Narrative Coherence in Games

An analysis of narrative interactive emergence in videogames

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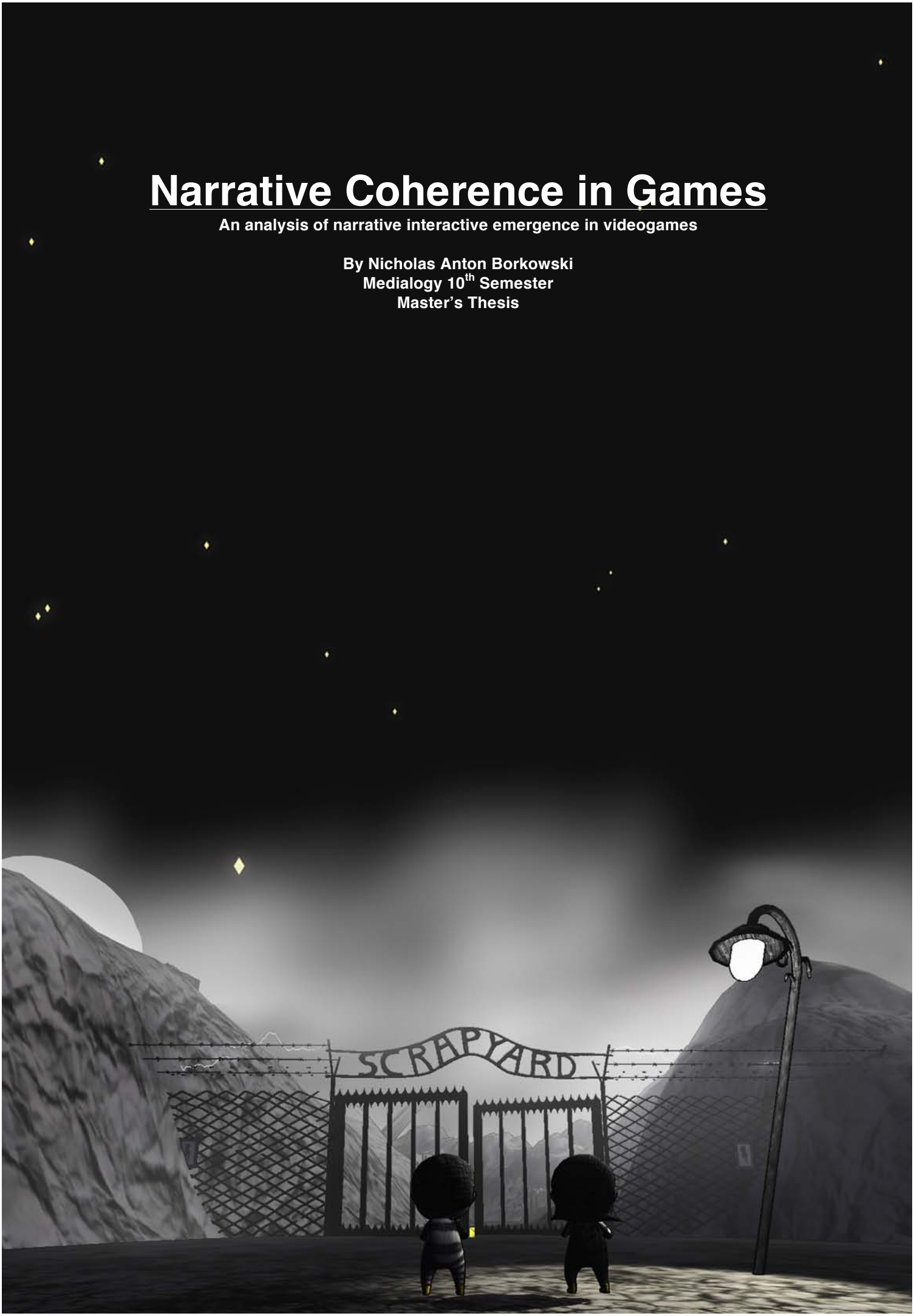

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1. Introduction

Recently, there have been some interesting trends within the commercial videogame industry that have caused discourse by both the consumer and developer communities respectively. These trends have to do with multimillion-dollar flops, independent crowd funded endeavors and the ease of digital distribution. Mobile devices in tandem with traditional interactive media consumption mediums like PCs and consoles have been undergoing the same renaissance focusing on successful titles with humble beginnings rather than those with gargantuan resources. Reminiscent to the New Hollywood era in film [8], focus has shifted from high cost low risk endeavors to low cost high risk gambles appealing to the volatile market of consumer gaming today [7]. This progression in the industry is awaiting new paradigms in order to force into place a respectable industry that differs greatly from that of film and other entertainment media where the game developer is at the center creating games and publishers cater to their needs rather than bankrupt their talents and blame them for the economic follies of work that was highly infected by outside influences [5]. While some attempt to push gaming into brave new worlds of immersive and physical systems (occulus rift[9], cryengine [10], leap motion[11], etc.) others are pushing traditional methods of gameplay off onto new tangents (Limbo[12], Braid[13], Superbrothers: Sword & sorcery[14], etc.). Arguments can be made in regard to why these smaller productions are relatively successful compared with big budget productions that push technological limitations. One may jump to the conclusion that such games provide enough of a satisfying experience (for a game) that their small price and simplified game play extends their value to par with that of an expensive, high budgeted and highly marketed videogame.

