobble or pulsate, release particle effects, begin to shatter, all on clicking the mouse, these added features makes the mechanic of clicking button feel more interesting. Juiciness has been used to better advance the feeling players get when playing a game and now has work in its area that produced a framework for it.

## Report Structure

## Literature Review

A critical review of past research, projects and documentation related to the topics of this project has been carried out, looking at literature researching the general subject of player experience, looking at how players interact with video game's in all aspects and the 2 prevalent subjects flow and juiciness assessing what past work in these areas have found, how their studies were carried out and how they apply and aid in the discussion of this project.

### **Player Experience:**

Games, sports and video games are known to be highly pertinent to intrinsic motivation due to the fact they are often carried out as recreational activities, for fun and enjoyment (Deci, E.L. Et al, 1975), (Ryan, R.M. Et al, 2008) and for this reason academia and industry have taken to researching why players find them so intrinsic, how to strengthen or foster intrinsic gameplay and motivation to play and how to use this fact to produce higher quality games in general.

De Liu (Liu, D. Et al, 2013) states how flow is often measured in intrinsically motivating activities and that although the topics are closely conjoined they are not the same with intrinsic enjoyment or motivation simply being an outcome of flow, in their research and paper they reviewed several past research into intrinsic motivation while also carrying out their own study into how competition may also provide a means of motivation that allows for gameplay to become intrinsic, there are several papers looking into how skill and challenge balance effect's flow however other facets such as competition specifically and in the same vein juiciness have a rather shallow pool of past work indicating space for this projects study, the study carried out by De Liu [(Liu, D. Et al, 2013) had 2 players compete twice, once against a equally skilled competitor and once against an unequally skilled competitor the order of these matchings were random, upon playing against an unequally skilled competitor players were notified of this through several on screen messages making them aware if they were against someone better or worse than them several factors of the participants were measured these being; effort, enjoyment and arousal, finding that equally skilled competitors expend more effort by playing more games for longer whereas players competing again a player of lower skill are winning a higher level of enjoyment was measured but a lower level of arousal.

This paper aid's in showing how perhaps multiple factors including juiciness may have impact in motivation and therefore in turn flow, it also shows several factors that could be measured to aid in analysing models such as flow, however such aspects as player nuances

and personality traits were not taken into consideration in which the paper itself identifies as an issue as some people are more competitive than others and some do not enjoy competition at all, perhaps this factor of personality traits should be taken into consideration in all studies looking at players experiences with-in video game's.

Immersion in Digital Games: a Review of Gaming Experience Research (Cairns, P. Et al, 2014) also found that personality traits also affect a players accessibility to immersion a topic also closely linked to flow in the fact that such traits as a players cognitive absorption which is their likeness to become absorbed in most tasks they carry out, this fact is solidified through their extensive review of past research into how players interact with games and raises interesting hypotheses that could be applied to this project as perhaps participants gathered all may have varying traits that affect their ability to enter flow and therefore may affect collected data, with that said the paper does not mention how critical the fact of cognitive absorption is nor carries out a study to produce any qualitative data to provide such an answer.

Outside of this fact the paper studies the connections between flow and immersion and its differences reviewing papers from J.chen (Jenova, C. 2007) to K. Procci (Procci, K. Et al, 2011) each that review flow specifically, stating how in flow, immersion is used to define the essence of absorption into a task, they however argue that outside of flow, immersion in digital games is a different concept as players may become immersed in games that supply no final goal and yet a requirement of flow is the fact that it requires a clear goal from an activity (Procci, K. Et al, 2011), the paper Immersion in Digital Games: a Review of Gaming Experience Research even go as far as deducing and saying “immersion is more of a graded experience whereas flow is an all-or-nothing sense of being “in the zone”, however J.Chen in Flow in Games and Everything Else (Jenova, C. 2007) states specifically, while taking experts directly from Csikszentmihalyi’s definition of flow to validate, how not all 9 dimensions of flow are needed for players to achieve entering flow and there for perhaps makes this argument revolving clear goals and what flow is irrelevant.

Immersion in Digital Games: a Review of Gaming Experience Research (Cairns, P. Et al, 2014) does however provide several interesting factors that aid in producing games with immersion in mind and therefore in turn flow concluding that such factors as location a game is being played, aspect ratio, screen size and the like can all have significant effect on a players immersion all of which should be taken inconsideration when producing games for research in areas such as measure flow or when producing games that attempt to make use of these theories. Overall this paper aids this project in offering an understanding of what affect's immersion and offers some insight into how immersion and flow share connections perhaps supporting the theory juiciness may affect immersion and in tandem flow.

Gamification of Education Using Computer Games (Nah, F.F.H. Et al, 2013) produced a framework for gamification, this was applied to education material for teaching but may be

abstracted to the gamification of most things, its production took a teaching element and made it into a game, they found through a study of students playing these educational games and therefore games in general created an increased level of cognitive absorption. Time Flies When You're Having Fun: Cognitive Absorption and Beliefs about Information Technology Usage (Agarwal, R. Et al, 2000) aid's in supporting this finding that games create a higher level of cognitive absorption stating how fun and enjoyment goes are closely linked to cognitive absorption, for example when a player is having fun they are more prone to losing track of time, in this paper a multidimensional construct labeled cognitive absorption was defined as a state of deep involvement with software, the construct was supported through review of past research into immersion and games, cognitive absorption theorized as being exhibited through the five dimensions of temporal, dissociation, focused immersion, heightened enjoyment, control, and curiosity clearly shares similarities of dimensions found in flow, perhaps simply more related to interactive systems, an interesting finding often not mentioned when studying flow in games is how individual traits of playfulness and personal innovativeness are important factors to what they label as cognitive absorption and therefore perhaps flow.

In summary there are clearly a large range of specific sub genres and area's to be researched under the overarching subject of player experience and that they share many similarities of connections to one another, finding how immersion a subject often found in games research and flow share large similarities and that perhaps immersion aid's in producing the higher level and more abstract flow state (Procci, K. Et al, 2011), (Jenova, C. 2007). Some of this research also opens the question of whether or not personality traits in people have a significant effect on their interactions with immersion, cognitive absorption and flow (Nah, F.F.H. Et al, 2013), (Agarwal, R. Et al, 2000).

### **Flow:**

Toward an understanding of flow in video games by Cowley and others (Cowley, B. Et al, 2008) discuss how a deeper understanding flow in relation to games can improve the description of the relationship between a player and a game system and investigate both mechanical and aesthetic facets of games and flow. Using several pre-existing schema such as the Person-Artifact-Task model which is based on task performance they produced a framework on game-player interaction which suggested there is a strong functional similarity between gameplay and flow which was validated with a large quantity of past research that solidifies this suggestion, one means of validation was the mapping of the 9 dimensions of flow to the Corresponding Game-Play Attributes produced by Jones in 1998 (Jones, M.G., 1998).

The framework produced for this paper allows for a more concrete means of practical mapping of flow onto game's due to the amount of research applied into past papers and work of such schemas's as USE (user-system-experience) (Cowley, B. Et al, 2006) , in which

the construct for evaluation of a player's experience being the Experience Fluctuation Model (EFM) present in flow theory (Csikszentmihalyi, M. 1990), and breaking them into subsequent specific topics such as game structure, player modeling and game experience and then reviewing them in relation to papers and past work in flow. What was found through producing this aforementioned framework was that games give immediate access to an inherent potential for an optimal experience and therefore there is a clear and common correlation between simply playing a video and entering flow and therefore they theorize that games provide a means of activity that almost forces a player into a cognitive state that begins to approximate the flow state to support this they explain how games create a physc disorder (a challenge) and an often an overwhelming means of resolving this and therefore producing a surefire way of producing negentropic state (the state or feeling of completing a challenge) which satisfies several of the flow dimensions. Also found is how when playing a game 3 of the dimensions with-in flow are almost consistently present' these being; One is fully immersed in the task, no other concerns intrude, One becomes less conscious of the passage of time, Sense of identity lessens, but is aftwards reinforced through statements found in several past studies into players reacting to flow. Toward an understanding of flow in video games not only reaffirms that players can enter flow when interacting with video games but also identifies specific reasons why people may enter flow when playing games, in which these reasons can be adapted into or mapped to my project.

The Benefits of Playing Video Games (Granic, I. Et al, 2014) investigates such topics as the cognitive, motivational, emotional and social benefits where for each of these topics a simple background research into other papers that produce findings that can be mapped to each benefit, their investigation in to the emotional benefits of video games highlights how flow is a positive emotional experience that is often described by gamers when playing a game mentioning how they felt a loss of conscious, a heightened sense of control and a feeling of carrying out intrinsically rewarding task's, all of which fit flow dimensions this may support the hypothesis that juiciness does indeed have an effect on flow as at its core juiciness is audio visual feedback often presented as subtle reward mechanisms for carrying out something in a game, interestingly they go on to hypothesis that games my even benefit a players life in general offering a sense of accomplishment, the paper however does not attempt to support this theory at all, however the idea or thought of how much a game may impact our day to day lives seems like an extension of the outcomes of flow and may have actually aided in supporting their theory of benefits behind games if a prolonged study into the topic was carried out, the benefits of playing videos game's is simply the writers extrapolation of past research into games and applying their physiological background onto the subject of game's and therefore perhaps a lack of understanding into game's design and the like hinders the paper, along with this The Benefits of Playing Video Games (Granic, I.) also does not carry out its own qualitative or quantitative research into their stated gamer's statements and excerpts them from Flow and Media Enjoyment (Sherry, J. L. 2004) in which carried out studies with separate focus groups based upon age from 5th graders to 18 to 24 year old's with participants consistently mentioning their interaction with these 3 dimensions

of flow, this data aids in validating the statements made in The benefits of playing video games (Granic, I.) and is quite a considerably large pool of participants, varying age range between focus groups may also produce interesting data into how different audiences interact with video games and flow however the paper did not analysis or perhaps study their data deeply enough to do so, they also did not apply any validated means of measuring flow and instead simply took statements on how participants interacted with games and mapped them to dimensions in flow, beyond the study the paper also notes specifically how “games have abundant visual and aural information that helps screen out distraction and facilitate concentration” which produces another theory into perhaps why juiciness may aid in fostering flow in the fact that it helps players focus on the task of playing, originally the explortled theory of my project stemmed from the dimension of flow that ambiguous and constant feedback is given to participants of a task in which juiciness bolster’s, with this being said Flow and Media Enjoyment (Sherry, J. L. 2004) does not produce a value to back up this statement that audiovisual information does indeed aid in flow but simply hypothesis how it meets a dimension of flow but does mention how audiovisual feedback offers a heightened sensory immersive experience.

To support the theory this paper make’s that juiciness can be mapped to a handful of the dimensions of flow can be further seen validated by GameFlow: A Model for Evaluating Player Enjoyment in Games (Sweetser, P. Et al, 2005), in which they produced a model that attempts to measure and evaluate game experiences and participant enjoyment using flow theory at its core structure, there reasoning to behind this is justified as flow is also used to measure enjoyment and also share some similarities in tasks such as sport’s although they do not mention specifically what similarities playing a game and carrying out a sport’s activity is. Upon assessing the flow theory they slightly adjusted the 8 elements of flow to better fit the specific task of video games this was done by mapping the 8 pre-existing elements of flow to the Elements from Games Literature as to support the means of mapping these elements they broke down each of them and gathered different pieces of literature that identifies how for example audiovisual feedback mimics the flow element “the task provides immediate feedback”. Several papers and past research does indeed support some of the mapping, several papers that produce guidelines and that study heuristics of usability & playability in games state how games inherently need to provide frequent feedback for players to determine distance and progression towards objects (Pagulayan, R., Et al, 2003), while (Gee, J. P. 2004.) also mentions the importance of not only positive feedback when players do something correct but also be provided feedback when doing something wrong or losing as players may become frustrated if they do something wrong and are not taught what they are doing wrong as to avoid the mistake in the future all of which are provided in this papers artefact.

As an outcome of juiciness is enchanted immersion (Kao, D., 2020) looking at the mapping of immersion in GameFlow: A Model for Evaluating Player Enjoyment in Games and the element of flow that states “Deep but effortless involvement, reduced concern for self and sense of time” is critical as there are an abundance of studies into how players interact with games with several finding how players become less self aware and less aware of their

surroundings (Brown, E., Et al, 2004), (Agarwal, R. Et al, 2000), Johnson and wiles found from observing players how deep and effortless involvement in playing a game quickly stemmed (Johnson, D., Et al, 2003), several papers review or find how players often have a high level of emotional investment in games (Brown, E., Et al, 2004, Georgios Christou found that both experienced and inexperienced players both experience the same level of immersion in games and more importantly and more specific to the study of how juiciness may affect flow found a highly recurring positive correlation between immersion and game appeal, meaning a game with high appeal will lead to a higher level of immersion (Christou, G., 2014).

To further validate the produced Gameflow measuring instrument and mapped game elements they had an expert in the field of games review 2 different games while applying gameflow, the expert had to review both games based of the 8 elements of gameflow and produced a score for them while highlighting what criteria of each lament was present or not present in each game finding Gameflow can indeed produce accurate qualitative data and measurements of the likeness and ability of a game to induce flow, it does not specifically however measure the flow of a player during gameplay, nor does a single experiment with one expert validate their work requiring perhaps a larger pool of actually applying gameflow, there is also the limitations of how the expert only played and weighted 2 games in regard of Gameflow both in a specific genre, there is no proof that the Gameflow model could be applied universally to all genres of games, they also found themselves that some elements of gameflow criteria are not best fit to be measured through an expert review and instead would require play-testing to correctly evaluate them, which they did not carry out they also found that Immersion is also better studied through observation of a player as a self-report could be falsified or limited due to self-perception, this issue could also apply to the study carried out for this project as the user study had to be carried out remotely I could not observe the player and therefore miss out on collecting perhaps valuable metrics. Beyond that the paper aids my study as several criterias mentioned for each individual element of games design mapped are created, aided by or are an outcome of well implemented juiciness. Two of the big 8 criteria of Gameflow is Immersion and Feedback, the fact that this mapping, criteria and theory has been validated with clear and proven examples of overlapping features between flow aid's in supporting the validation of this project, that perhaps juiciness does indeed foster flow.

### **Juiciness:**

In industry juiciness is referred to or used as an overarching descriptor of a range of aesthetic trends that appeal to audiences, during a talk Martin Jonasson, Petri Purho offer a large range of audio visual tools and features that can be applied to games to produce a better game feel and in turn a juicier game (Jonasson. M., Et al, 2013). Academia has gone beyond perhaps buzzword descriptors stemmed from games developers and have carried out research into the deeper thoughts and topics of Juiciness, J. Juul, A defines juiciness as a an excessive amount of positive feedback to a player (Juul, J., 2010), (Deterding, S., 2015) stating how juiciness is

not only used as a means of instruction for making a game easier to play but instead through immediate feedback feel more rewarding offering pleasurable experiences with several other papers stating similar excerpts(Juul, J., 2010).

Dominic Koa in The effects of juiciness in an action RPG (Kao, D., 2020) carried out a empirical investigation in which they carried out a study consisting of 3018 participants, with the aim of studying the outcomes and player interactions to compare four identical versions of an action role playing game each with varying levels of juiciness being None, medium, high & extreme, there is no specific reason given as to why 4 brackets were decided upon however there was extensive work put into validating each bracket ensuring what juicy features were included was fitting to the title of the bracket by having 119 different participants watch video clips of one of the randomly chosen 4 brackets of gameplay and were then asked on weather or not sound and visuals fit the game which was marked on a 7 point likert scale along with a 10 scale item, 1 being minimal in regards of special effects and 10 being excessive special effects to rate the level of special effects on the gameplay of the game, using the findings from these 3 elements the mean scores of each condition has a relative valence matching Dominics expectations and therefore validating the brackets, it helps support their other findings in doing this method of validation however suffers from some issues firstly it may be difficult to correctly feel a sense or the full effect of a juicy feature through a gameplay video rather than playing the game, the participants used were not from the games industry nor had any specific understanding of games design or juiciness and that lack of understanding may skew findings as to one person who classes a bracket as “low / 1-4” may be seen as obstructive and annoying to another person who plays or views the brack, instead perhaps employing experts from the field of games industry to carry out the same study may have produced more believable and fitting bracket evaluation.

As for the method of producing each bracket a past review of known means of applying juiciness to a game covering; colour, audio, feedback, seductive details and polish of game, this list along with the Grounded Framework for Juicy Design (K.Hicks, Et al. 2008), Koa’s study specifically highlights in what was changed, removed or added between each bracket the same approach and mannerisms of bracket different could be extrapolated for this project, each build in koas study raised the amount of audio effects, visual effects and Audio/visual effects, Player Experience of Need Satisfaction was used as the measuring instrument chosen to analyze competence, autonomy,relatedness, immersion and intuitive controls their reasoning for this was because PENS is considered to be a robust framework for easing play experience, the study outside of this reasoning does not explain why PENS specifically was used however does offer an option of choice as a means of measuring certain aspects for this study. The effects of juiciness in an action RPG found that the brackets None and Extreme had significantly decreased player experience, an interesting find that perhaps there is such a thing as to much juiciness, presnetaint a scenario where perhaps juicy instead of fostering flow removes players from flow due to sensory overload, more specifically Koa found that

the Extreme brack lead to a large decrease in intrinsic motivation, lessening the want of players to keep on playing.

Providing a further understanding of the outcomes of juiciness in games and to solidify findings of other papers such as the above, Understanding the Effects of Gamification and Juiciness on Players (K. Hicks., Et al, 2019) carried out at smaller numerical study of 36 participants to compare traditional gamification elements, and the concept of juicines using the Self-Determination Theory, which is the distinction between autonomous motivation and controlled motivation, the use of extrinsic rewards such like immediate feedback in a video game is found to induce controlled motivation (Gagné, M., Et al, 2005). For the study they carried a within-in subject assessment of participants playing the game “Predator!” in which they produced 4 versions of, these varied from one with juicy features applied, gamification design applied, one with neither and one with both much like how Koa carried out studies into brackets of juiciness, however unlike Koa they did not get the brackets validated through testing, that being said it may not have been needed as they were not varying brackets of 1 topic but several bracket for several separate topics, as long as juicy features were in one and gamification methods in other the brackets were identifiable and fitting. The game was played in VR and participants played all 4 versions a long time in vr could skew participants way of perceiving juiciness and gamification due to sickness, dizziness and fatigue however to counter this they used SSQ (Simulator Sickness Questionnaire) as to determine whether or not participants had any negative experiences while playing with results showing no indication of sickness, that does not however account for as mentioned player fatigue. The study found that gamification and juiciness improve user experience, but that only juiciness fulfills all basic psychological needs that facilitate intrinsic motivation when applied in non-gaming settings once again validating this projects hypothesis of juiciness links to the intrivaly motivated task in which flow stems from, furthermore participants of there study found that specifically juicy design elements produced an increased feeling of engagement witch plays into the element of flow covering loss of time to due captivation, the study also offers a broader means of creating engaging playful experiences some of which could be applied to the development of this project.

## Methodology

### Project Management

Often games made for research or within academia are designed with a specific research question in mind and therefore the artefacts created are often not fully developed games (input academic), due to the nature of this project revolving around a rather design heavy subject and the fact the artefact shall be part of a user study a fully developed and polished complete experience was needed, thus from the beginning the full process and development cycle of a video game’s creation was planned for, rather than planning to use a design process for an artefact requiring a more structured development, thus meaning rather than simply

having to design a single specific feature which is rather linear in comparison to the multi-facet elements of designing an entire game in which also encapsulates having to produce;

- Fitting gameplay
- An actual playable and complete game
- Code implementation of mechanics
- Code implementation of any scripted juicy features
- Art and design work of game assets
- Creation of particle effects
- Producing UI elements and UI programming

Most of which would not be needed nor relevant to a project set to produce a specific tech demo in which the artefact would not be affected by its game scene.

To further ensure the artifact created was polished and perceived as a full game time was allocated to allow its development to go through several iterative stages further advancing the game based upon early feedback from the supervisor of this project, additionally it was to be planned from early in development the game was to be validated later into the development process once the core game's creation was viewed to be complete in regards to each build of juiciness via 3 experts during this time further feedback was given or deduced through the validation process which shall be covered later, upon receiving feedback, the feedback was briefly evaluated deciding whether or not its implementation was critical to polishing the game or if it would in anyway negatively affect the occurrence of the juicy features the game has been made to highlight. As mentioned during project management and production of the projects scheduling the scope of this project was considered allowing to allot time for the above mentioned iterative stages.

In the same vein due to a complete game being needed a bug testing phase would be needed and therefore planned allowing for any lingering bugs upon the games development completion to be fixed that being said the possibility of bug's cropping up during feedback testing was foreseen and planned to be fixed on the fly during each iteration of the games development.

The project itself was broken down into several phases that follow a general timeline of most games development processes, these phases being design, prototyping, implementation, user study & data analysis. Due to the nature of this project handling a heavily design focused feature of games design, juiciness, a large amount of time and focus was allotted to the design stage as the games main focus are these features in which require research into past means and uses of employing juiciness and adapting them while also creating the games own juicy features not only would the process of designing and implementing juicy features take time they also had to be evaluated before implementing to ensure they seemed fitting for the game made, how they relate to and whether or not they would work with one another and which features suited which build of the game, this pre-planning was to ensure that the main focus

topics of this project were the key focus and therefore more time was given, the design concepts were also in a way iterative, implementing a feature and ensuring it fits with the games genre and style referring back to the juicy framework to ensure this, if a juicy didn't quite fit it was reworked or removed.

Due to social distancing measures that were in place during this project it was planned to be a remote user study, planning was yet to be over when these changes came into place therefore allowing the schedule to be reworked to cater for this as the study will have to be moved to online means, it is known that people taking part in the study at home may not be able to or want to carry out their part immediately , nor does the author have any control in ensuring they do therefore knowing this scenario may have a chance to arise extra time was allotted to the data collection stage giving testers ample time to carry out their play testing and survey. Initially this project's user study was to be carried out in person, operated by the author, gathering testers and sitting with them as they carried the study out, in doing so it would ensure a tester would complete their play through and feedback stage almost instantly upon being prompted or asked to partake.

Due to the nature of the project the need to take in consideration the time it would take to also producing a paper, in a comfortable manner it was planned to fluidly and constantly allow time for work on it thus meaning the project was planned to allow time to work on development of the artefact and on the paper ensuring to much time was not put into one and not the other, avoiding creating a situation in where due to lack of time left on one aspect of the project it's production level would severely lessen.