Though most interesting are the aspects of the lesser productions and what elements congregate in order to provide them with success. Videogames are a multifaceted media that have been theorized from different perspectives since their conception. There have been heated debates between entrenched narrotologists and ludologists that demand thorough definitions of all aspects of games and their experiences [1]. Whether games are fundamentally narratives or interactions is not nearly as intriguing as attempting to analyze the hybrid experience they provoke. The fact that there are those who so adamantly believe that there is any progression in understanding the media by narrowing the concise experience of play or gameplay by constricting the definition cheat themselves from understanding the intricate relation of narrative and interactivity that summate the gaming experience. Other definitions of the experience of playing video games can be shrouded by thesefragmented explanations of gameplay. This leaves room for the development of new theories and arguments in new directions taking into account more and more aspects of hybrid interactive media into their frameworks and definitions.
It is between the areas of already established scientific definition of game experience that there is room for further development of scientific analysis.

1.1 Weight of Narrative

Though most noteworthy are the narratives which they (games) communicate to the player, and the cognitive responses they provoke in the player. The interactivity available to the user is an integral part of the surrounding narrative and the two are intertwined at an undistinguishable level. User experience is established

by *both* semiotic relations (narrative & interactive) in order to distinguish a subjective affect. This however is not true for all games and all contexts. One is not necessarily emotionally taken with the narrative of *Tetris* [2], but perhaps *taken* with sweaty palms and exasperation when after a long period of gameplay the blocks pile to the top, resulting in a game over.

In the game *Bioshock Infinite*, reviewers and gamers alike have commented on the AI of the in game "companion" or "sidekick" Elizabeth which is an interactive helper throughout the game but also promotes the narrative [6]. This is done by allowing Elizabeth to interact with in-game objects, react to them, comment on them from her own character's point of view. Though lots of time and effort has gone into weighing the possibilities for her to investigate, in relation to importance and proximity, the player can nonchalantly choose to venture onward down passageways and through doors to progress the game unaware and indifferent to the narrative context that could be extracted by observing Elizabeth's observations of the game world. This is an integral part of the power of player interactivity in the game.
There are many possibilities to explore. While the developers after having worked on the Elizabeth AI, carefully planning weighted events and triggering animations and dialogs suitable to the situations and objects she encounters, wince and moan when a player tester decides to just *keep on trucking* past certain areas and never realizes the capabilities of the Elizabeth AI and ultimately missing out on the small bits of story that can be extracted from observing her character. This leads to the questions about weight of narrative in general in relation to interaction. The semiotic relations between the two, interactivity and the story that is being told on the side lines – throughout – and during the interactivity, is an area of interest.
These relations are present since videogames have always been considered a complete singular media unto itself. Ludologists have argued that games and narratives are distinctly separate from one another and should be treated as such in order to pursue a better understanding of the essence of games. This segregation is rational and useful when studying games. Though as a cultural phenomenon, videogames are perceived and marketed as consumable entertainment along the lines of literature and film.

1.2 Suitable material

A framework should be made and maintained throughout this research that depends on certain criteria, for characterizing both narrative and interactivity. Such criteria should exist within a single example narrative. This would allow for analysis of the particular narrative-structure and narrative elements within a game.
One exemplary game should also consist of a traditional level of interaction that is common if not standard in contemporary videogames. A prevalent narrative structure is also important as to allow for narrative analysis using contemporary methods. Therefore the elected videogame should reside on a traditional narrative such as a well-known fairy tale structure;

1. initial state of equilibrium (a description of the initial setting of the story)

2. disruption of the state of equilibrium (something bad happens)

3. mission of the hero (the hero tries to restore the state of equilibrium)

4. return to state of equilibrium (or not, if the hero fails) [19]

Furthermore, the example should have a well-known method of interaction, being real time interaction where player actions result in instantaneous feedback from an onscreen avatar [15]. This allows for a cognitive connection between the player and their on-screen avatar, an aesthetic sensation of control. Within instantaneous feedback, players are likely to identify with their avatar, in the same way car drivers insist that "He hit *me*" rather than "that car hit my car". The player can roam and move their avatar throughout the virtual world, as they like, yet only to be guided and constrained by the narrative. It is herein the object of interest resides. The specific relation between the interactivity and its surrounding narrative or, in other words the narrative and its surrounding interactivity, the reason for naming both prioritizations of the combination it to accentuate the possibility of different levels of weight in different games. Some games might lead on narrative rather than interactivity or vice versa. This is important to note since the combination of the two lead to the final experience the player receives.
The experience is of course developed and guided by an author with an intended level of *narrative intelligibility* and received by the player, leaving the player with some subjective form of narrative closure.
The implications of an area where the narrative and interactivity join is not so much an objective of this paper but rather an insinuation. That which is of greater interest is where such an area might be assumed to be and the existence of such areas outside of intended design.