## Software Development

Before work began implementing the artefact time had to be spent designing the game, its mechanics, planned juicy features and other games design topics. Upon finalizing the design stage of the project 2 digital prototypes were made to aid in deciding art style and how basic mechanics were implemented, this is due to employing the iterative process of games design to find the optimal and most fitting means of game before full implementation of the game is produced, producing several prototypes allowed to weigh up pro's and con's of both prototypes, it is vital to have cohesion between art style and game play as to ensure the game is not distracting hence the need of producing several prototypes, upon deciding both of these topics, work began on the games development which was broken into sub-sections of work starting with creating and implementing all art assets needed.

Production then became iterative in implementing core gameplay mechanics due to the nature of games development in the fact that when a mechanic is implemented it would be tested and then reworked on if needed, by the nature of games development I refer to the clear link between prototypes (and other playable versions of the game), playtesting, feedback, and game quality, creating a loop throughout the development process (Henna-Riikka Ruonala)

and this loop was applied and carried out several times during development of this artefact as it has been found to produce higher quality produced games mentioned in the findings of the study into Agile Game Development by Henna-Riikka Ruonala (Ruonala, H.R., 2017) and supported by Clinton Keith in “The State of Agile in the Game Industry” (Keith , C. 2010), Jussi Koutonen and Mauri Leppänen in “How Are Agile Methods and Practices Deployed in Video Game Development? A Survey into Finnish Game Studios and several other past studies (Koutonen, J., Et al, 2013) .

The artefact needed to be broken down into several stages and each of these stages due to implementing feedback and needing to ensure the game was polished needed to be iterative, therefore example upon descending upon different design features, they were implemented to ensure they would fit, if not they would be removed or reworked, this happened for each feature.

Several builds of one game was to be created, while the base game was produced with all juicy features, during their creation each of these features were pre-scripted to be dynamically turned on or off at a tick in the unity inspector allowing for time saving in place of having to from almost the ground up rebuild the same game, with out implementing the dynamic means of turning on and off features to produce the varying amounts of juice each build outside of assets would have had to be reproduced starting from recoding core mechanics in doing so would not only seriously extended the time frame needed for the development but also produce a lot of unneeded extra code and work bloat. The way this was implemented was that with in a single unity project at first the scenes containing the most amount of juice was first implemented as it was the most time consuming to produce and also allowed for easier and faster creation of the lesser juice builds, upon the full juice levels being produced and scripts for all mechanics being implemented the scenes were duplicated for the lesser juice variants, using as mentioned pre-implemented checks with in the code the amount of juicy features called were turned on or off, this was done by checking in an if statement if we were in the scenes in the build settings labelled either all juice, some juice or small juice, if the all juice tick box in the unity editor was ticked all if statements calling juicy features or intilaising them in the code is ran therefore all gameplay mechanics are called as well as all juicy features, the same method was used for the middle bracket simply within the if statement for it less juicy features were called compared to the highest brackets if statement, doing so also allowed development to avoid having to fix any bugs or remake any changes 3 times for each build as if a bug was found as each version shared the same scripts a fix to one build was a fix to all. Upon building the base game and the juiciest bracket the other 2 brackets were quickly created by duplicating the first build and simply unticking or ticking the juicy bracket inspector check I implemented. Iterative development then began again fine tuning each build to ensure they follow and keep to the juicy frameworks criterium.

## Toolset's & Machine Environments

Unity (Unity Technologies (2020))

- Chosen games engine for this project and therefore used as the primary program to produce the artefact/ game the main drive behind this choice is unity's prowess, documentation, tools and support for 2D game development. The software has intuitive UI tools that allow for quick and neat implementation of UI features such as local snapping allowing users to define UI object's origin points quickly or applying UI auto-grid layout tools which take ui objects and align them in varying neat and organized way's while offering user's the amount of spacing wanted between each ui object in the layout group both of these features were used optimally in the projects artefact
- UI programming is also intuitive with-in Unity's C# library which allows for quick high-level control and easy means of editing UI object's content allowing easy access to any text elements within UI objects and other granular elements UI objects may contain. Unity also offers several 2D tools that allow for intuitive implementation of sprites and sprite editing as most of what the artifact game are sprite elements it seemed fitting which is what allowed for the ability to "explode" sprites to be implemented which was used for when a player made a match in the juiciest build the pieces matched explode into pieces. Other games engines such as Unreal would allow for the creation of 2D games however due to lack of tools made specifically for 2D games, tool and library bloat and therefore producing an overall more resource and time heavy endeavour when wanting to produce a 2D game, same cannot of course been said for 3D games. As for other engines known to be used for 2D games production such as Game Maker, Unity allows for the creation of more intricate games to be development again due to tools and the programming libraries offered, Game maker is great for a starting point into 2D game development as it has the ability to produce games without any programming needed, of course you can also program in Game Maker however its library and documentation are a slightly lacking compared.

## Datasets/knowledgebase and statistical analysis

The recruitment process for this project had to be carried out in a controlled and contained study rather than a public wide-spread study in means of distribution of the survey this is due to the fact that each participant had to carry out several surveys (4 in total) and therefore a means of tracking which 4 surveys related to each other and the same participant, if this was carried out simply by putting the game builds online for access there would be no way to track the game bracket order participants played in which is a vital piece of information needed for the data analysis, as this information could show there are discrepancies in juiciness's level of effect on flow when playing certain brackets prior to one another, there

would also be no way as mentioned to track which participant each of the 5 surveys relate to and therefore produce no means of viable data as there would be no way to compare their flow experiences per game bracket.

To ensure all data collected and stored is related to its corresponding participant correctly all participants were contacted, asked if they were comfortable taking part, showing them documents detailing what they would be doing if they took part in the study, upon deciding if they will or won't take part, participants taking part were given a random participant ID between #1 and #14, they were given this detail and each survey prompted them to enter their ID, this allowed them to keep track of which surveys related to which participants, this was necessary as different participants were given the 3 game brackets in different order.

To ensure all procedures relating to the user study all ethical requirements have been carried out, qualtrics have been used to create and distribute surveys as information collected there is known to follow guidelines in regards to data handling and the like. As to ensure participants were comfortable taking part in the study they were first briefed on what the study entails with an information sheet (See Appendix Item 1). Upon accepting to take part, they were given a chance to ask any questions about the study, along with a document explaining exactly what data will be collected and how it will be handled along with disclaimers on how they are free to withdraw at any time and rescind any data collected, before providing informed consent (See Appendix Item 2)."

A hybrid of both quantitative and qualitative data will be provided with the majority of data collected being quantitative where the qualitative data will simply be excerpts and statements from participants on their experiences with the study, therefore the qualitative data collected for this study will simply be used to support the quantitative data. The quantitative data is needed as the measuring instruments being used for this study require scaling of items, scale's output numerical scaled data, qualitative data therefore is the most fitting to measure participants experiences with the study, the artefact and flow, more on this has been covered in the research methods section of this paper. All data will be ordinal again this is due to measuring instruments collecting data on a 5 or 7 point likert scale, scales are inherently ordinal, during data collection participants will be present with strongly disagree/ strongly agree questions in which will then when collecte dbe outputted as numerical values of 1 to 7, 1 being strongly disagree and 7 being strongly agree.

As to measure the effectiveness of juicy features fostering flow the need to carry out a with-in subjects study arises, this is because flow is a very abstract, personal and high level psychological effect and different participants may have different requirements of entering flow therefore to compare the varying levels of flow achieved between each bracket specific to each participant was needed, with-in subjects allowed for this as all participants would have to carry out and see all brackets of the game, thus having the ability for themselves to compare which they preferred or felt more intrinsic meaning individual differences will not

distort results. Within subject is also most fitting as due to the small amount of participants targeted for this project as between-subjects would require double the amount of participants as several testers would be needed to test several factors.

Before statistical measuring can begin the collected data from all surveys had to be sorted into their juiciness bracket's, as the study carried out within subjects each participant had a varying order in which they played the brackets and therefore data collected for each game was not coherent for each bracket, once all data to each bracket was sorted, all scale data taken from the 7 point likert scale of PXI and 5 point likert scale of Activity Flow per bracket was plotted out into excel creating 3 excel sheets one for each bracket. All scales were then broken up between PXI and Activity Flow into separate sections per excel sheet. After this as evaluate data produced all scales were divided into relevant elements of their respected measuring instruments, Activity flow can be broken into 9 over arching dimensions these being: MAA = merging actions and awareness; CG = clear goals; CO = concentration on task at hand; UF = unambiguous feedback; CS = challenge skill balance; TT = transformation of time; CN = sense of control; SC = loss of self-consciousness; AE autotelic experience & PXI's dimensions dimensions being: Meaning; Mastery; Immersion; Autonomy; Curiosity; Ease of Control; Challenge; Progress feedback; Audiovisual appeal; Goals and rules. This created several sheets within each bracket, each sheet consisted of all questions relating to each dimension, meaning a sheet for MAA, CG and so on. Below show's all participants answers regarding the 3 questions related to Autotelic Experience (AE), these 3 scales per participant were then averaged producing a weight or numerical number for AE per participant.

A	B	C	D	E
1 I really enjoyed the experience.	The experience left me feeling better than before carrying it out.	The experience was rewarding.		
2	1	2	3	
3	2	2	2	
4	3	3	3	
5	2	1	2	
6	2	3	2	
7	3	3	3	
8	1	2	2	
9	2	2	2	
10	4	4	4	
11	1	3	2	
12	5	5	5	
13	1	1	1	
14	2	2	2	
15				
16 Inverted (5-1 now 1-5)	Inverted (5-1 now 1-5)	Inverted (5-1 now 1-5)	Autotelic_Experience	
17	5	4	3	4
18	4	4	4	4
19	3	3	3	3
20	4	5	4	4.333333333
21	4	3	4	3.666666667
22	3	3	3	3
23	5	4	4	4.333333333
24	4	4	4	4
25	2	2	2	2
26	5	3	4	4
27	1	1	1	1
28	5	5	5	5
29	4	4	4	4
30				
31	◀ ▶ ...   Inverted AutotelicExperience Loss of Self-Conscious ... + : ⌂			

Once having the averages of each dimension per participant to prejudice a means of comparing and analysing data between each bracket, the average of all participants averages per dimension was calculated, producing a single value for each dimension per bracket, these averages were then charted into a bar chart along with their standard deviations as error bars. As to analysis data what will be compared are the bar charts produced for each dimension per bracket, as an example if bracket 3's average for Autotelic Experience is greater than the other 2 bracket's perhaps something can be extrapolated by this data.

As to ensure the above findings, data and bar charts are valid, significance in data and its p values will be produced in spss. As the data being analysed is non-parametric, the fact that this project is studying a difference between data, the data was gathered via the with-in subject's method and there are more than 2 samples, a Friedman's ANOVA, as for clarification Wilcoxon can only be applied to 2 related samples, Friedmans's ANOVA is carried out in the same manner but simply allows for "k" related samples (any number), shall be carried out on each set of dimensions scales per participant per bracket. If any dimensions p values are significant a Friedman's Anova will be applied as to define the degrees of freedom.

## Research Methods

As to ensure data collected was accurate and valid, all juiciness and juicy features had to be applied appropriately to the game, to ensure this requirement was met development was consistently produced regarding the Juicy Design Framework (K.Hicks, Et al. 2008) in doing so made sure all features produced were coherent and implemented in a correct manner as to not negatively affect gameplay in which would skew results found, invalidating data collected as participants would have been interacting with a game that cannot even properly use juicy features and therefore making an attempt to track if flow was fostered moot, this was done by referring to each element of the Direct Feedback framework and reviewing every single juicy feature implemented each time a new feature was added it went through this process, to ensure cohesion throughout the entire game for the same reasons upon the games polish stage of development the Game Characteristics and Game State sections of the framework elements were reviewed.

Once again to ensure the 3 brackets were fitting and to once again ensure data collected was valid and coherent between each version the brackets were developed via a structure built upon past studies in which also applied varying brackets in regards to juiciness, mainly referencing the level and presence of juicy features and effects based on Koa's study in which they produced several builds of the same game with varying amounts of juiciness which was validated by the author pursuing experts in the field to approve of these brackets. Therefore to further ensure each brackets features were fitting for what they are labelled as, minimal/ no juice, some/ average juice and a lot of/ too much juice, each build was validated by 3 experts in the games field, each expert played an average of 5 to 10 minutes on each

bracket and then were asked to write inserts to specific questions revolving around engagement and the juicy framework and whether or not a build met the frameworks criterium, in doing so we can see whether or not each bracket does indeed contribute a fitting amount of juiciness or not. If a build or all 3 builds did not meet the 3 experts validation if was revised and reworked or built-up based on their replies to each framework criterium. Thus empathising the need of agile methods.

The measuring instruments chosen allow for a validated means of collecting data as the 2 chosen are known and validated tools with-in they're respective academic areas thus meaning they have been tried and tested to correctly collect data needed for what they are analysing or measuring. As this project is looking to specifically answer whether or not flow was present during play for each build of the artefact game it is of course crucial and fitting to present a scale used to assess Flow, as to ensure the survey chosen allowed for the collection of valid data a review of several Flow measuring instruments were assessed, due to the roots of measuring flow and applying the flow theory stemming from sport's a lot of the measuring instruments for flow are catered specifically to active/ sport activities thus the measuring instruments featured questions or scale's that could only really relate to a sports activity, if this was applied to an activity such as playing a game the information collected from these sports specific related scales would either be moot or skew data as participants may attempt to scale an item that does not relate to their experience thus producing fudged or non correlating data due to this the 12 item short scale (Jackson, S.A., Et al, 1996) was not used, The Witmer and Singer Presence Questionnaire (Witmer, B.G., Et al, 2005) barely touches on any of the 8 factors of flow and was created specifically for measuring tasks carried out with-in VR environments as an example of how these questions cannot be used to apply to simply playing a game one item ask's "How easy was it to identify objects through physical interaction, like touching an object, walking over a surface or bumping into a wall or object", the Immersive Tendencies Questionnaire (Witmer, B.G., Et al, 1998) measures scales related to flow but not directly to the flow theorem as it relates more specifically to immersion and peoples likeness in their lifestyles to become immersed therefore not only does it not specifically target measuring flow but also cannot be applied to a single activity. Some measuring instruments were actually developed specifically for gaming activities such as the Game Engagement Questionnaire (GEQ) (Brockmyer, J.H., Et al, 2009), however it featured several odd and unfitting questions/ scales such as "'I feel scared" which does not apply to the artefact game in any aspect not only that but a lot of items were fairly similar to items found in the PXI questionnaire which is already being applied to this projects study, the FSS (The Flow State Scale) features a long and short version one with 9 items and one with 36 items, the long version was ruled out as to not cause fatigue in participants when they are filling out surveys as the flow scale was also paired with the PXI scale which in of itself feature 30 items, and as to ensure data collected was reliable and true to the participant fatigue needed to be avoided as there was a chance if they were overloaded with survey items they may begin hap-hazardly answering rather than putting actual thought into their answers which leaves the short Flow state scale, this scale seemed fitting as it was produced solely to

measure flow, validated and not too long however it was once again originally produced to measure flow in athletes and although all items in the scale could be extrapolated and applied to other activities the scales had a slight misalignment therefore the The Activity Flow Scale was chosen as the flow measuring instrument this is because it was created upon the Short FFS just mentioned however each item from the FSS was extrapolated and generalized therefore allowing a better suited scale that was not made primarily for sports but for any activity (Payne, B.R. Et al, 2011) the hope of this scale evaluation was to ensure relevant, usable, coherent and valid data in regards to participants' experience with flow.

PXI (Player Experience Index) (Abeele, V.V. Et al, 2020) was chosen to accompany the Activity Flow Scale as a means to aid in gauging more granular game elements that may affect or are closely linked to flow such as immersion and participants general experience with the game. In doing so the data provided from the PXI scale may support mapped findings from the ActivityFlow, as an example if in Activity Flow one bracket is exceeding in regards to positive scales and yeh in the PXI model the same bracket is consistently negatively scaled there may have been an issue with the manner of data collection, a misunderstanding of scales or questions on the Activity Flow, where as is all data produced from PXI mimics or follows a trend the Activity Flow Scale exhibits it simply strength's that trend. It stands to reason that Flow is a positive experience for participants carrying out a task, models that measure flow specifically measure their flow levels in regards to the task of completing the game it does not specifically measure the players experience with the game, thoughts on the game or whether the participant enjoyed it.

## Design and Development

### Requirements

To produce a complete base game with all functioning gameplay along with ensuring each build of the game is equal in regards to all functions ensuring all testers have access to the exact same gameplay with the only differing features being juicy elements as to not receive different findings between each build simply due to difference of gameplay. In the same vain each build of the game must be polished and bug free as to not affect testers in any negative way or change the gameplay at all, this is because bugs and shoddy work may negatively affect the players experience and thus take away from the focus on the juicy elements to remove the player from flow completely, it is also seen in the juicy framework (K.Hicks, Et al. 2008) that to ensure juicy features are most optimally consumed a polished game is needed to ensure these features feel grounded in the game, all of these measures and design factors also simply ensure people feel like they are playing an actual game ensuring testers expectations are met again offering an optimal space for fostering flow & allowing juicy

features to seem fitting. In the same vein a simple genre game with simple gameplay elements felt were a must to ensure again that what is highlighted are the juicy features

A key requirement of this project was to produce several versions of the game that encompass several brackets in regards to the amount of juicy features incorporated as to be able to compare the effect of these features and their likeness to foster flow. Overall 3 bracket's of varying amounts of juice were produced, the hope of employing 3 different bracket's was to allow for enough range of changes between each version, another reason 3 versions were produced instead of a higher amount was due to the manner of which the study to collect data was to be carried out, anything above 3 may have caused player exhaustion in the fact the study may have taken too long for participant comfortability, if between subject testing was carried out perhaps more brackets could have been implemented without irritating and therefore negatively affecting finding's. The 3 brackets in regards to the amount of juicy features present are; 1-Minimal, 2-Average and 3-Plenty

The brackets of juiciness for each build of the game, the amount of juicy features and they're hoped impactfulness was chosen and deemed suitable through mapping previous studies in varying levels of juiciness in a single game (Kao, D., 2020) along with referring to the juicy framework (K.Hicks, Et al. 2008) looking at each criteria with-in the framework and reflecting on what features would need to be implemented to hit each criteria and to what level

As mentioned each build has varying levels of juiciness, and therefore the need to ensure all information needed for the player to fairly play the game through all builds to be the same/ shared with the only varying factor is the amount of juicy features were offered, this was difficult to balance as juiciness is inherent feedback and therefore instead of adding too many means of information in most scenarios the pre-existing feedback's juiciness was simply amplified through build's, to tell players they have clicked a button it changes colour on all builds, in builds 2 and 3 an accompanying sound is also given on click, they all tell the player a button has been clicked but the later 2 does so in more ways thus ensuring that the base information is given to players on all builds.

As to ensure juiciness is at the forefront of this study and participants are able to consume each juicy feature entirely without being to distracted by gameplay or story the game needed to be interesting and provide a challenge however simple enough in regards to gameplay, this was to reaffirm this studies sole focus into measuring effects of juiciness on flow, past research has looked into how challenge (Michailidis, L., Et al, 2018) and other gameplay elements may affect flow therefore to avoid participants becoming too distracted and the fact that this is a game for research it seemed fitting to create a simple match 3 puzzle game (Oei, A.C, Et al, 2013) (Birk, M.V. Et al, 2017). In the same vain the game's gameplay could not be to long and must be kept to a short play time per bracket, in this case play time was kept to about 8 to 10 minutes per bracket this to avoid participant exhaustion meaning to ensure valid data is collected participants should not be disgruntled or tired of playing the game as this

could skew their answers on the provided measuring instruments, it also allows participants to have their experiences with each bracket and all features in each bracket fresh in their mind when completing questionnaires.

### Design and Implementation

The games art direction was kept sleek and stylish with the hope as to not overwhelm players and tester's once again ensuring their focus is on playing the game, the sleek design also avoids removing players from flow by avoiding the appearance of anything that doesn't seem fitting in the games world, this safety net does not apply to the whether or not a juicy feature may remove a player from flow as this project also studies whether or not there is such a thing as too much or too little juice in relation to fostering flow.

To give the game a polished feel and to have it presented as a finished game a simple starting menu was created along with a simple menu in game, the starting menu serves as a gateway to the rules of the game and how to play, to the game itself and to exit the game. Between each bracket some simple juiciness to the ui elements were added to add a subtle sense of predictability the player could make on the game, the more static the main menu perhaps the more of an expectancy of a static and bland game (S.Swink, 2009), with the Minimal bracket when hovered the buttons simply change colour, in brackets 2 and 3 a “bounce” animation is also played upon hovering offering a sense of the button reacting to the player.

The game itself is a match 3 style game which structure can be broken into sections such as;

#### **Win Conditions:**

For players to win a level they must complete given goals of matching a specified colour or dot type, for example a player to win must match 5 red's and 11 blue's, there are 2 types of dot's in regards to the matching mechanic the default coloured dot's in which a single match is needed to destroy them and gain points and the “locked” dot's which are provided with a white squircle background these dot's require including them in 2 set's of matches rather than just 1 to destroy them, upon meeting this condition players are moved to the next level until 3 levels are completed and the game is finished.

#### **Level Structure:**

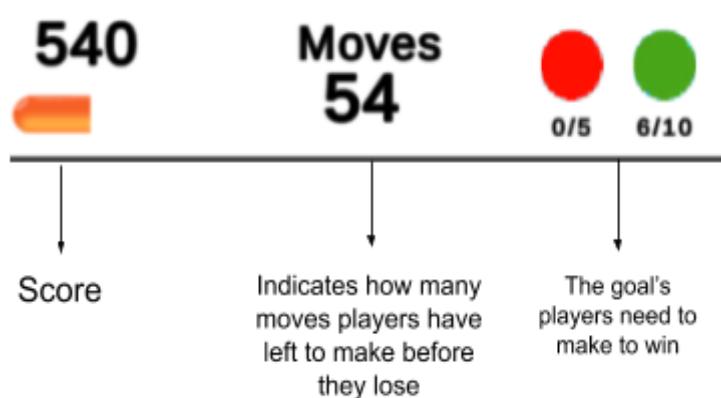
There is no specific difficulty order in the levels however each levels conditions and state differ in regards to juiciness as to ensure findings can be applied to not just a specific static game world, what can change between levels are, the boards size, meaning instead of for example a board of 10 x 8 dot's some levels may be 15 x 9 or 6x4, there is no set minimum or maximum to the mount of rows and columns of dots a level may have and the shape of the board game also change in regards to the addition of “blank spaces” which can be placed in replace of dot's anywhere, these blank spaces cannot be interacted with and therefore make

more complex boards, as seen in the image below, into the centre of the board there is a cluster of blank spaces:



### Lose Conditions:

There are 2 varying means of losing a level in that some levels require players to match all goals within a certain amount of move's or with-in a given time, this is indicated by a large either timer or counter found at the top of the board. The amount of move's a player has to make can change per level, some levels may require the player to reach all goals in 10 moves or for 60 for example, the same goes for the levels on a timer rather than move in the fact the amount of time a player has may also vary.



Shown: The top UI bar that persists throughout the game at the top of the game scene

The goal tracker seen on the right of the above image will add the amount of the corresponding dot's matched indicating how many players have matched so far and how many are left to match, the left element on the image is a simple score bar and score counter,

score does not affect the players win state's and are simply there as a means of either competition, the score system work like so, for every match made the player gains 20 points, if there is a chain of matches made from one match, for each chained match the 20 points are incremented by \*2 meaning if a player made a match gaining 20 points, then another match automatically happens after they receive another 40 points (20\*2) gaining 60 points. Originally the score was going to be another means of a win condition however due to feedback gathered during some early play testing from friends, games experts and the like we found that for such an already short and small game offering 2 win conditions meant gameplay would end way to fast and therefore for balancing reasons score was removed as a win condition.

The reason behind this design choice is specifically linked to flow and juiciness, if each level was the exact same scenario with simply the types of goals needed changing players may become bored and there for their experience and opinion of the later brackets provided to them may suffer, a negatively experience with repetition and boredom may negatively skew data. Each bracket has 3 level's, all brackets share the same level structure.

A lot of the juicy features added or created for this artifact were built upon or stemmed from examples and principles from talks and gamasutra blogs from games designers and developers in the field on the subject (Jonasson. M., Et al, 2013) (Lovato, N. 2015.) applying such theories as tweening, in the case of this project a simple lerp between dots when players make a move is carried out, simple inertia representation is applied to the game menus when moving between buttons they ever so slightly “bounce” however they way this was implemented was through animation and not applying equations, other well known means of implementing juiciness was also applied such as having something animate when a player collided with or in regards to this artefact interacts with something in the game. Below goes into depth of explaining all other juicy features implemented and why they were added to the game;

### **Breakdown of juicy elements:**

	Features	“On-Click” Sound Effect	“Wrong Move” Sound Effect	“Match Made” Sound Effect	“Level Victory” Sound Effect	“Hint” particle effect	“Dot’s Darken on Mouse Click”
Bracket							
1-Minimum							
2-Average							

e								
3-Plenty								

	Feature	“Match” animation	“Dot ripple” on mouse hover	Animated “explosion” type indicators	Screen Shake	“On-Do t” Mouse Following Arrows	Dot shatter on match	Celebra tory confetti win screen
Bracket								
1-Mini mum								
2-Avera ge								
3-Plent y								

#### “On-Click” Sound Effect

Ensuring both visual and audio player feedback was given some juicy features are a handful of sound effects starting from a “clicking” sound played every time a player clicks a button, this was included in all builds as it was mentioned during a stage of feedback that to seem fitting all builds need some form of sound as all builds are meant to offer a polished game feel and to meet players expectations do that a game would often have some sound, this feedback was implemented to give players an audio key that they have pressed a dot on the board.

#### “Wrong Move” Sound Effect

A second juicy sound effect was implemented for when a player made a wrong move this sound emphasises that the player did something wrong rather than leaving it too the player to understand fully what had just happened in the game this audi effect is an easy and quickly recognized way to note they did something wrong.

#### “Match” Sound Effect

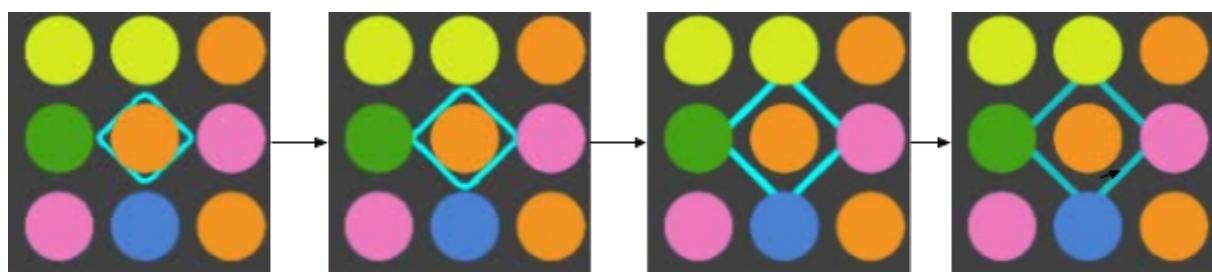
A third juicy audio feedback provided player’s a pleasing and rewarding sound when they make a match, in doing so this juicy feature offers a slight reward to players as the do

something right, the idea behind this is if they enjoyed hearing this sound they would be more engaged with the game and will want to reproduce that feeling and in doing so will begin to look for more matches on the board. It was decided not to add this into the version with the least amount of juice, bracket 1; Minimal, as players are still given enough information on the fact that they made matches the dot's being removed from the board is noticeable and the points's score increasing also reflects this and the feature is simply being deployed as a means of reward. Finally another pleasing means of feedback is provided upon a player winning a level, a short pleasant song is played, mimicking the reasoning for the prior rewarding sound effect the music does not play in bracket 1 but does in 2 and 3.

Beyond these audio feedback features the majority of juicy features implemented are visual; In bracket one (Minimal) almost none of these are present as it being the lowest bracket, what it does have are 2 visual juicy features;

#### Hint Effect:

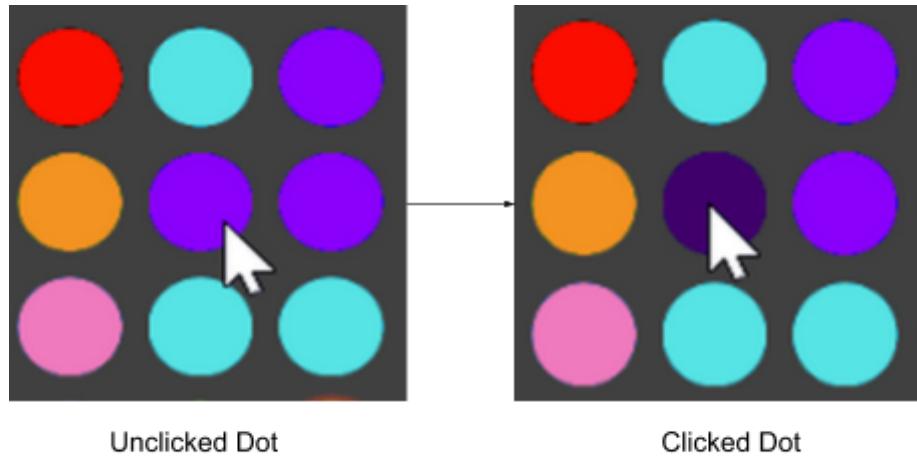
an animation for the hint mechanic due to having no other way of indicating the fact a hint is being given and this needed to be included in all brackets as to make gameplay fair between them, this may just seem like a feature however the fact the animation and particle effect played over the hint dot is so present it applies juicy requirements stated by Martin Jonasson during the talk Juicy it or lose it “Juicy things are things that wobble, squirt, bounce around, and make little cute noises” (Jonasson, M., Et al, 2013) it is over the top and a means of feedback to players indicating they have taken too long to find a match. The effect is a pulsating diamond that emits from the dot the hint is informing the player to move, the diamond gradually expands and fades out, restarting the animation until the player clicks on the highlighted dot.



#### “Mouse Click” Visual Effect:

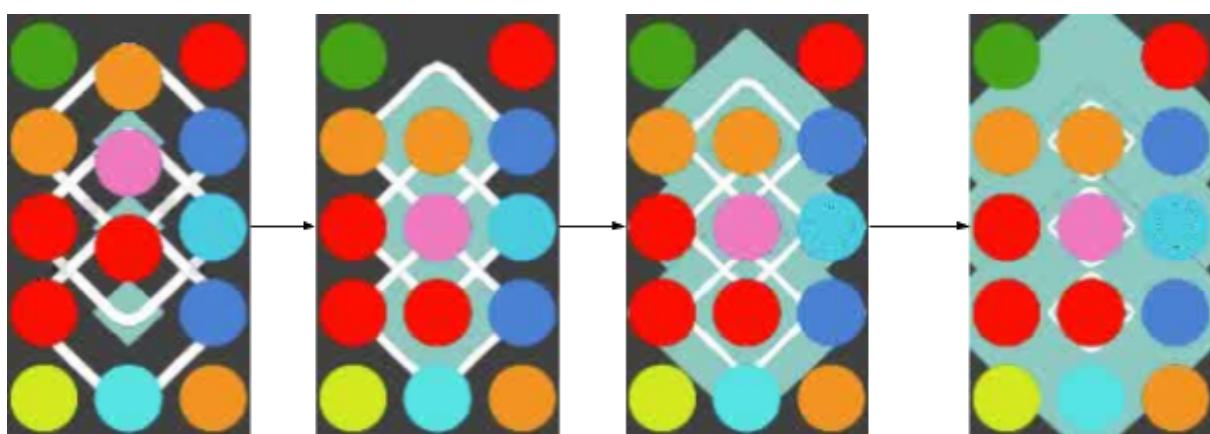
The second juicy feature implemented in to the Minimal bracket is how upon a player clicking a dot the colour of the dot darkens as though it is like an UI element being clicked as a subtle means of informing the player the game understands which dot has been clicked, it is also a simple way of allowing the dot's to feel grounded in the game space as though they are actually being pressed in, this is a very subtle means of informing the player the game is reacting to them and that they are doing something correct and therefore seemed fitting for

the minimal bracket, this may not apply to the “over the top” aspect a lot of juicy features are known to exhibit how still applies as a form of visual feedback.



#### “Match Made” Animation

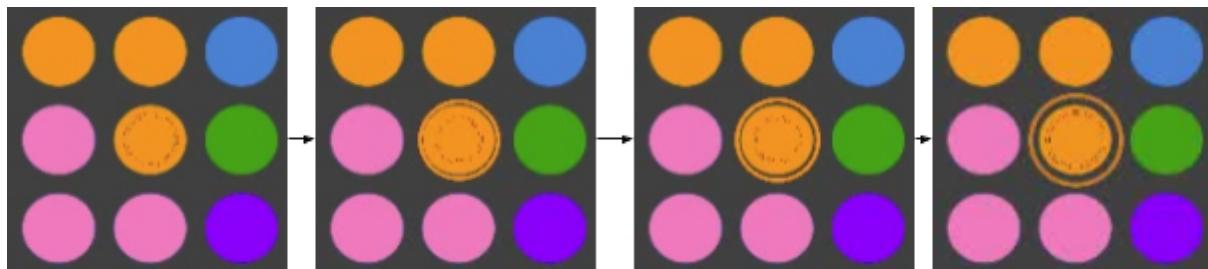
Included in the second bracket and up supplied as a means of informing players a match 3 has been made and that doing so is a good thing a noticeable sleek “explosion” animation around the matched dots is played, this not only looks pleasant but grounds the dot’s on the board into the “world space” of the game, along with also offering a sense of control to players when making a match. The explosion animation much like the hint particle expands a blue diamond however in this case is also filled rather than just an outline and at a much higher high speed matched with a contracting white diamond outline.



#### “Hover Ripple Effect”

As a form of informational feedback informing players whether or not they have hovered and which dot they are currently hovering over a “ripple” effect is projected from around the dot

their mouse is over, the ripple effect begins in the centre of the dot, hence the light black line in the first image below on the left, it then expands to the outer of the dot, while another circle outline begins to emit from the center again which can be seen on the far right image below.

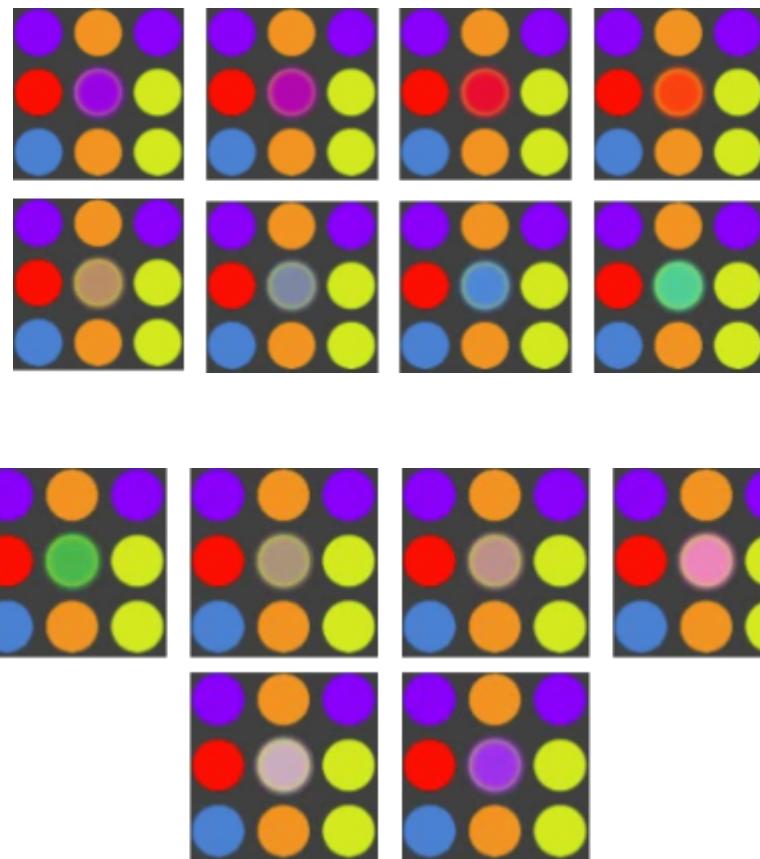


#### “Animated Explosion Type Indicators”

The introduction of animated indicators of “explosion” types are introduced, there are 4 types of explosions that are awarded to players when they carry out certain things such as getting a match for 3 or higher (row or column explosion, matching the entire row or column), getting a match of 6 or higher (colour bomb, matching all the dots of the same colour), or getting a match both horizontal and vertically in one move (adjacent bomb, matching all bombs in a 3x3 area) these in bracket 1 were simply indicated via static images that are shown on top of the dot, in brackets 2 and 3, for the row/ column bomb a set of large arrows are show behind the dot’s that are animated across the entire row or column that will be effected upon matching the bomb piece and fading out when reaching the end of the animation cycle, the adjacent bomb is accompanied with a sleek animated indicator that grows outwards from the dot with the explosion on it until it is around the 3x3 dot’s that will get matched, the hope of introducing these juicy features are to make using the explosion types more appealing, while also acting as an more emphasis means of showing players what each explosion does these animations and particle effects also applies the idea several games developers advise on using in games for example how adding trails to put emphasis on an object's nature this could either indicate such thing as the object's movement (Lovato, N. 2015.) or in regards to this project applying trails and effects for dot explosions indicate how they would move or act once being used.

#### “Colour Explosion Animation”

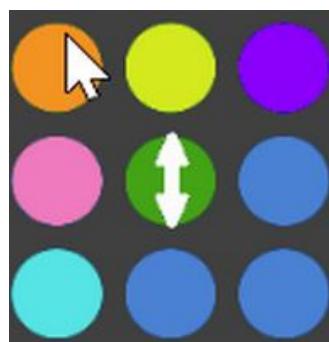
The colour bomb animation only is also used in all 3 brackets this is due feedback gathered from 3 games experts that found that the static option of the colour bomb was misleading and an eye sore, its animation cycle is simple having the dot with the explosion shuffle smoothly through a the possible colored dots on the board, with an added slight glow effect. The shuffling of colours informs the player exactly what the explosion will do if used and the smooth transitions and glow effect add appeal and importance to the dot.



The colour bomb animation transitioning through all colours, starting a purple and finishing at purple. Several time lapse images had to be cut due to the amount provided and therefore the smoothness of colour transitions may not be fully resembled in these images

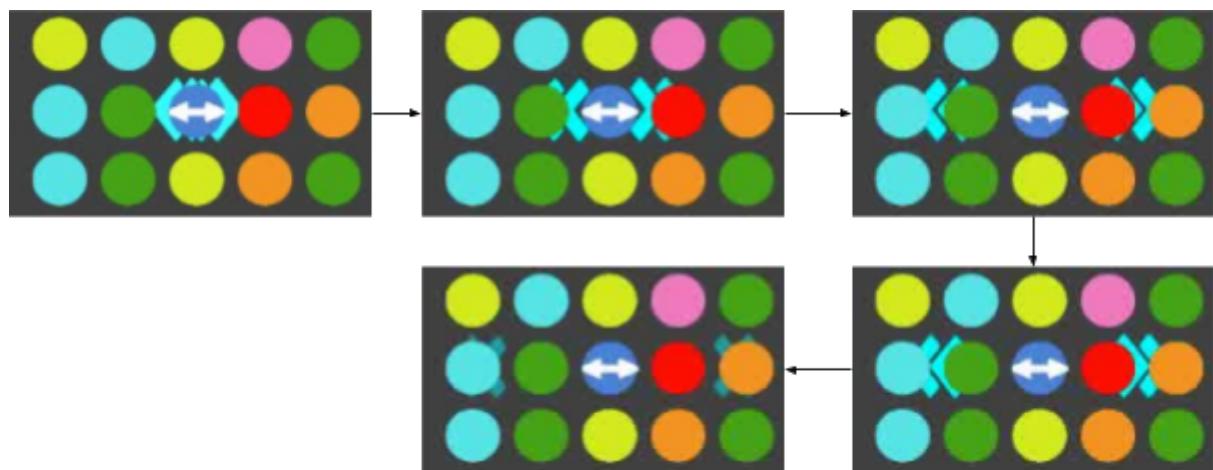
#### “Static Row/ Column Explosion Indicator”

As mentioned the row and column bombs in bracket 1 are simply indicated via static image on top of the dot, as seen below:



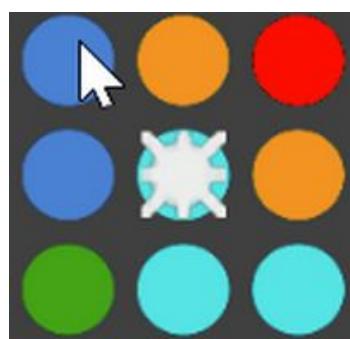
“Animated Row/Column Explosion Indicator”

Juicy Brackets 2 and 3’s row/ column explosion bomb animated:



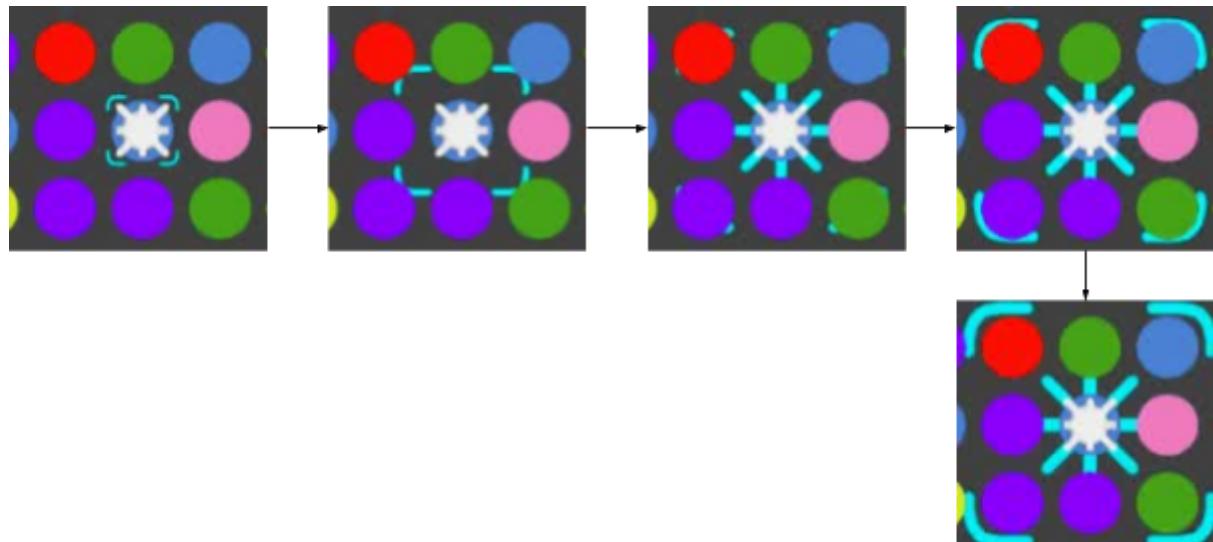
“Static Adjacent Explosion Indicator”

Adjacent Bomb’s bracket 1 static indicator:



“Animated Adjacent Explosion Indicator”

Adjacent Bomb’s bracket 2 and 3 animated indicator:

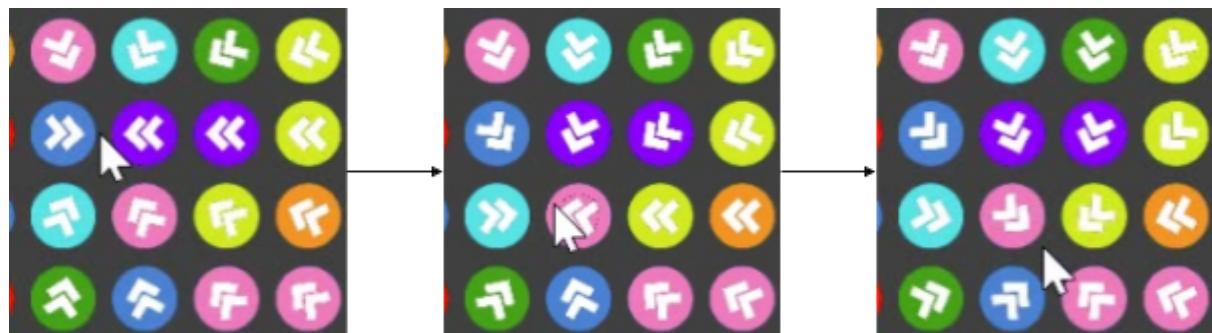


“Wrong Move Screen Shake”

The final juicy feature introduced in the second bracket is actually used as a means of relaying to players a negative source of feedback, this being an aggressive screen shake (in tandem with the previously stated negative sound effect) when a player makes a move that doesn’t lead to a match, the shake is rather jarring and grabs attention making the player highly aware they did something wrong and that they shoulda void doing it again.

“On Dot Mouse Tracking Arrows”

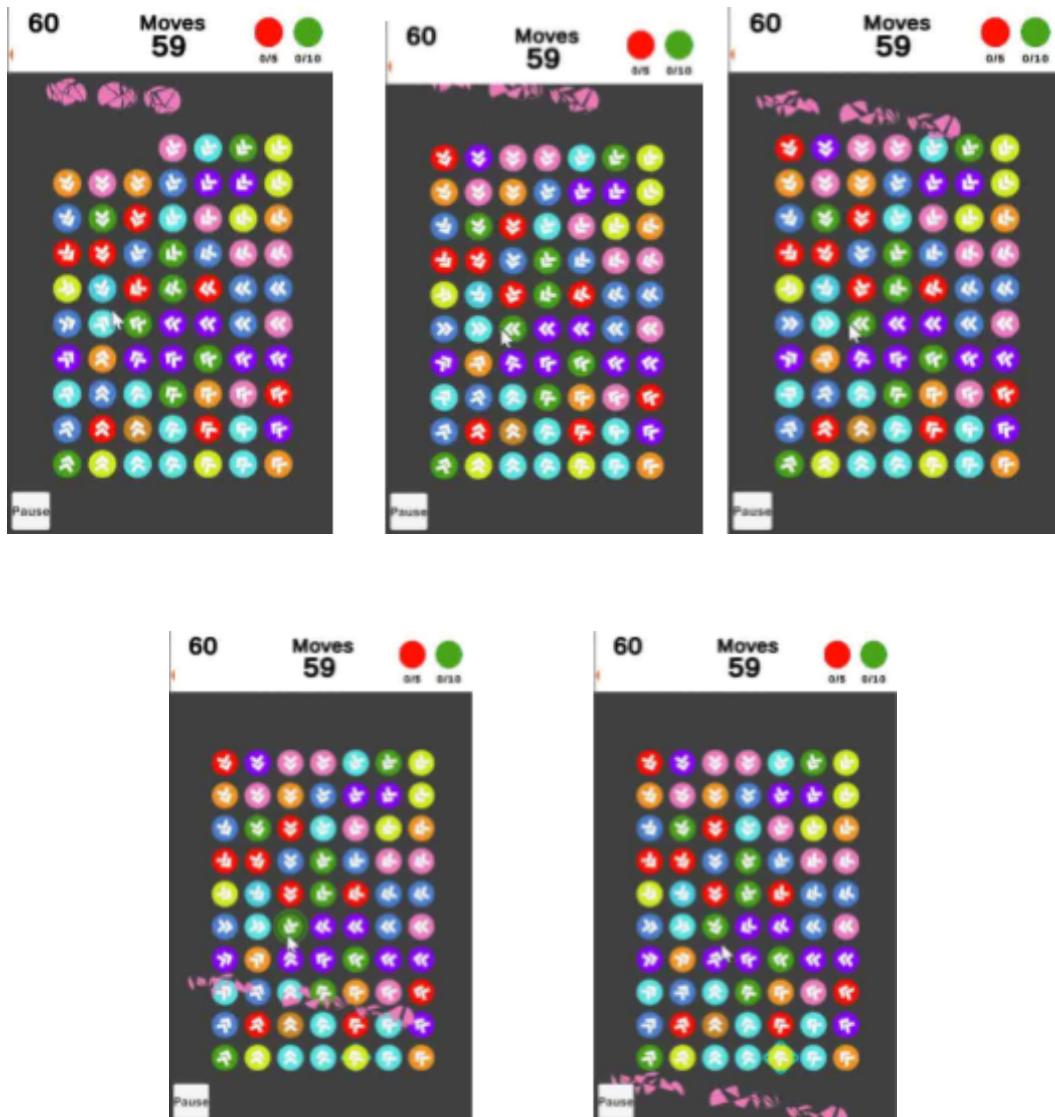
In the third and final bracket 3 more juicy features were added, the first feature is present on all dot’s within the board and was placed to enhance the fact that the board is an actual object in the game world and emphasizes the fact that it is reacting to the players interaction was a compass arrow that followed the players mouse around in regards to location as a sort of “location tracking”, this also produced another means of feedback informing players on theyre constant location, it also add’s simple whimsy and visual appeal a staple use of juiciness, this affect also gives the dot’s some form of liveliness, once again providing a feeling of the world space being more interactive.



#### “Dot Shattering Effect on Match”

The second feature introduced into the 3rd bracket is the explosion of the dot sprites on match, in bracket 2 a simple animation is played around the matched dot's, here the dot's self also shatter into several pieces with a defined force and then falls off the board as according to gravity, the fact that the pieces do fall down and react to gravity is yet another means of grounding the game in a world space, the pieces exploding at a comically force however was implemented to aid in rewarding players, it should make the player feel more powerful and simply seeing the pieces exploding is fun and something to focus on, it may also led to participants to want to carry out playing to once again see them explode.





Shown: Upon making a match, the dot's shatter, creating several fragments, a force is then applied to these fragments causing them to fly upwards and outwards, before falling back down and off screen, they are then deleted after 5 seconds

### “Confetti Win Screen”

The final feature is a more dynamic reward screen in which contains a particle effect that looks like confetti running down on to the screen is played if players complete a level, this adds an reward in the form of an emphasized celebration for players completing level, this was added as when carrying out the aforementioned expert study onto each bracket, the 3 tester's found the winning screen way to static as compared to the rest of the bracket and

there for unfitting, one expert also mentioned how they didn't feel as though the original win screen was not rewarding enough.



All features were implemented through unity with oop fundamentals being used, each feature and mechanic within the game have their own methods and functions, no specific algorithms were needed in the construction of this artefact.

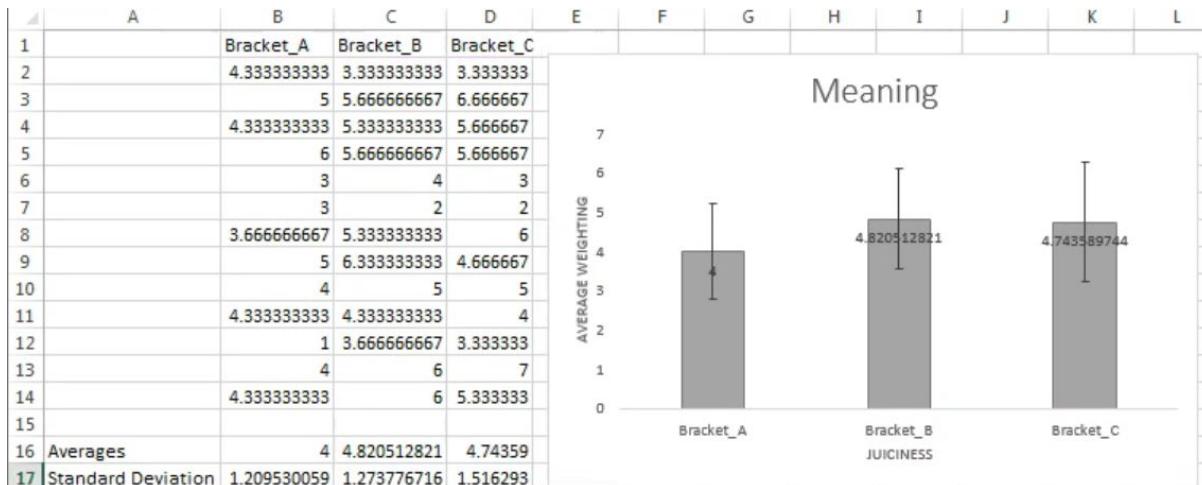
## Experiments and Evaluation

The order in which participants played are as follow:

	Tester	1	2	3	4	5	6	7	8	9	10	11	12	13
Bracket Order														
1 - 2 - 3			█						█					█
1 - 3 - 2				█						█				
2 - 1 - 3					█					█				
2 - 3 - 1						█					█			
3 - 1 - 2							█					█		
3 - 2 - 1								█					█	

## Player Experience Inventory:

### Meaning:



Descriptive Statistics								
	N	Mean	Std. Deviation	Minimum	Maximum	25th	50th (Median)	75th
Meaning_A	13	4.0000	1.20953	1.00	6.00	3.3333	4.3333	4.66667
Meaning_B	13	4.8205	1.27378	2.00	6.33	3.8333	5.3333	5.8333
Meaning_C	13	4.7436	1.51629	2.00	7.00	3.3333	5.0000	5.8333

### Friedman Test

Ranks	
	Mean Rank
→ Meaning_A	1.69
Meaning_B	2.27
Meaning_C	2.04

### Test Statistics<sup>a</sup>

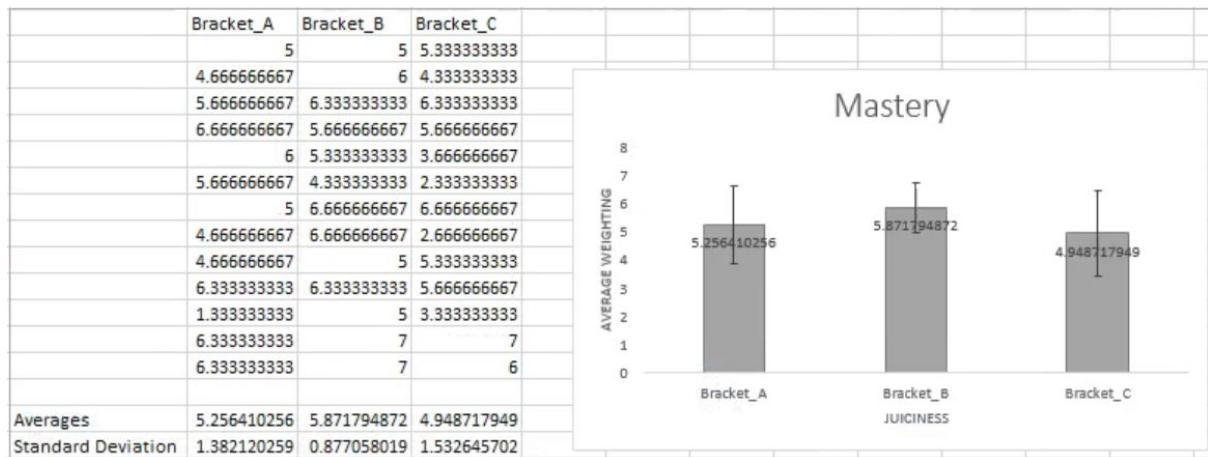
N	13
Chi-Square	2.478
df	2
Asymp. Sig.	.290

a. Friedman Test

A Friedman's test indicated that there was no significant difference between the player's scoring of scales relating to Meaning measured per each bracket,  $\chi^2_f(2)=2.478$ ,  $p < .290$ . The average of all players' scores of scales relating to Meaning was compared between each bracket. Post-hoc tests using Wilcoxon signed-rank tests show on average players scored all scales relating meaning higher when playing version 2/ bracket 2 the

**most (Mdn = 5.3r) compared to when playing bracket 3 (Mdn = 5.0) and bracket 1 (Mdn = 4.3r).**

### Mastery:



Descriptive Statistics								
	N	Mean	Std. Deviation	Minimum	Maximum	25th	50th (Median)	75th
Mastery_A	13	5.2564	1.38212	1.33	6.67	4.6667	5.6667	6.3333
Mastery_B	13	5.8718	.87706	4.33	7.00	5.0000	6.0000	6.6667
Mastery_C	13	4.9487	1.53265	2.33	7.00	3.5000	5.3333	6.1667

### Friedman Test

Ranks	
	Mean Rank
Mastery_A	1.85
Mastery_B	2.38
Mastery_C	1.77

### Test Statistics<sup>a</sup>

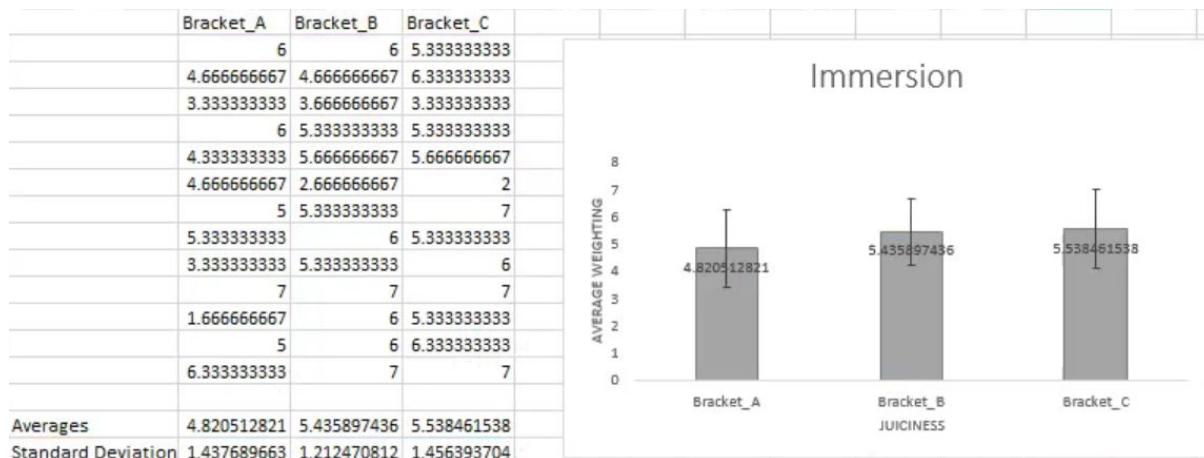
N	13
Chi-Square	3.304
df	2
Asymp. Sig.	.192

a. Friedman Test

A Friedman's test indicated that there was no significant difference between the player's scoring of scales relating to Mastery measured per each bracket,  $\chi^2_f(2)=3.304$ ,  $p < .192$ . The average of all players' scores of scales relating to Mastery was compared between each bracket. Post-hoc tests using Wilcoxon signed-rank tests show on average players scored all scales relating to Mastery higher when playing version 2/ bracket 2

**the most (Mdn = 6.0r) compared to when playing bracket 1 (Mdn = 5.667) and bracket 3 (Mdn = 5.3r).**

### Immersion:



Descriptive Statistics								
	N	Mean	Std. Deviation	Minimum	Maximum	25th	50th (Median)	75th
Immersion_A	13	4.8205	1.43769	1.67	7.00	3.8333	5.0000	6.0000
Immersion_B	13	5.4359	1.21247	2.67	7.00	5.0000	5.6667	6.0000
Immersion_C	13	5.5385	1.45639	2.00	7.00	5.3333	5.6667	6.6667

### Friedman Test

Ranks	
	Mean Rank
Immersion_A	1.62
Immersion_B	2.27
Immersion_C	2.12

### Test Statistics<sup>a</sup>

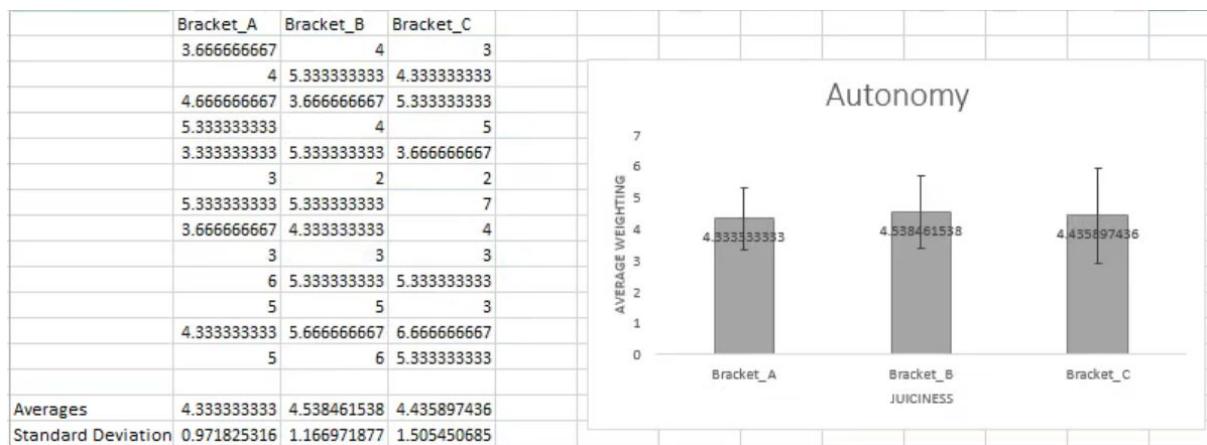
N	13
Chi-Square	3.854
df	2
Asymp. Sig.	.146

a. Friedman Test

A Friedman's test indicated that there was no significant difference between the player's scoring of scales relating to Immersion measured per each bracket,  $\chi^2(2)=3.854$ ,  $p < .146$ . The average of all players' scores of scales relating to Immersion was compared between each bracket. Post-hoc tests using Wilcoxon signed-rank tests show on average players scored all scales relating to Immersion equally higher for

**bracket 2 (Mdn = 5.6667 ) & bracket 3 (Mdn = 5.6667) compared to when playing bracket 1 (Mdn = 5.0r).**

### Autonomy:



### Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	25th	50th (Median)	75th
Autonomy_A	13	4.3333	.97183	3.00	6.00	3.5000	4.3333	5.1667
Autonomy_B	13	4.5385	1.16697	2.00	6.00	3.8333	5.0000	5.3333
Autonomy_C	13	4.4359	1.50545	2.00	7.00	3.0000	4.3333	5.3333

### → Friedman Test

Ranks	
	Mean Rank
Autonomy_A	1.85
Autonomy_B	2.15
Autonomy_C	2.00

### Test Statistics<sup>a</sup>

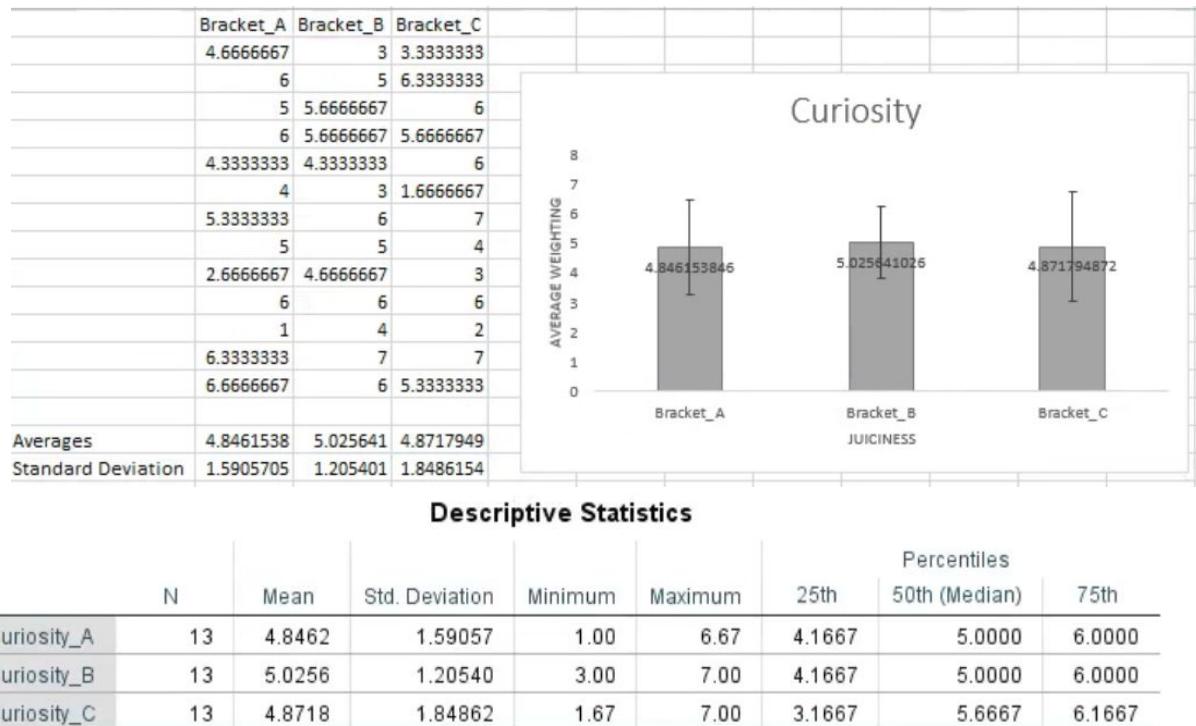
N	13
Chi-Square	.727
df	2
Asymp. Sig.	.695

a. Friedman Test

A Friedman's test indicated that there was no significant difference between the player's scoring of scales relating to Autonomy measured per each bracket,  $X^2f(2)=.727$ ,

**p < .695.** The average of all players' scores of scales relating to Autonomy was compared between each bracket. Post-hoc tests using Wilcoxon signed-rank tests show on average, players scored all scales relating to Autonomy higher when playing version 2/ bracket 2 the most (Mdn = 5.0r) compared to when playing bracket 1 (Mdn = 4.3r) and bracket 3 (Mdn = 4.3r).

### Curiosity:



### Friedman Test

#### Ranks

##### Mean Rank

▶ Curiosity_A	1.92
Curiosity_B	2.00
Curiosity_C	2.08

#### Test Statistics<sup>a</sup>

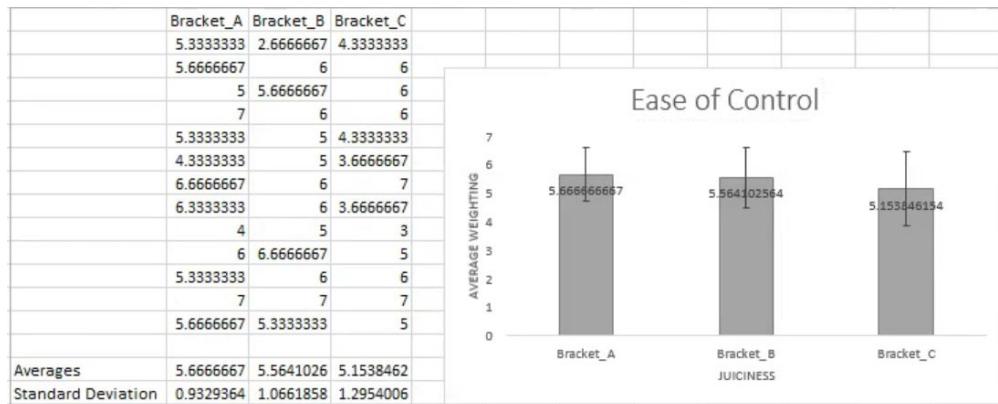
N	13
Chi-Square	.182
df	2
Asymp. Sig.	.913

a. Friedman Test

A Friedman's test indicated that there was no significant difference between the player's scoring of scales relating to Curiosity measured per each bracket,  $\chi^2_f(2)=.182$ ,  $p < .913$ . The average of all players' scores of scales relating to Curiosity was compared

**between each bracket. Post-hoc tests using Wilcoxon signed-rank tests show on average players scored all scales relating to Curiosity equally less for bracket 1 (Mdn = 5.0r ) & bracket 2 (Mdn = 5.0r) compared to when playing bracket 3 (Mdn = 5.6667).**

### Ease of Control:



Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	25th	Percentiles 50th (Median)	75th
Ease_of_Control_A	13	5.66667	.93294	4.00	7.00	5.1667	5.6667	6.5000
Ease_of_Control_B	13	5.5641	1.06619	2.67	7.00	5.0000	6.0000	6.0000
Ease_of_Control_C	13	5.1538	1.29540	3.00	7.00	4.0000	5.0000	6.0000

### Friedman Test

#### Ranks

	Mean Rank
Ease_of_Control_A	2.15
Ease_of_Control_B	2.12
Ease_of_Control_C	1.73

#### Test Statistics<sup>a</sup>

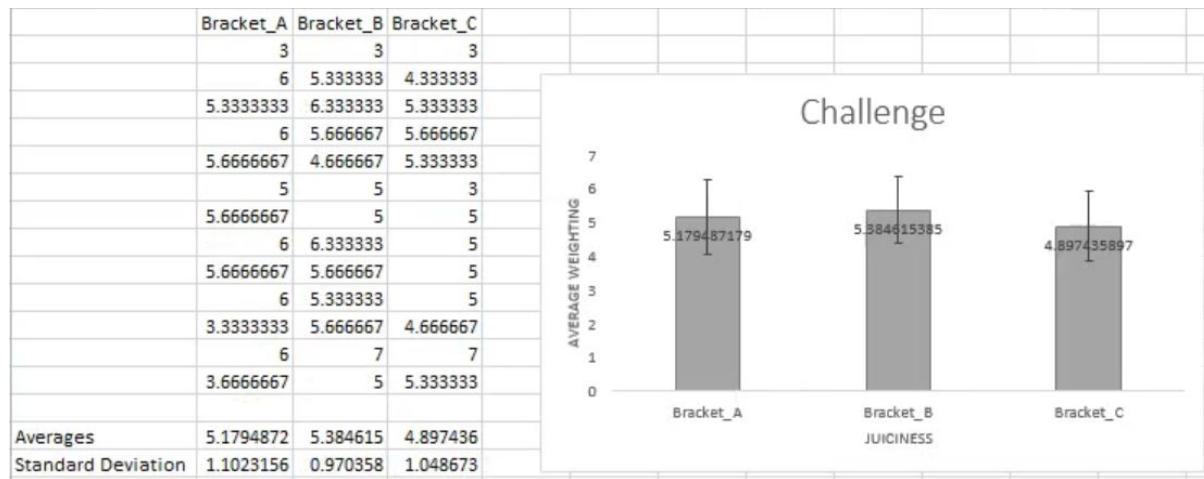
N	13
Chi-Square	1.644
df	2
Asymp. Sig.	.439

a. Friedman Test

A Friedman's test indicated that there was no significant difference between the player's scoring of scales relating to Ease of Control measured per each bracket,  $\chi^2_f(2)=1.644$ ,  $p < .439$ . The average of all players' scores of scales relating to Ease of Control was compared between each bracket. Post-hoc tests using Wilcoxon signed-rank tests show on average players scored all scales relating to Ease of Control

**higher when playing version 2/ bracket 2 the most (Mdn = 6.0r) compared to when playing bracket 1 (Mdn = 5.667) and bracket 3 (Mdn = 5.0r).**

### Challenge:



Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	25th	Percentiles 50th (Median)	75th
Challenge_A	13	5.1795	1.10232	3.00	6.00	4.3333	5.6667	6.0000
Challenge_B	13	5.3846	.97036	3.00	7.00	5.0000	5.3333	6.0000
Challenge_C	13	4.8974	1.04867	3.00	7.00	4.5000	5.0000	5.3333

### Friedman Test

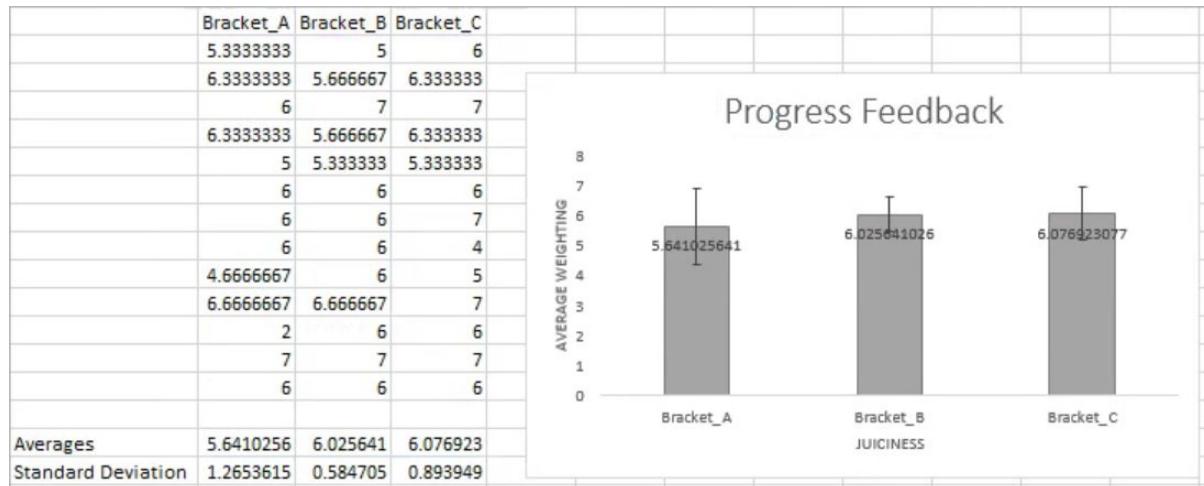
### Test Statistics<sup>a</sup>

Ranks	
	Mean Rank
Challenge_A	2.19
Challenge_B	2.19
Challenge_C	1.62

N	13
Chi-Square	3.571
df	2
Asymp. Sig.	.168

a. Friedman Test

A Friedman's test indicated that there was no significant difference between the player's scoring of scales relating to Challenge measured per each bracket,  $\chi^2(2)=3.571$ ,  $p < .168$ . The average of all players' scores of scales relating to Challenge was compared between each bracket. Post-hoc tests using Wilcoxon signed-rank tests show on average players scored all scales relating to Challenge higher when playing bracket 1 the most (Mdn = 5.6667) compared to when playing bracket 2 (Mdn = 5.3r) and bracket 3 (Mdn = 5.0r).

**Progress Feedback:****Descriptive Statistics**

	N	Mean	Std. Deviation	Minimum	Maximum	25th	50th (Median)	75th
Progress_Feedback_A	13	5.6410	1.26536	2.00	7.00	5.1667	6.0000	6.3333
Progress_Feedback_B	13	6.0256	.58471	5.00	7.00	5.6667	6.0000	6.3333
Progress_Feedback_C	13	6.0769	.89395	4.00	7.00	5.6667	6.0000	7.0000

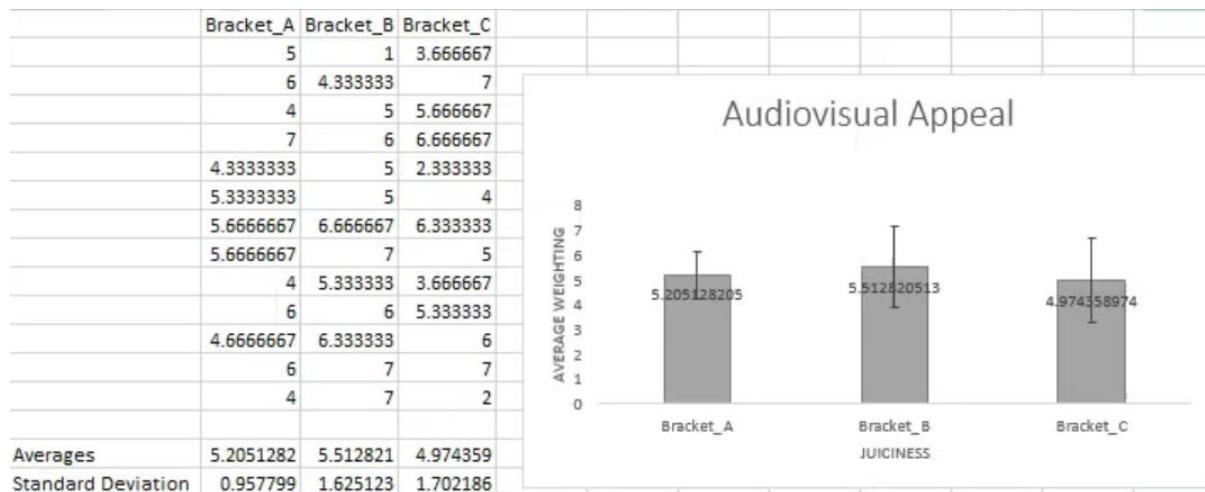
**Friedman Test****Test Statistics<sup>a</sup>**

<b>Ranks</b>	
	Mean Rank
Progress_Feedback_A	1.73
Progress_Feedback_B	1.92
Progress_Feedback_C	2.35

N	13
Chi-Square	4.187
df	2
Asymp. Sig.	.123

a. Friedman Test

A Friedman's test indicated that there was no significant difference between the player's scoring of scales relating to Progress Feedback measured per each bracket,  $\chi^2(2)=4.187$ ,  $p < .123$ . The average of all players' scores of scales relating to Progress Feedback was compared between each bracket. Post-hoc tests using Wilcoxon signed-rank tests show on average players scored all scales relating to Progress Feedback equally for all brackets ( $Mdn = 6.0$ ).

**AudioVisual Appeal:****Descriptive Statistics**

	N	Mean	Std. Deviation	Minimum	Maximum	25th	Percentiles 50th (Median)	75th
Audiovisual_Appeal_A	13	5.2051	.95780	4.00	7.00	4.1667	5.3333	6.0000
Audiovisual_Appeal_B	13	5.5128	1.62512	1.00	7.00	5.0000	6.0000	6.8333
Audiovisual_Appeal_C	13	4.9744	1.70219	2.00	7.00	3.6667	5.3333	6.5000

**Friedman Test****Test Statistics<sup>a</sup>**

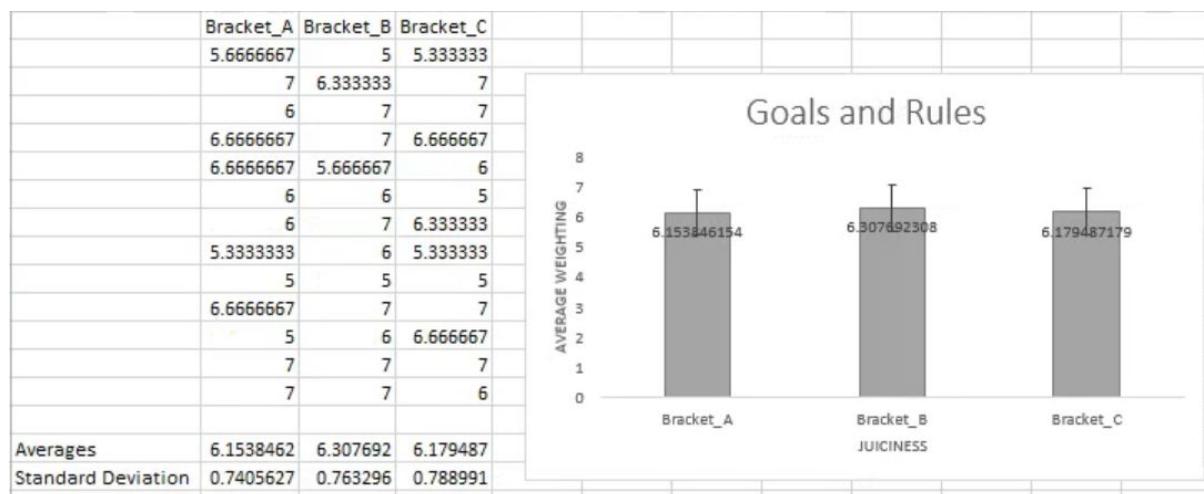
<b>Ranks</b>	
	Mean Rank
Audiovisual_Appeal_A	1.96
Audiovisual_Appeal_B	2.31
Audiovisual_Appeal_C	1.73

<b>N</b>	13
Chi-Square	2.280
df	2
Asymp. Sig.	.320

a. Friedman Test

A Friedman's test indicated that there was no significant difference between the player's scoring of scales relating to AudioVisual Appeal measured per each bracket,  $\chi^2(2)=2.280$ ,  $p < .320$ . The average of all players' scores of scales relating to AudioVisual Appeal was compared between each bracket. Post-hoc tests using Wilcoxon signed-rank tests show on average players scored all scales relating to AudioVisual Appeal higher when playing bracket 2 the most (Mdn = 6.0r) compared to when playing bracket 1 (Mdn = 5.3r) and bracket 3 (Mdn = 5.3r).

### Goals and Rules:



### Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	25th	Percentiles 50th (Median)	75th
Goals_and_Rules_A	13	6.1538	.74056	5.00	7.00	5.5000	6.0000	6.8333
Goals_and_Rules_B	13	6.3077	.76330	5.00	7.00	5.8333	6.3333	7.0000
Goals_and_Rules_C	13	6.1795	.78899	5.00	7.00	5.3333	6.3333	7.0000

### Friedman Test

Ranks	
	Mean Rank
Goals_and_Rules_A	1.88
Goals_and_Rules_B	2.15
Goals_and_Rules_C	1.96

### Test Statistics<sup>a</sup>

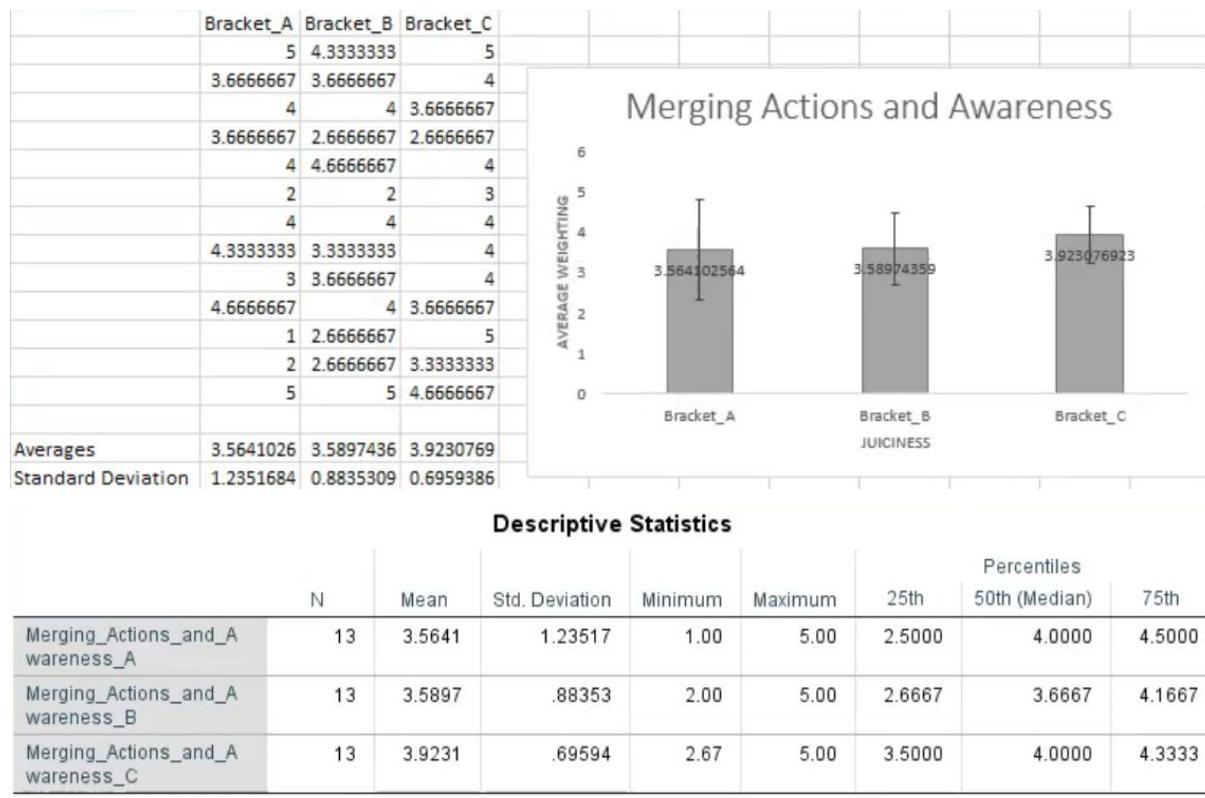
N	13
Chi-Square	.703
df	2
Asymp. Sig.	.704

a. Friedman Test

A Friedman's test indicated that there was no significant difference between the player's scoring of scales relating to Goals and Rules measured per each bracket,  $\chi^2(2)=.703$ ,  $p < .704$ . The average of all players' scores of scales relating to Goals and Rules was compared between each bracket. Post-hoc tests using Wilcoxon signed-rank tests show on average players scored all scales relating to Goals and Rules equally higher for bracket 2 (Mdn = 6.3333) & bracket 3 (Mdn = 6.3333) compared to when playing bracket 1 (Mdn = 6.0r).

### Activity Flow Scale:

#### Merging Action & Awareness:



## Friedman Test

### Ranks

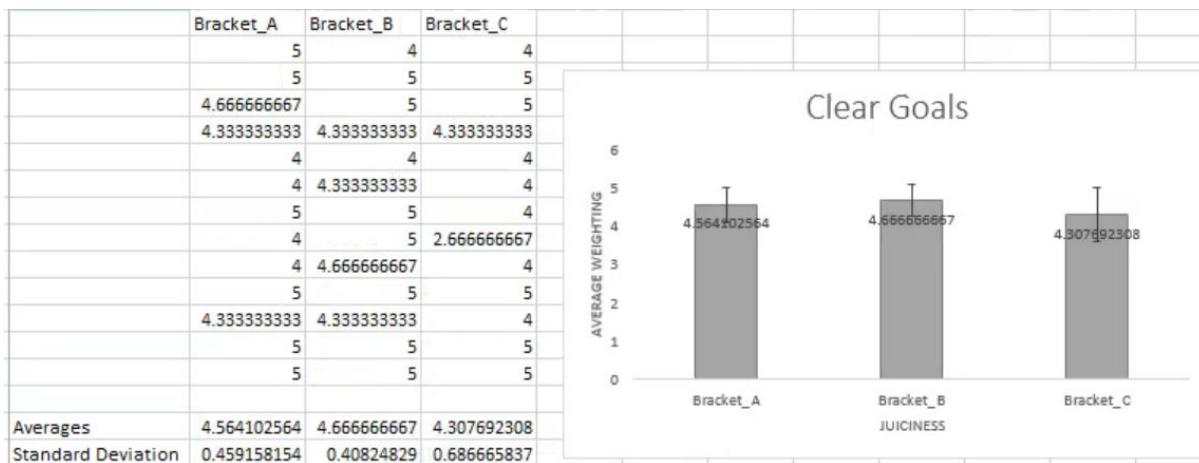
	Mean Rank
Merging Actions_and_Awareness_A	2.00
Merging Actions_and_Awareness_B	1.88
Merging Actions_and_Awareness_C	2.12

### Test Statistics<sup>a</sup>

N	13
Chi-Square	.439
df	2
Asymp. Sig.	.803

a. Friedman Test

A Friedman's test indicated that there was no significant difference between the player's scoring of scales relating to Merging Action & Awareness measured per each bracket,  $\chi^2_f(2)=.439$ ,  $p < .803$ . The average of all players' scores of scales relating to Merging Action & Awareness was compared between each bracket. Post-hoc tests using Wilcoxon signed-rank tests show on average players scored all scales relating to Merging Action & Awareness equally higher when playing bracket 1 and bracket 3 ( $Mdn = 4.0$ ) compared to bracket 2 ( $Mdn = 3.6667$ )

**Clear Goals:****Descriptive Statistics**

	N	Mean	Std. Deviation	Minimum	Maximum	25th	50th (Median)	75th
Clear_Goals_A	13	4.5641	.45916	4.00	5.00	4.0000	4.6667	5.0000
Clear_Goals_B	13	4.6667	.40825	4.00	5.00	4.3333	5.0000	5.0000
Clear_Goals_C	13	4.3077	.68667	2.67	5.00	4.0000	4.0000	5.0000

**Friedman Test**

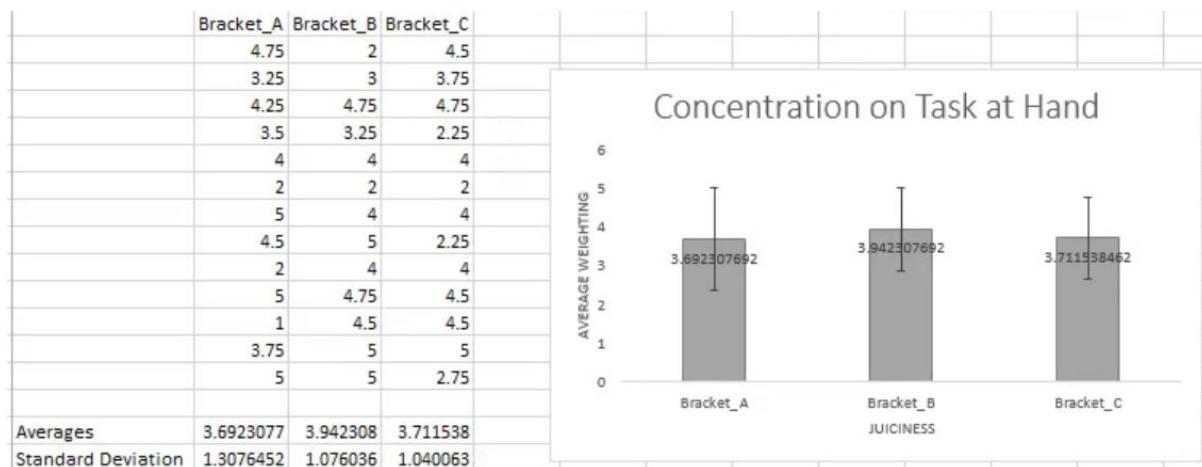
Ranks	
	Mean Rank
Clear_Goals_A	2.00
Clear_Goals_B	2.31
Clear_Goals_C	1.69

**Test Statistics<sup>a</sup>**

N	13
Chi-Square	5.818
df	2
Asymp. Sig.	.055

a. Friedman Test

A Friedman's test indicated that there was no significant difference between the player's scoring of scales relating to Clear Goals measured per each bracket,  $\chi^2(2)=5.818$ ,  $p < .055$ . The average of all players' scores of scales relating to Clear Goals was compared between each bracket. Post-hoc tests using Wilcoxon signed-rank tests show on average players scored all scales relating to Clear Goals higher when playing bracket 2 the most (Mdn = 5.0r) compared to when playing bracket 1 (Mdn = 4.6667) and bracket 3 (Mdn = 4.0r).

**Concentration on Task at Hand:****Descriptive Statistics**

	N	Mean	Std. Deviation	Minimum	Maximum	25th	Percentiles 50th (Median)	75th
Concentration_on_Task_at_Hand_A	13	3.6923	1.30765	1.00	5.00	2.6250	4.0000	4.8750
Concentration_on_Task_at_Hand_B	13	3.9423	1.07604	2.00	5.00	3.1250	4.0000	4.8750
Concentration_on_Task_at_Hand_C	13	3.7115	1.04006	2.00	5.00	2.5000	4.0000	4.5000

**Friedman Test**

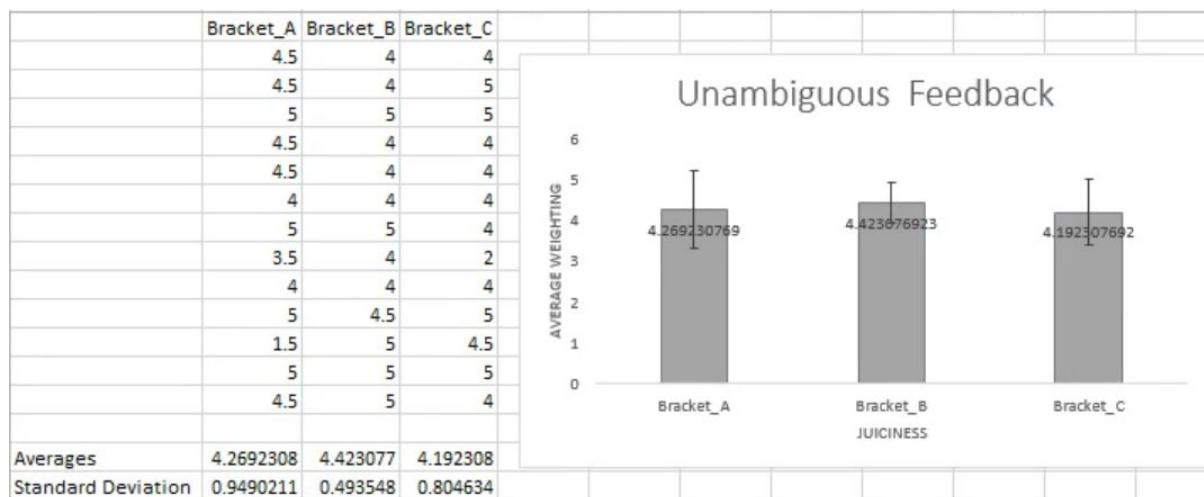
Ranks	
	Mean Rank
Concentration_on_Task_at_Hand_A	2.04
Concentration_on_Task_at_Hand_B	2.08
Concentration_on_Task_at_Hand_C	1.88

**Test Statistics<sup>a</sup>**

N	13
Chi-Square	.368
df	2
Asymp. Sig.	.832

a. Friedman Test

A Friedman's test indicated that there was no significant difference between the player's scoring of scales relating to Concentration on Task at Hand measured per each bracket,  $\chi^2_f(2)=.368$ ,  $p < .832$ . The average of all players' scores of scales relating to Concentration on Task at Hand was compared between each bracket. Post-hoc tests using Wilcoxon signed-rank tests show on average players scored all scales relating to Concentration on Task at Hand equally when playing all 3 bracket's (Mdn = 4.0r).

**Unambiguous Feedback:****Descriptive Statistics**

	N	Mean	Std. Deviation	Minimum	Maximum	25th	Percentiles 50th (Median)	75th
Unambiguous_Feedback_A	13	4.2692	.94902	1.50	5.00	4.0000	4.5000	5.0000
Unambiguous_Feedback_B	13	3.9423	1.07604	2.00	5.00	3.1250	4.0000	4.8750
Unambiguous_Feedback_C	13	4.1923	.80463	2.00	5.00	4.0000	4.0000	5.0000

**Friedman Test**

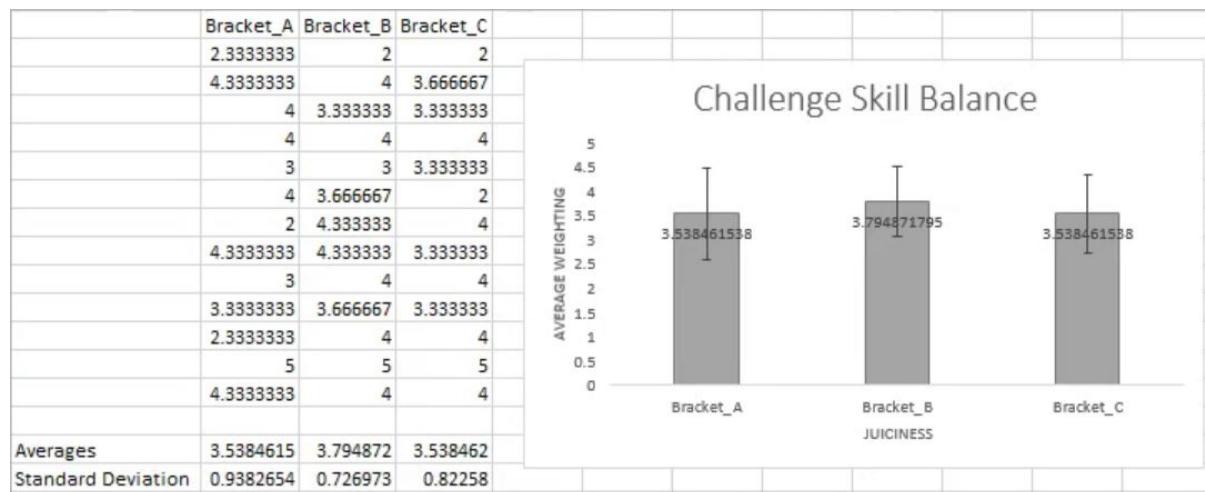
Ranks	
	Mean Rank
Unambiguous_Feedback_A	2.35
Unambiguous_Feedback_B	1.65
Unambiguous_Feedback_C	2.00

**Test Statistics<sup>a</sup>**

N	13
Chi-Square	4.263
df	2
Asymp. Sig.	.119

a. Friedman Test

A Friedman's test indicated that there was no significant difference between the player's scoring of scales relating to Unambiguous Feedback measured per each bracket,  $X^2_f(2)=4.263$ ,  $p < .119$ . The average of all players' scores of scales relating to Unambiguous Feedback was compared between each bracket. Post-hoc tests using Wilcoxon signed-rank tests show on average players scored all scales relating to Unambiguous Feedback higher when playing bracket 1 the most (Mdn = 4.5r) compared to when playing bracket 2 (Mdn = 4.0r) and bracket 3 (Mdn = 4.0r).

**Challenge Skill Balance:****Descriptive Statistics**

	N	Mean	Std. Deviation	Minimum	Maximum	25th	Percentiles 50th (Median)	75th
Challenge_Skill_Balance_A	13	3.5385	.93827	2.00	5.00	2.6667	4.0000	4.3333
Challenge_Skill_Balance_B	13	3.7949	.72697	2.00	5.00	3.5000	4.0000	4.1667
Challenge_Skill_Balance_C	13	3.5385	.82258	2.00	5.00	3.3333	3.6667	4.0000

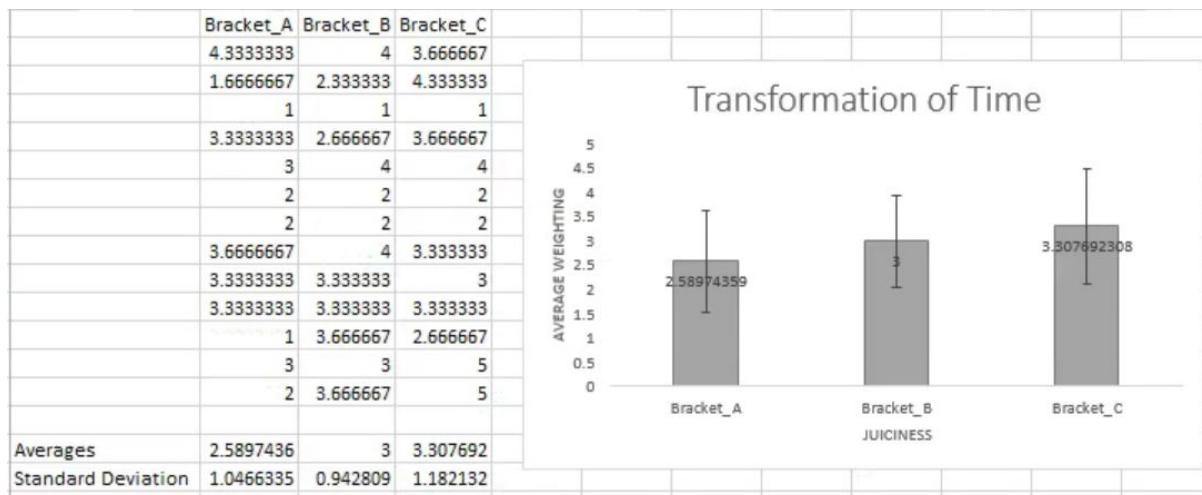
**Friedman Test****Test Statistics<sup>a</sup>**

Ranks	
	Mean Rank
Challenge_Skill_Balance_A	2.12
Challenge_Skill_Balance_B	2.12
Challenge_Skill_Balance_C	1.77

N	13
Chi-Square	1.500
df	2
Asymp. Sig.	.472

a. Friedman Test

A Friedman's test indicated that there was no significant difference between the player's scoring of scales relating to Challenge Skill Balance measured per each bracket,  $\chi^2_f(2)=1.500$ ,  $p < .472$ . The average of all players' scores of scales relating to Challenge Skill Balance was compared between each bracket. Post-hoc tests using Wilcoxon signed-rank tests show on average players scored all scales relating to Challenge Skill Balance equally higher when playing bracket's 1 and 2 ( $Mdn = 4.0$ ) compared to bracket 3 ( $Mdn = 3.6667$ ).

**Transformation of Time:****Descriptive Statistics**

	N	Mean	Std. Deviation	Minimum	Maximum	25th	Percentiles 50th (Median)	75th
Transformation_of_Time_A	13	2.5897	1.04663	1.00	4.33	1.8333	3.0000	3.3333
Transformation_of_Time_B	13	3.0000	.94281	1.00	4.00	2.1667	3.3333	3.8333
Transformation_of_Time_C	13	3.3077	1.18213	1.00	5.00	2.3333	3.3333	4.1667

**Friedman Test**

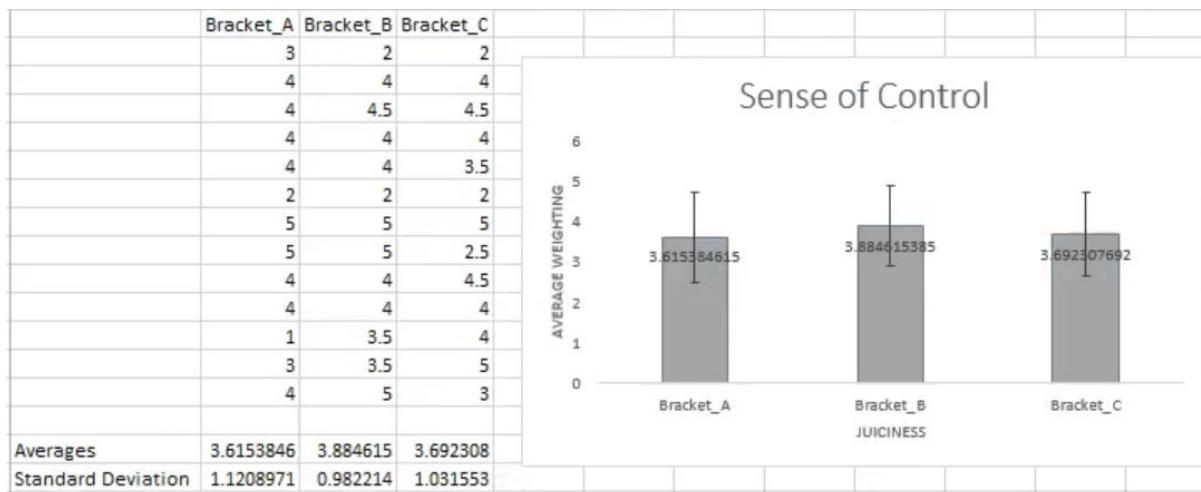
Ranks	
	Mean Rank
Transformation_of_Time_A	1.77
Transformation_of_Time_B	2.12
Transformation_of_Time_C	2.12

**Test Statistics<sup>a</sup>**

N	13
Chi-Square	1.636
df	2
Asymp. Sig.	.441

a. Friedman Test

A Friedman's test indicated that there was no significant difference between the player's scoring of scales relating to Transformation of Time measured per each bracket,  $\chi^2_f(2)=1.636$ ,  $p < .441$ . The average of all players' scores of scales relating to Transformation of Time was compared between each bracket. Post-hoc tests using Wilcoxon signed-rank tests show on average players scored all scales relating to Transformation of Time equally higher when playing bracket's 2 and 3 ( $Mdn = 3.3r$ ) compared to when playing bracket 3 ( $Mdn = 3.0r$ ).

**Sense of Control:****Descriptive Statistics**

	N	Mean	Std. Deviation	Minimum	Maximum	25th	Percentiles 50th (Median)	75th
Sense_of_Control_A	13	3.6154	1.12090	1.00	5.00	3.0000	4.0000	4.0000
Sense_of_Control_B	13	3.8846	.98221	2.00	5.00	3.5000	4.0000	4.7500
Sense_of_Control_C	13	3.6923	1.03155	2.00	5.00	2.7500	4.0000	4.5000

**Friedman Test**

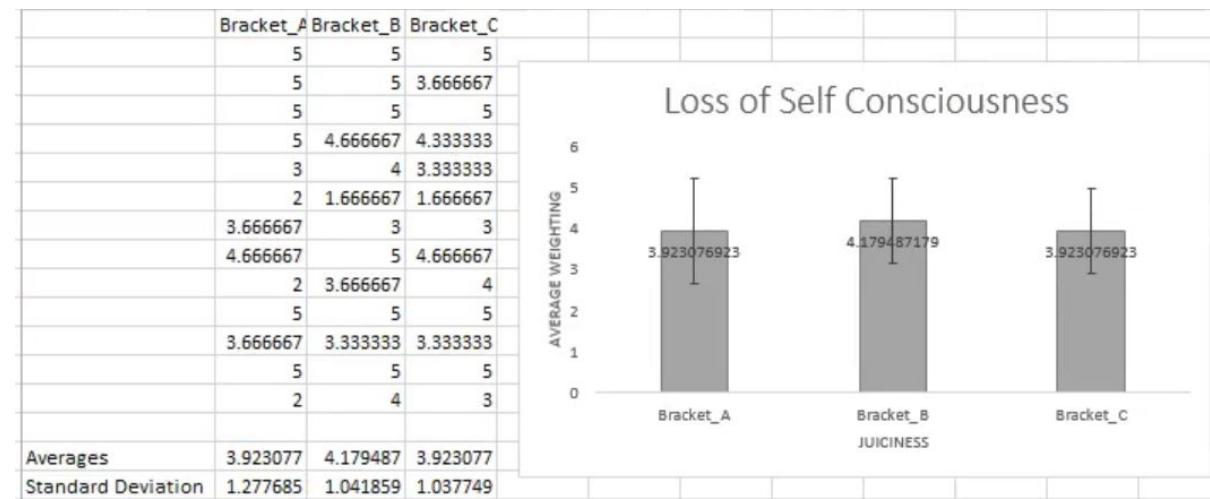
Ranks	
	Mean Rank
Sense_of_Control_A	1.88
Sense_of_Control_B	2.12
Sense_of_Control_C	2.00

**Test Statistics<sup>a</sup>**

N	13
Chi-Square	.667
df	2
Asymp. Sig.	.717

a. Friedman Test

A Friedman's test indicated that there was no significant difference between the player's scoring of scales relating to Sense of Control measured per each bracket,  $\chi^2_f(2)=.667$ ,  $p < .717$ . The average of all players' scores of scales relating to Sense of Control was compared between each bracket. Post-hoc tests using Wilcoxon signed-rank tests show on average players scored all scales relating to Sense of Control equally when playing brackets ( $Mdn = 4.0$ ).

**Loss of Self Consciousness:****Descriptive Statistics**

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
Loss_of_Self_Consciousness_A	13	3.9231	1.27768	2.00	5.00	2.5000	4.6667	5.0000
Loss_of_Self_Consciousness_B	13	4.1795	1.04186	1.67	5.00	3.5000	4.6667	5.0000
Loss_of_Self_Consciousness_C	13	3.9231	1.03775	1.67	5.00	3.1667	4.0000	5.0000

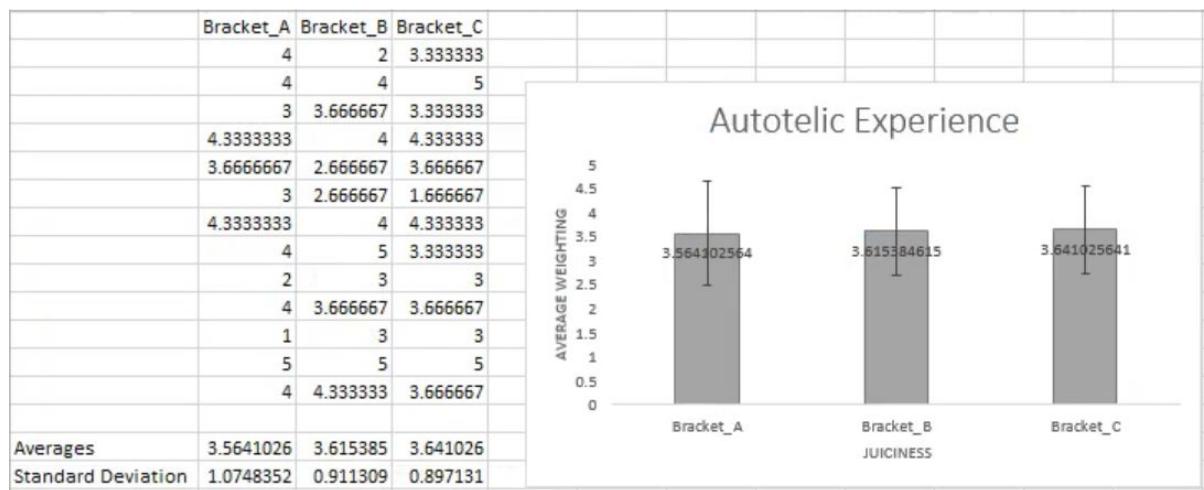
**Friedman Test****Test Statistics<sup>a</sup>**

Ranks	
	Mean Rank
Loss_of_Self_Consciousness_A	2.08
Loss_of_Self_Consciousness_B	2.15
Loss_of_Self_Consciousness_C	1.77

N	13
Chi-Square	1.806
df	2
Asymp. Sig.	.405

a. Friedman Test

A Friedman's test indicated that there was no significant difference between the player's scoring of scales relating to Loss of Self Consciousness measured per each bracket,  $\chi^2_f(2)=1.806$ ,  $p < .405$ . The average of all players' scores of scales relating to Loss of Self Consciousness was compared between each bracket. Post-hoc tests using Wilcoxon signed-rank tests show on average players scored all scales relating to Loss of Self Consciousness equally higher when playing bracket 1 and 2 (Mdn = 4.6667) compared to bracket 3 (Mdn = 4.0r).

**Autotelic Experience:****Descriptive Statistics**

	N	Mean	Std. Deviation	Minimum	Maximum	25th	Percentiles 50th (Median)	75th
Autotelic_Experience_A	13	3.5641	1.07484	1.00	5.00	3.0000	4.0000	4.1667
Autotelic_Experience_B	13	3.6154	.91131	2.00	5.00	2.8333	3.6667	4.1667
Autotelic_Experience_C	13	3.6410	.89713	1.67	5.00	3.1667	3.6667	4.3333

**Friedman Test**

<b>Ranks</b>	
	Mean Rank
Autotelic_Experience_A	2.08
Autotelic_Experience_B	1.92
Autotelic_Experience_C	2.00

**Test Statistics<sup>a</sup>**

N	13
Chi-Square	.195
df	2
Asymp. Sig.	.907

a. Friedman Test

A Friedman's test indicated that there was no significant difference between the player's scoring of scales relating to Autotelic Experience measured per each bracket,  $\chi^2_f(2)=.195$ ,  $p < .907$ . The average of all players' scores of scales relating to Autotelic Experience was compared between each bracket. Post-hoc tests using Wilcoxon signed-rank tests show on average players scored all scales relating to Autotelic Experience higher when playing bracket 1 the most (Mdn = 4.0) compared to when playing bracket 2 (Mdn = 3.6667) and bracket 3 (Mdn = 3.6667).

## Player Metrics & Bracket Rankings and Qualitative Data:

### **Participant 1:**

Bracket 1:

#### Metrics

```
Amount of clicks in total this build: 110
Amount of matches in total made: 309
Amount of wrong moves made: 4
Total score of level: 10770
Total moves to match: 103
```

Bracket 2:

#### Metrics

```
Amount of clicks in total this build: 200
Amount of matches in total made: 180
Amount of wrong moves made: 1
Total score of level: 14940
Total moves to match: 170
```

Bracket 3:

#### Metrics

```
Amount of clicks in total this build: 155
Amount of matches in total made: 100
Amount of wrong moves made: 0
Total score of level: 10000
Total moves to match: 90
```

Ranking:

Q1. Please in order from least enjoyed (at the top of the list) to most enjoyed (at the bottom of the list), rate your favourite build/ version

Version 2	1
Version 1	2
Version 3	3

Statements:

Page: 59

Cameron Khan. KHA16607446



Q2. Why did you rank each build like so?

Version 2 was most pleasing aesthetically and the game felt most rewarding, the visuals of version 3 were too distracting and disrupted my concentration

Q4. Did any feature or build trigger any sense of sensory overload, if so which and why?

version 3's animations were overwhelming; too many moving objects at once

## Participant 2:

Bracket 1:

Metrics

Amount of clicks in total this build: 129  
Amount of matches in total made: 314  
Amount of wrong moves made: 23  
Total score of level: 11770  
Total moves to match: 106

Bracket 2:

Metrics

Amount of clicks in total this build: 156  
Amount of matches in total made: 116  
Amount of wrong moves made: 9  
Total score of level: 12050  
Total moves to match: 147

Bracket 3:

Metrics

Amount of clicks in total this build: 196  
Amount of matches in total made: 150  
Amount of wrong moves made: 25  
Total score of level: 15640  
Total moves to match: 171

Ranking:

Q1. Please in order from least enjoyed (at the top of the list) to most enjoyed (at the bottom of the list), rate your favourite build/ version

Version 1	1
Version 3	2
Version 2	3

Statements:

Q2. Why did you rank each build like so?

Version 2's effects and sounds made matching the circles more fun compared to the others and motivated me to want to keep playing.

Q4. Did any feature or build trigger any sense of sensory overload, if so which and why?

No

### Participant 3:

Bracket 1:

Metrics

Amount of clicks in total this build: 140  
Amount of matches in total made: 96  
Amount of wrong moves made: 18  
Total score of level: 13290  
Total moves to match: 122

Bracket 2:

Metrics

Amount of clicks in total this build: 116  
Amount of matches in total made: 20  
Amount of wrong moves made: 7  
Total score of level: 12180  
Total moves to match: 109

Bracket 3:

### Metrics

Amount of clicks in total this build: 85

Amount of matches in total made: 16

Amount of wrong moves made: 4

Total score of level: 10310

Total moves to match: 81

### Ranking:

Q1. Please in order from least enjoyed (at the top of the list) to most enjoyed (at the bottom of the list), rate your favourite build/ version

Version 1	1
Version 3	2
Version 2	3

### Statements:

Q2. Why did you rank each build like so?

Version 1 seemed to respond better to my controls whereas versions 2 and 3 did not always do what I wanted them to do. However Version 3 gave better responses to making a match than version 2 so it placed middle.

Q4. Did any feature or build trigger any sense of sensory overload, if so which and why?

No.

### Participant 4:

#### Bracket 1:

### Metrics

Amount of clicks in total this build: 108

Amount of matches in total made: 62

Amount of wrong moves made: 8

Total score of level: 13760

Total moves to match: 100

#### Bracket 2:

#### Metrics

Amount of clicks in total this build: 53  
Amount of matches in total made: 31  
Amount of wrong moves made: 8  
Total score of level: 3980  
Total moves to match: 45

Bracket 3:

#### Metrics

Amount of clicks in total this build: 33  
Amount of matches in total made: 20  
Amount of wrong moves made: 4  
Total score of level: 2300  
Total moves to match: 29

Ranking:

Q1. Please in order from least enjoyed (at the top of the list) to most enjoyed (at the bottom of the list), rate your favourite build/ version

Version 3	1
Version 1	2
Version 2	3

Statements:

Q2. Why did you rank each build like so?

V2 had a bit too much going on visually, looked good but it was harder to concentrate. V1 was like V3 but was slightly jankier. V3 was smoother and easier to concentrate on.

Q4. Did any feature or build trigger any sense of sensory overload, if so which and why?

V2, the arrows constantly pointing to the mouse and the other effects made it tricky to stay concentrated.

#### Participant 5:

Bracket 1:

Metrics

```
Amount of clicks in total this build: 131
Amount of matches in total made: 80
Amount of wrong moves made: 15
Total score of level: 11460
Total moves to match: 116
```

Bracket 2:

Metrics

```
Amount of clicks in total this build: 147
Amount of matches in total made: 50
Amount of wrong moves made: 20
Total score of level: 16220
Total moves to match: 127
```

Bracket 3:

Metrics

```
Amount of clicks in total this build: 105
Amount of matches in total made: 136
Amount of wrong moves made: 19
Total score of level: 9590
Total moves to match: 86
```

Ranking:

Q1. Please in order from least enjoyed (at the top of the list) to most enjoyed (at the bottom of the list), rate your favourite build/ version

Version 1

Version 2

Version 3

Statements:

Q2. Why did you rank each build like so?

Version 1's arrows were distracting and ugly, version 2 was nice but dull, 3 was a good balance

Q4. Did any feature or build trigger any sense of sensory overload, if so which and why?

the rotating arrows were very distracting

## Participant 6:

Bracket 1:

Metrics

```
Amount of clicks in total this build: 124
Amount of matches in total made: 34
Amount of wrong moves made: 12
Total score of level: 11430
Total moves to match: 112
```

Bracket 2:

Metrics

```
Amount of clicks in total this build: 51
Amount of matches in total made: 25
Amount of wrong moves made: 3
Total score of level: 6820
Total moves to match: 48
```

Bracket 3:

Metrics

```
Amount of clicks in total this build: 17
Amount of matches in total made: 0
Amount of wrong moves made: 0
Total score of level: 3120
Total moves to match: 17
```

Ranking:

Q1. Please in order from least enjoyed (at the top of the list) to most enjoyed (at the bottom of the list), rate your favourite build/ version

Version 3	1
Version 2	2
Version 1	3

Statements:

Q2. Why did you rank each build like so?

Less distractions made the game easier to play.

Q4. Did any feature or build trigger any sense of sensory overload, if so which and why?

Build one, spinning arrows made the game difficult at first to understand their significance, and also were distracting and irritating.

### Participant 7:

Bracket 1:

Metrics

Amount of clicks in total this build: 136  
Amount of matches in total made: 63  
Amount of wrong moves made: 16  
Total score of level: 12510  
Total moves to match: 120

Bracket 2:

Metrics

Amount of clicks in total this build: 104  
Amount of matches in total made: 52  
Amount of wrong moves made: 2  
Total score of level: 11270  
Total moves to match: 102

Bracket 3:

Metrics

Amount of clicks in total this build: 94  
Amount of matches in total made: 80  
Amount of wrong moves made: 2  
Total score of level: 10230  
Total moves to match: 92

Rankings:

Q1. Please in order from least enjoyed (at the top of the list) to most enjoyed (at the bottom of the list), rate your favourite build/ version

Version 2	1
Version 3	2
Version 1	3

Statements:

Q2. Why did you rank each build like so?

I found the last 2 more visually appealing, though 2 had a lot less going on which I preferred

Q4. Did any feature or build trigger any sense of sensory overload, if so which and why?

The arrows in 3 were a bit much at times

## Participant 8:

Bracket 1:

### Metrics

Amount of clicks in total this build: 187  
Amount of matches in total made: 65  
Amount of wrong moves made: 12  
Total score of level: 13760  
Total moves to match: 175

Bracket 2:

### Metrics

Amount of clicks in total this build: 86  
Amount of matches in total made: 18  
Amount of wrong moves made: 6  
Total score of level: 11770  
Total moves to match: 80

Bracket 3:

### Metrics

Amount of clicks in total this build: 119  
Amount of matches in total made: 130  
Amount of wrong moves made: 7  
Total score of level: 15570  
Total moves to match: 112

### Rankings:

Q1. Please in order from least enjoyed (at the top of the list) to most enjoyed (at the bottom of the list), rate your favourite build/ version

Version 2	1
Version 1	2
Version 3	3

### Statements:

Q2. Why did you rank each build like so?

I'd rather prefer the plain build (version 1) than the overstimulating one (version 2). I felt version 3 was the most balanced, offering the best playing experience.

Q4. Did any feature or build trigger any sense of sensory overload, if so which and why?

Build version 2 induced me a feeling of dizziness due to all the arrows constantly rotating towards the cursor. That ruined 80% of my concentration, causing me to forget the goals of the game, what I was trying to achieve, and making it quite difficult to control it.

### Participant 9:

#### Bracket 1:

### Metrics

Amount of clicks in total this build: 139  
Amount of matches in total made: 191  
Amount of wrong moves made: 11  
Total score of level: 9440  
Total moves to match: 128

#### Bracket 2:

### Metrics

Amount of clicks in total this build: 207  
Amount of matches in total made: 74  
Amount of wrong moves made: 15  
Total score of level: 15960  
Total moves to match: 192

Bracket 3:

### Metrics

Amount of clicks in total this build: 129  
Amount of matches in total made: 114  
Amount of wrong moves made: 8  
Total score of level: 13370  
Total moves to match: 121

Ranking:

Q1. Please in order from least enjoyed (at the top of the list) to most enjoyed (at the bottom of the list), rate your favourite build/ version

Version 1	1
Version 2	2
Version 3	3

Statement:

Q2. Why did you rank each build like so?

I felt that the first build was the right amount of feedback, the second one didn't have enough, however the third one had too much going on making it worse than the second one

Q4. Did any feature or build trigger any sense of sensory overload, if so which and why?

(build C) The arrows facing the position of the cursor was too much, it distracted me from the game itself.

### Participant 11:

Bracket 1:

### Metrics

```
Amount of clicks in total this build: 130
Amount of matches in total made: 37
Amount of wrong moves made: 6
Total score of level: 14250
Total moves to match: 124
```

Bracket 2:

### Metrics

```
Amount of clicks in total this build: 120
Amount of matches in total made: 92
Amount of wrong moves made: 2
Total score of level: 12760
Total moves to match: 118
```

Bracket 3:

### Metrics

```
Amount of clicks in total this build: 112
Amount of matches in total made: 16
Amount of wrong moves made: 10
Total score of level: 13340
Total moves to match: 102
```

Ranking:

Q1. Please in order from least enjoyed (at the top of the list) to most enjoyed (at the bottom of the list), rate your favourite build/ version

Version 2	1
Version 3	2
Version 1	3

Statements:

Q2. Why did you rank each build like so?

I enjoyed the aesthetics overall, however, I felt version two of the game looked quite basic in comparison to the other versions. I really enjoyed the arrows following the cursor on version 1

Q4. Did any feature or build trigger any sense of sensory overload, if so which and why?

When first playing version 1, there was a visual overload to start off with but quickly became accustom to it. The flashes from creating a combo seemed slightly distracting and I couldn't always differentiate between the hint marker and the combo alert

## Participant 12:

Bracket 1:

Metrics

Amount of clicks in total this build: 23  
Amount of matches in total made: 108  
Amount of wrong moves made: 0  
Total score of level: 26550

Bracket 2:

Metrics

Amount of clicks in total this build: 128  
Amount of matches in total made: 79  
Amount of wrong moves made: 35  
Total score of level: 12180  
Total moves to match: 93

Bracket 3:

Metrics

Amount of clicks in total this build: 135  
Amount of matches in total made: 14  
Amount of wrong moves made: 28  
Total score of level: 10600  
Total moves to match: 107

Ranking:

Q1. Please in order from least enjoyed (at the top of the list) to most enjoyed (at the bottom of the list), rate your favourite build/ version

Version 3	1
Version 1	2
Version 2	3

Statements:

Q2. Why did you rank each build like so?

the feedback given by the first game was too much, while the second was just right and made it an enjoyable experience while the lack of feedback of the 3rd game made losing more interesting than getting something right and I gave up playing on the first level

Q4. Did any feature or build trigger any sense of sensory overload, if so which and why?

the arrows of the first game were so much and were distracting couldn't focus on the distinguishing the colours from the arrows

### Participant 13:

Bracket 1:

Metrics

Amount of clicks in total this build: 30  
Amount of matches in total made: 108  
Amount of wrong moves made: 0  
Total score of level: 26550

Bracket 2:

Metrics

Amount of clicks in total this build: 128  
Amount of matches in total made: 79  
Amount of wrong moves made: 10  
Total score of level: 12180  
Total moves to match: 93

Bracket 3:

### Metrics

Amount of clicks in total this build: 149  
Amount of matches in total made: 14  
Amount of wrong moves made: 4  
Total score of level: 10600  
Total moves to match: 107

### Rankings:

Q1. Please in order from least enjoyed (at the top of the list) to most enjoyed (at the bottom of the list), rate your favourite build/ version

Version 3	1
Version 2	2
Version 1	3

### Statements:

Q2. Why did you rank each build like so?

3 had more going on so held my attention better, 2 had a bit less than 3 and 1 had even less

Q4. Did any feature or build trigger any sense of sensory overload, if so which and why?

the arrows in version 3 were a bit distracting from the colours but it also helped engagement in the overall game

### Participant 14:

#### Bracket 1:

### Metrics

Amount of clicks in total this build: 203  
Amount of matches in total made: 332  
Amount of wrong moves made: 25  
Total score of level: 19980  
Total moves to match: 178

Bracket 2:

Metrics
Amount of clicks in total this build: 104
Amount of matches in total made: 0
Amount of wrong moves made: 10
Total score of level: 10530
Total moves to match: 94

Bracket 3:

Metrics
Amount of clicks in total this build: 178
Amount of matches in total made: 42
Amount of wrong moves made: 13
Total score of level: 16050
Total moves to match: 165

Ranking:

Q1. Please in order from least enjoyed (at the top of the list) to most enjoyed (at the bottom of the list), rate your favourite build/ version

Version 3	1
Version 1	2
Version 2	3

Statements:

Q2. Why did you rank each build like so?

version one gave an intro to how the game was played, Version two evolved it but due to the style and some animations was difficult on the eyes. Version took the evolution of 2 and but kept the ease on the eyes of one.

Q4. Did any feature or build trigger any sense of sensory overload, if so which and why?

Version 2 Arrows following mouse was rather disorientated by the end of it. Straining on the eyes.

## Discussions & Analysis

While the data produced and shown via bar charts suggests that on average for each dimension of the Player Experience Inventory was consistently scored higher for the second bracket (Average) game and that, that trend also transpired through the Activity flow dimensions too, due to high p- values the evidence is not strong enough to actually suggest

this effect exists in population. This finding in the fact this study not being able to support any sort of effect, in the area of player experience, juiciness and flow seems to conflict with several previously published papers that also research such topics, as a large majority of other studies such as Koa, K.hicks in regards to juiciness, Lennart Nacke in regards to flow, all find differences and correlation between conditions being measured, often finding significant data supporting theories much like the hypothesis of this paper, as an example we know that the presence and implementation of juiciness can indeed affect where significance is found (K.Hicks, 2019), Where as this study found no significance across all three conditions. What can be taken away from this study although no proof effect has been made is that perhaps the means of which and the requirements of a study involving juiciness, flow and the like may require factors to be able to produce a significant finding and that perhaps the implementation of this project or study was incorrect in some aspect.

The first theory as to why perhaps this study was not successful in finding significant data is due to lack of participant population, with this study only gathering 14 participants compared to most successful studies often ranging participants in the hundred's, this may be due to larger sample size allowing for hypothesis testing to detect smaller effect's, where as if sample size is small and variability in the sample is high, random error can stem from difference in participants (Frost.J., Undated) (Rusticus.A.S., Et al., 2014), a clear discrepancy in successful studies revolving juiciness and flow and this study is sample size. Perhaps when measuring instruments containing sub dimensions or aim to evaluate psychological affect a larger number of participants may be needed or perhaps sampling should have been applied to data.

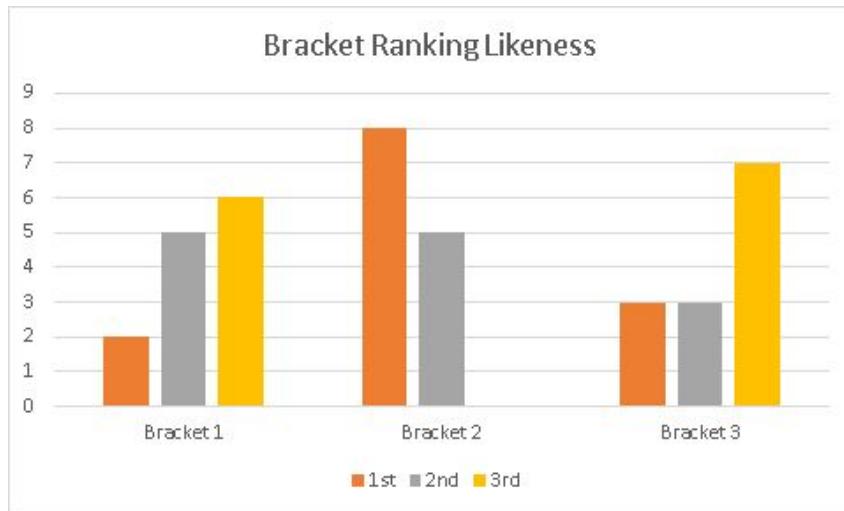
Perhaps for varying juicy features implemented for the match 3 game, could have been implemented in an incorrect manner for the experiences hoped to be measured in this study, meaning some juicy features do not target or invoke dimensions from PXI and ActivityFlow, there also may be specific juicy features that better have an effect on how players experience a game specific to these dimensions. It was hoped that employing 3 experts to carry out an evaluation on the design of the game and bracket of juiciness, how juicy features were implemented and what juicy features were implemented in retrospect to ensure correct implementation and adequate feedback regarding these factor's perhaps a larger quantity and more diverse group of experts were required to truly evaluate the game, there is also the chance that the 3 experiments chosen due to lack of control for whether or not they were indeed experts of games nor whether or not they had any understanding of such topics as juiciness and therefore perhaps invalid validation was carried out, leading to the production of a game or varying brackets of juice that were unfitting for what was trying to be measured. Finally perhaps the genre of game chosen for implementing juicy features perhaps is not best suited for measuring dimensions present with-in PXI and Flow, previous studies stated have studied the application of juiciness with RPG games, Competitive Games and with VR, after research a paper looking at measuring flow, play experience and juiciness in regards to a Match 3 game could not be found and therefore it cannot be concluded whether or not this

reason influences the significance of findings, if another study was to have also carried out a similar study on a similar genre of game and produced significant findings then perhaps there could have been discrepancies in the studies implementation however due to the lack of such a study, perhaps the genre of a Match 3 game is not best suited for producing significant findings with-in play experience and flow.

Again as we know juiciness effect's player experience and produces significant findings with PXI & other Player experience measurements and this project found the opposite not only for PXI but also the Activity Flow Scale and therefore flow theory itself in games there is a suggestion that perhaps this correlation would be existent in the flipped scenario, perhaps if this project did find significant data it would have found it for both measuring instruments and perhaps follow suite in their findings, hinting towards the fact that flow can indeed be measured in games and more specifically revolving around juiciness and immersion.

What can be taken from this study however is a gauging of players preference to a specific bracket, please refer to the bar chart below, perhaps alluding to a more popular choice in regards to a bracket, this information cannot be analysed any further past preference however and therefore cannot be used as proof that flow was present or fostered in the preferred choice. The data was gathered through a self made survey by the author featuring a short amount of questions, asking participants to rank each bracket in regards to preference, a short excerpt as to why said chosen bracket was their preference and if any bracket or feature induced sensory overload. The participants rankings were plotted into a chart to show how often each bracket was ranked 1st, 2nd & 3rd. We can see an overwhelming amount of participants ranked bracket 2 (Average) the highest making it seem like a preferred version, Bracket's 1 and 3 are more volatile in preference with players either really disliking bracket 3 or really like bracket 3, meaning a majority of people who preferred bracket 2 the most also least preferred bracket 3, this can be supported by gathered excerpts from the same survey with participants who ranked the 2nd bracket the highest stating such thing as "Version 3, Arrows following mouse was rather disorientated by the end of it. Straining on the eyes." or "(build C) The arrows facing the position of the cursor was too much, it distracted me from the game itself.", such statements were reoccurring, this data hints towards the fact that perhaps the implementation of the juicy feature featured in bracket 3 where arrows on all dot's follow the players mouse was a form of incorrect implementation of a juicy feature. Statements from people who did enjoy the third bracket were; "3 had more going on so held my attention better, 2 had a bit less than 3 and 1 had even less" Showing for some all juicy features raised engagement, perhaps different audiences have preference to the amount of juicy in games and perhaps have varying requirements for better focus, flow and enjoyability. This bar chart was created with rankings put in the correct order of participants referencing, these orders are supported by their statements, in future studies perhaps the question proposed to participants asking to rank their preferred versions should be written with more clear and understandable instructions as the data show above in the screenshots of rankings doesn't

match the statements and it seems participants misunderstood the question, this means not much can be concluded from this.



## Reflective Analysis:

Starting this project only with a basic understanding of both the flow theory and what are & how to correctly implement juicy feature's I feel as though a much stronger grasp on them were developed rather quick and therefore artefact development went smoothly working towards planned deadlines as during the design phase I could put this now stronger understanding of juicy features to use allowing for the quick production of them, reaching deadlines was also rather do-able due to the workload being correctly weighted, spread out and planned for.

Although the development of the artefact went well I do feel as though perhaps I would have carried out a few things differently, removed certain features or have added more into the game produced, firstly it may have produced more of an interesting finding and simply more data if the 3 brackets varied more than they did, rather than producing the bracket with the lowest amount of juiciness perhaps a build with no juice should have been supplied however due to feedback this was decided against, perhaps another way to implement this was to produce 4 versions of the game rather than 3 including the versions created and a 4th with no juicy features at all, I also feel as though there was room in the 3rd bracket featuring the most juicy features for perhaps even more of them as all juicy features revolved around the board of dot's no juicy features were implemented for the top UI bar in which shows and tracks score, goals reached and how much time is left for players in the round.

It may have been interesting to add such juicy features as a rewarding sound effect when players reach milestone scores or the text plays a juicy animation each time points are added to the score or a goal is incremented, a warning noise or high action music could be played when the timer near reaches zero or when the move count reaches a certain number, I had

thought however I employable a viable means of validation of these brackets through asking experts to verify if they felt the features in the brackets were fittin and the design of the game worked for juicy feature's thanks to myself carrying out research into how past studies verified varying brackets of game's in due time it seems as though the correct means was chosen but carried out incorrectly as previously mentioned in the discussion perhaps more experts were needed to review the brackets and perhaps a measurement of or validation of the experts themselves should have been carried out as perhaps the experts gathered may have not truly been true experts or perhaps only experts in a specific part of the games development process therefore not having an understanding of jicinkess nor design. If I was to carry out this research again more time would have been spent ensuring experts understood what they were reviewing, validating the fact they were actually experts and would have reached out to more of them for the review.

Perhaps a better understanding of software used to collected data was required to avoid dealing with issues that stemmed during data handling and analysis, not knowing that qualtrics exported likert scales in reverse order, 1 being strongly agree and 7 being strongly disagree meant time had to be spent inverting all values so that 7 = strongly agree and 1 = strongly disagree, preliminary research into qualtrics before starting the study may have informed me of this and therefore the issue may have been avoided. I also feel they were issues stemmed from perhaps the creation of questions in the survey with unclear instructions, take for example how some participants incorrectly ordered their rankings due to a misunderstanding to remedy this, if this project was to be carried out again the self made survey will go under heavy validation and scrutiny perhaps through practice runs of the study to ensure participants had an understanding on what all questions where asking.

I feel most of the juicy features were implemented well and in a correct manner even though I had no previous work with juicy implementation before, for example the different explosion type's indicators in the shape of particle effects looked appeasing, smooth and genuinely added well implemented juice. However I do feel as though the juicy feature featuring the moving arrows on all dot's in the third bracket could have been implemented in a more elegant and incorporated fashion rather than the too busy eye sore of large arrow's following the players mouse it could have been instead a more subtle feature on each dot that follows players such as a specular light or animated eye's thus avoiding the possibility of incorrect or badly implemented juice and causing strain on participants

The project although having a strong focus on flow, does not provide much insight into the topic due to insignificant outcomes of the user study in which the majority of the flow aspect was covered dut its psychological ties and not design with this said a great amount of knowledge into how flow has so far be studied and interacted with in games design has been learnt through a critical academic review. I also feel the means of measuring flow in games revolving juiciness was carried out well carrying out and in-depth review of flow measuring instruments was carried out to ensure the most fitting instrument was chosen. To counter this

issue of lack of flow incorporation and in general to rectify not producing any support of affect if this study was to be carried out again a much larger sample size and participant amount with have been gathered, although with the pandemic occurring at the time the study began part of the lack of participants stemmed from this, extra time was accounted for and put into attempting to recruit participants via online means however only a handful of people got back in touch and even a smaller amount accepted to partaking, I do feel the original planned means of carrying out the study would have produced a larger sample size as participants may have been more willing to take part outside of a pandemic and when asked in person, it would have also been much easier to advertise the study physically, more metrics may have also been produced through carrying out the study in person as participant behaviour could have been analysed during testing, carrying out the study online does not allow for this easily nor organically something important to flow, for example in person the participants could be watched, online they could have been asked to explain their experience while playing however that provides a distraction to their testing.

The manner of which the study was carried out seemed fitting with having participants carry out each survey (PXi and Activity Flow) after playing each game however the chose to have with-in subjects play the brackets in random order created several issues and at times confusion for me to work through and didn't seem to produce enough data to analyze whether or not the order played in affected anything, the issues that arose from the randomized order meant that when a participant who played the order of brackets outside of bracket 1 to 2 to 3, when filling out the first set of pxi and activity flow questions it did not relate to bracket 1 but whichever bracket they first played, for example take participant doing 3.1.2, the first survey related to the 3rd bracket for this person whereas for someone playing in order of 2.3.1 the first game played and therefore set of questions are related to the 2nd bracket, this meant that upon collection all data had to be sorted into the correct order of brackets, the participant id number provided allowed me to keep track of what order participants played but lack of forward thinking did not think of the issue of having to order data collected.

If this project was to run again I would have either implemented a 4th bracket of juice that had even more juicy feature's or perhaps lessen the amount of juicy features present in the "average" bracket, bracket 2 as I feel in this study the differing amount of features included between bracket 2 and bracket 3 may have not been enough, with only 3 new features added to bracket 3, to produce a clear difference of affect in regards to how effective juicy features were. There was also simply more room for juicy features from adding scaling impactful sound effects per every chained match made from one move, fading in contratrurtory text when a player chains a certain amount of matches or produces a high score off of one move and several others.

In summary carrying out this project was a large learning experience providing strengthened insight into flow and its relation to game's, what classes as and how to implement juicy features and how to study player experiences, the development of the artefact I feel went well

however not perfect with more time allowing for more features to be implemented and more validation to be applied. The study itself could have been more fruitful with a larger participant gathering however justified measuring instruments were chosen.

## Conclusion

The project did not find any conclusive outcomes in regards to answering the question of whether or not flow can be fostered by juiciness due to the findings of this project left much to be found due to the overwhelming production of insignificant data deduced through high p-values. What was carried aimed to produce a means of supplying some contribution to the analysis of flow's connections to juiciness and game's and perhaps may have if the study produced any significance in effect between participants' interactions with the artefact., its 3 varying brackets and the data collected from the Player Experience Inventory and Activity Flow Scale. All objectives were carried out however in doing so aim's were not reached and the hypothesis of this project was left null, with this said the aim of this project still seems fitting, perhaps such a set of aim's required a larger project in regards to time and outreach and therefore instead perhaps should have been structured better for example working towards and understanding of juiciness effects on flow rather than the hope of specifically attempting to define a concrete "yes" or "no" finding of whether or not juiciness fosters flow and measuring by how much. With that perhaps the positive of this project is that it spotlight's the need for more work to be carried out that studies the relationship between juiciness and flow.. This does not show or mean that juiciness does not induce flow, simply that this project wasn't able to provide any evidence that it does.

Future work could look into applying this study into a bigger audience with the hope that a larger sample size produces value and significant data, prehap's more brackets could be created ranging from 4 to 5, including a bracket with no juice and a bracket with an overwhelming amount of juice. Other scales and measuring instruments for flow should also be applied to the study for a deep analysis on whether there are more fitting models for measuring players flow experience in games and for specifically measuring juiceness's effect on flow.

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## Acknowledgements

I would like to thank all participants who took part in the study, the 3 colleagues who carried out the expert validation, this project's supervisor Kieran Hicks and my friends and family for their support.

## Appendix

### Appendix Item 1: Exploring Flow & Juiciness Recruitment info

Recruitment Materials:

Email Text:

I'm contacting you as I'm currently recruiting for participants in my study who have played any form of video game.

The purpose of the study is to scale, document and study players intrinsic engagement (flow) one may enter when playing a game and how this engagement may be amplified or nullified through the employment of different feedback features (Juiciness)

Page: 86

Cameron Khan. KHA16607446

The study consists of a short gameplay session in which you will play the same game 3 times, each with varying differences, playing through each time is estimated to take around 10 mins in total, for each time you play the game, you will be prompted to carry out 3 short surveys in total filling 58 items, taking no longer than 15 minutes each time you play. In total the study is estimated to take 40 to 45 minutes.

This project contributes to the research on behalf of the University of Lincoln and has received approval by the University Research Ethics Committee.

Thanks,

Cameron Khan.

## Appendix Item 2: Flow and Juiciness User Study Information

### **Participant Information Sheet**

**(Version 1: 01/07/2020)**

**Title of Study:** Investigating the Effects of Juiciness on Flow and its Ability to Foster State of Flow in Players.

**Name of Researcher(s):** Cameron Khan

**Contact Details of the Researcher(s) are given at the end.**

I'd like to invite you to take part in a research study. Joining the study is entirely up to you, before you decide we would like you to understand why the research is being done and what it would involve for you. We'd suggest this should take about 40 minutes. Please feel free to talk to others about the study if you wish.

#### **What is the purpose of the study?**

The purpose of the study is to scale, document and study players' intrinsic engagement (flow) one may enter when playing a game and how this engagement may be amplified or nullified through the employment of different feedback features (Juiciness). The study will take place remotely over a communication tool of your choice.

#### **Why have I been invited?**

You are being invited to take part because you have some known experience playing games.

#### **Do I have to take part?**

It is up to you to decide whether to take part. If you do decide to take part, you will be given this information sheet to keep. If you decide to take part, you are still free to withdraw at any time and without giving a reason. This would not affect your legal rights. Upon withdrawal from the study any data collected that is associated with you will be destroyed.



### **What will happen to me if I take part?**

The study consists of a short gameplay session in which you will play the same game 3 times, each with varying differences, playing through each time is estimated to take around 10 mins in total, for each time you play the game, you will be prompted to carry out 3 short surveys taking no longer than 15 minutes in total each time you play. In total the study is estimated to take 40 to 45 minutes.

### **What are the possible disadvantages and risks of taking part?**

The only disadvantage is that this study will take up a little bit of your time.

### **Will my taking part in the study be kept confidential?**

We will follow ethical and legal practice and all information about you will be handled in confidence.

### **Privacy notice**

The University of Lincoln is the lead organisation for this study. The university's Research Participant Privacy notice <https://ethics.lincoln.ac.uk/research-privacy-notice/> will explain how we will be using information from you in order to undertake this study and will be the data controller for this study. This means that we are responsible for looking after your information and using it properly.

### **What will happen if I don't want to carry on with the study?**

Your participation is voluntary, and you are free to withdraw at any time, without giving any reason, and without your legal rights being affected. If you withdraw from the study, we will keep the information about you that we have already obtained. To safeguard your rights, we will use the minimum personally identifiable information possible.

### **What will happen to the results of the research study?**

The results of this research will be analysed and used in future academic publications. Any data that is used in these publications will be anonymised and will not be identifiable to you in anyway.

### **Who is organising and funding the research?**

This research is being organised by the University of Lincoln.

### **Who has reviewed the study?**

All research conducted by the University of Lincoln is looked at by an independent group of people, called a Research Ethics committee, to protect your interests.

## **What if there is a problem?**

If you have a concern about any aspect of this study, you should ask to speak to the researchers who will do their best to answer your questions. The researchers contact details are given at the end of this information sheet. If you remain unhappy and wish to complain formally, you can do this by contacting [ethics@lincoln.ac.uk](mailto:ethics@lincoln.ac.uk).

If you feel that I have let you down in relation to your information rights then please contact the Information Compliance team by email on [compliance@lincoln.ac.uk](mailto:compliance@lincoln.ac.uk) or by post at Information Compliance, Secretariat, University of Lincoln, Brayford Pool, Lincoln, LN6 7TS.

You can also make complaints directly to the Information Commissioner's Office (ICO). The ICO is the independent authority upholding information rights for the UK. Their website is [ico.org.uk](http://ico.org.uk) and their telephone helpline number is 0303 123 1113.

## **Further information and contact details**

Cameron Khan – [16607446@students.lincoln.ac.uk](mailto:16607446@students.lincoln.ac.uk)

## **Appendix Item 3: Expert Validation of Brackets**

### **Expert One:**

#### **Bracket 1**

##### **A. Game Characteristics**

###### **a. Mechanic**

For the most part, yes. The dots are removed when matched and reset when they don't

###### **b. Thematic Coherence**

Yes, the swapping of dots works as expected

###### **c. Gameplay Coherence**

Yes, all the mechanics work together

###### **d. Feedback Coherence**

No, swapping dots just removes them, and getting rid of more in one go doesn't give any greater feedback

##### **B. Game State**

- a. Exaggerate

No, the reactions are standard

- b. Focus of Attention

There is a hint highlighting effect that's common to see, everything else is either rare or doesn't exist

- c. Highlighting

There's not many systems, but the ones that exist are combined well

- d. Ambient Feedback

There is no ambient feedback

#### C. Direct Feedback

- a. Confirmatory

Yes, when you click and drag the dots they move as expected

- b. Multimodal

no, there's only 1 channel of feedback

- c. Unambiguous

Yes, the dots move when you click and drag them

- d. Relevant

The feedback received is important

- e. Supplementary feedback

There is no supplementary feedback

#### Bracket 2

#### D. Game Characteristics

- a. Mechanic

Yes, everything works as expected

- b. Thematic Coherence

yes

- c. Gameplay Coherence

yes

- d. Feedback Coherence

I believe so, yes.

#### E. Game State

- a. Exaggerate

I think the reactions are fine for the various state changes

- b. Focus of Attention

yes

- c. Highlighting

yes

- d. Ambient Feedback

There is not, from what I can gather

#### F. Direct Feedback

- a. Confirmatory

yes

- b. Multimodal

Yes, visual and audio

- c. Unambiguous

Yes, it's clear why the feedback happened

- d. Relevant

yes

- e. Supplementary feedback

I don't think it does

Bracket 3

G. Game Characteristics

a. Mechanic

yes

b. Thematic Coherence

They are, even though they are a little dramatic

c. Gameplay Coherence

They are compatible

d. Feedback Coherence

The feedback sometimes is more than the importance of the event

H. Game State

a. Exaggerate

Some parts of the reactions are exaggerated, the rest are normal

b. Focus of Attention

The participle effects sometimes draw attention

c. Highlighting

yes

d. Ambient Feedback

no

I. Direct Feedback

a. Confirmatory

Yes it does

b. Multimodal

Yes, visual and audio

c. Unambiguous

yes

d. Relevant

Most of it is, the arrows pointing to the cursor are not relevant

e. Supplementary feedback

Some particle effects are used, so yes

### **Expert Two:**

Bracket 1

A

1 - Not really - feels extremely empty.

2 - There's very little reaction to events so it's difficult to say.

3 - There certainly seems to be a certain level of coherence with rows/columns detonating and setting up combos.

4 - Not particularly, no

B

1 - Not at all, no

2 - Not in the slightest

3 - Difficult to say because I barely noticed any feedback elements

4 - The scores and objectives are always displayed along the top - i don't feel as though these make the world feel real and interactive though. Undoubtedly i would miss them if they weren't there though.

C

1 - A small sound is played on click, that's about it.

2 - Buttons are 'depressed' and play a short sound, so to a small degree yes.

3 - I believe so

4 - Very limited feedback for either

5 - Not that I noticed

Bracket 2

A

1 - More so than the first bracket, but not extremely so.

2 - Sure, I would say so.

3 - I don't believe the gameplay mechanics are any different than the first, but the different audiovisual feedback certainly don't fight with each other for your attention

4 - Yes? I suppose so.

B

1 - Yes, definitely.

2 - Yes, for sure.

3 - I would say so yes, again, I do not get the sense that two elements are competing with one another.

4 - The big arrows stemming from the special dots and the diamonds growing from points of interest achieve this nicely (this was also in the first bracket, sorry cameron I am NOT going back)

C

1 - No more than the first bracket did, from what I can tell. The buttons get depressed and the sound plays.

2 - Yes, certainly.

3 - I definitely think so.

4 - Not really sure how to answer this but I suppose the critical events are highlighted more? It's difficult to say.

5 - Not that I noticed.

Bracket 3

A

1- Yes, absolutely.

2 - Very much so.

3 - I definitely think so.

4 - Yeah, sort of - you get a bigger animation but I think that's about it.

B

1- Yes, massively so.

2 - The arrows on the buttons on this one draw a lot of attention, far more so than anything else I've seen so far

3 - I think that the massive arrows coming out from special dots are clashing with the arrows on the dots that point to your cursor. Also, those arrows on the dots are clashing with the special dot icons.

4 - The same expanding diamond and arrows are present

C

1 - Yes - a ring expands when hovering over a button, along with the depressed state and sound that plays

2 - Yes, certainly

3 - I believe that is still the case, yes. There aren't too many actions I can take so its difficult to say.

4 - Again, not really sure how to answer this question, but I would say that in this version the vast majority of the feedback is unnecessary, and not critical.

5 - Just realised the expanding arrows from the special dots are doing this, so yes

### Expert Three:

Bracket 1

**A1 . Mechanic:**

Making a match blips as expected, fulfilling game objectives if relevant. Tiles are shown to break if matched over as expected. Powerups perform the role that their visuals would indicate.

**A2 . Thematic Coherence:**

New dots appear from outside the game world, allowing suspension of disbelief in their creation. Upon a match being made, the dots simply vanish making it feel very static and unrealistic.

Dots show no reaction to the presence of the cursor (player), making simply “exploring the board” far less satisfying.

**A3 . Gameplay Coherence:**

All presented mechanics are valid within the realm of a match 3 game and link together well.

**A4 . Feedback Coherence:**

There is zero feedback for a successful match, which would indicate a lack of importance from the primary gameplay mechanic. There is audio feedback on a failed move, which at least provides some information that the player did wrong. Powerups do not feel powerful at all, simply vanishing the relevant dots. Completing a level is also very unsatisfying with zero fanfare and audio cues for a major game event.

**Game State**

**B1 . Exaggerate:**

There is very little if any exaggeration of in-game actions.

**B2 . Focus of Attention:**

There are very few feedback methods, the main elements are the hint display which provides the only real visual feedback, and audio cues for clicking a dot (what should be an insignificant event in comparison) and making a wrong move.

**B3 . Highlighting:**

The presence of audio feedback for only a few systems does not sit well with the lack of feedback throughout the rest of the game.

**B4 . Ambient Feedback:**

There is one element of feedback that exists without player input, which is the hint display marker. It does not help the world appear more interactive, however.

**Direct Feedback**

**C1 . Confirmatory:**

There is an audio response and visual darkening upon clicking a button, showing that the button is indeed interactable and the user has clicked it.

**C2 . Multimodal:**

Only the clicking of a button provides multi-sensory feedback, all other interactions either feature solely audio, video or no cues at all.

**C3 . Unambiguous:**

It is clear that the feedback provided is specifically meant for one action or event.

**C4.A Relevant:**

Feedback is mainly given on minor player actions such as clicking a button but not on game critical events such as successful matches or level completion.

C4.B Supplementary Feedback:

There is no perceived additional feedback present.

Bracket 2

A1 . Mechanic:

Making a match blips as expected, fulfilling game objectives if relevant. Tiles are shown to break if matched over as expected. Powerups perform the role that their visuals would indicate.

Completing a level provides the player with a victory screen.

A2 . Thematic Coherence:

New dots appear from outside the game world, allowing suspension of disbelief in their creation. Upon a match being made, the dots play a visual animation and audio clip, providing context to their vanishing.

Dots show no reaction to the presence of the cursor (player), making simply “exploring the board” far less satisfying.

A3 . Gameplay Coherence:

All presented mechanics are valid within the realm of a match 3 game and link together well.

A4 . Feedback Coherence:

The audio and visual feedback on a successful match helps to highlight that the player has performed a positive action.

There is audio feedback on a failed move, which provides some information that the player did wrong, as well as a camera shake which emphasizes the action that was performed.

The feedback given for triggering a powerup is exactly the same as for a normal match, only the scale (number of dots affected) helps it feel any more powerful.

Completing a level is also somewhat unsatisfying with zero fanfare and audio cues for a major game event, but still, a victory screen, showing the player that they have indeed been successful.

Game State

B1 . Exaggerate:

Upon a match, there is a small but important visual animation which shows the dots disappearing.

Upon a failed match, there is a rather loud noise to indicate failure, as well as somewhat excessive camera shake.

B2 . Focus of Attention:

The main elements which grab the player’s attention are the hint display which provides visual feedback for a potential match.

The noise and camera shake from a wrong match do well to draw the player’s attention to their negative action.

B3 . Highlighting:

The presence of audio cues throughout the main game is well balanced, however, the silence of the victory or failure screens feels strange in comparison.

B4 . Ambient Feedback:

There is one element of feedback that exists without player input, which is the hint display marker. It does not help the world appear more interactive, however.

Direct Feedback

C1 . Confirmatory:

There is an audio response and visual darkening upon clicking a button, showing that the button is indeed interactable and the user has clicked it. There are video and audio cues upon making a match, good or bad, showing the player the positive or negative effect of their action.

C2 . Multimodal:

Many areas feature both audio and visual feedback.

C3 . Unambiguous:

It is clear that the feedback provided is specifically meant for one action or event.

C4.A Relevant:

Feedback is given on minor player actions such as clicking a button and some game critical events such as successful matches, however, it is not given upon goal or level completion.

C4.B Supplementary Feedback:

There is no perceived additional feedback present.

Bracket 3

A1 . Mechanic:

Making a match blips as expected, fulfilling game objectives if relevant. Tiles are shown to break if matched over as expected. Powerups perform the role that their visuals would indicate.

Completing a level provides the player with a victory screen.

A2 . Thematic Coherence:

New dots appear from outside the game world, allowing suspension of disbelief in their creation.

Upon a match being made, the dots play a visual animation and audio clip, the dots also break apart and fall out of the map, providing context to their vanishing within the game world. The breaking is perhaps over the top for every single move and could possibly be reserved for more important moves such as those which complete objects or break tiles for instance. The mouse movements affect the orientation of the dots, grounding them within the same world. Hovering over a dot highlights the dot with a pulsing animation providing the player context as to where they are.

A3 . Gameplay Coherence:

All presented mechanics are valid within the realm of a match 3 game and link together well.

A4 . Feedback Coherence:

The audio and visual feedback on a successful match helps to highlight that the player has performed a positive action.

There is audio feedback on a failed move, which provides some information that the player did wrong, as well as a camera shake which emphasizes the action that was performed.

The feedback given for triggering a powerup is exactly the same as for a normal match, only the scale (number of dots affected) helps it feel any more powerful.

Completing a level is also somewhat unsatisfying with zero fanfare and audio cues for a major game event, but still, a victory screen, showing the player that they have indeed been successful.

#### Game State

##### B1 . Exaggerate:

Upon a match, there is a small but important visual animation which shows the dots disappearing. They also disintegrate to help emphasize their departure.

Upon a failed match, there is a rather loud noise to indicate failure, as well as somewhat excessive camera shake.

The player's mouse movements (a rather mundane action), are given too much visual importance as it affects the orientation of every dot on the level.

##### B2 . Focus of Attention:

The main elements which grab the player's attention are the hint display which provides visual feedback for a potential match.

The noise and camera shake from a wrong match do well to draw the player's attention to their negative action.

The way the dots rotate to face the player is rather disorienting and can detract the player's visual attention from other more important elements (such as the hint display)

The powerups are also given a level of visual importance through an animation showing their whereabouts and effect.

##### B3 . Highlighting:

The presence of audio cues throughout the main game is well balanced, however, the silence of the victory or failure screens feels strange in comparison.

##### B4 . Ambient Feedback:

There are two elements of feedback that exist without player input.

The first is the hint display marker. The second is the powerup indicator. They do not help the world appear more interactive, however.

#### Direct Feedback

##### C1 . Confirmatory:

There is a visual response to the player hovering over a button, showing that the button is interactable.

There is an audio response and visual darkening upon clicking a button, showing that the user has clicked it.

There are video and audio cues upon making a match, good or bad, showing the player the positive or negative effect of their action.