The semiotic implications of the story world in which the user is immersed and what options the user is afforded, in regard to interacting with it, are also jointed in ways that can be addressed but not necessary easily defined. This lack of clarity is linked to the subjective understanding of the player, but also the myriad of choices afforded to the user by the game creator or "author".

Because of this level of abstraction within user experience in interactive worlds game designers do a balancing act, using rigorous user testing in order to find which elements are poignant in relation to the desired affect the designers had first envisioned, be it interactive possibilities or key points in narrative structure and story telling. Taking these thoughts into account the Action Puzzle game *Cantrip* will be used in this project.
Cantrip is a game that I helped develop together with a team during my 9th semester while enrolled in the DADIU program as a programmer. Having knowledge of *Cantrip*'s code, functionality, story and structure and having the possibility to manipulate these aspects of the game to suit possible testing criteria, *Cantrip* is a suitable game to study in this context. Furthermore it provides a very simple narrative fitting the aforementioned structure.

1. Two orphans (brother and sister) are collecting cans for deposit at a scrapyard.
2. The orphans meet a witch who kidnaps the sister and curses the boy.
3. The boy must traverse the scrap yard to save his sister from the witch and try to use his curse to his advantage.
4. After defeating the witch you are reunited with your sister.

The narrative is moderately provided by a voiceover describing the events that are happening to the main character, the orphan boy. The game is a puzzle adventure game. This entails that the story is told, thereafter the player must traverse certain obstacles/puzzles, and the next chapter of story telling is then experienced. The game mechanics along with how the mechanics relate to the narrative, mood, and aesthetic feel of the game will be examined in greater depth later in this paper.

This paper will focus on furthering the understanding of narratives and their intrinsic role in interactive games. The ways that narrative and interactivity align, and collide, will also be discussed. Semiotic congruence and narrative intelligibility are two key aspects that will be discussed and defined. This work will be in order to better understand the weight of narratives in interactive media and work towards the creation of a framework for fine-tuning narratives in games. The game *Cantrip* will be used for experimentation.

2. Preanalysis

In order to further understand the relation of interactivity and narrative in videogames some of the more obvious areas of theory will be explained and then further analyzed.

2.1 Narrative

Story telling is a vast part of human culture, it is how we document our history and learn from past mistakes. This has led narratives to become a field of humanistic study for many years. There are well known structures such has the hero's journey to describe many contemporary films we see today. This structure is of course an archetype derived from previous tendencies. According to Barthes narratives consist of *story* and *discourse* [17]. The story being the chronological path on which all events happen, while the discourse represents how this information is presented and what parts of the story are told. In essence there is a story and how it is told is the discourse. With this in mind one can interpret the interaction of a game as a part of the discourse of its narrative. The whole of the *story*, does not necessarily become part of the communicated *discourse* to the reader, interpreter, or player.

2.2 Interaction

Interaction is how multiple messages are answered simultaneously. Feedback must occur for interaction to exist. There is either one-way communication or multichannel communication. Interaction is defined on merriam-webster.com as "mutual or reciprocal action or influence". This definition implies two or more equal subjects. Yet when examining the interactivity found in videogames one can easily identify limitations in the player's capabilities. Though these capabilities are still methods of interaction within a designed system, it is important to note that interaction in games is dictated by outside criteria. In the case of videogames the designer of the game assesses the level of interaction in relation to the intended discourse.

In life, one may argue that interaction is decided by physics. For example a body builder would have an easier time 'interacting' with 200kg dumbbell than most others. But this principal, both physically and otherwise has been replicated in games. Experience points help a player excel through a game and unlock new possibilities to a player, just as learning to read or ride a bike unlock new possibilities in life.

"*While full interactivity is often considered an ideal type, toward which designers try to steer their systems, it may not be fully achievable by either mechanized or human participants. For full interactivity to occur, communication roles need to be interchangeable*"[18]

There are areas where communication roles are interchangeable. In MMORPGs (massively multiplayer online role-playing games) players create groups with assigned leaders but still are in a context of interactivity, which is the game they are playing. In videogames it seems that deciding upon a certain level of interactivity is a design choice.

2.3 Semiotics

The study of signs was theorized by Ferdinand de Saussure as signifier and signified. Where signifier is the *thing* and the signified is what you get out of the *thing*. A simplified computer science analogy would be that the signifier is the class and the signified are its attributes. The signifier is the sensual observation of the thing, its sight, smell, feel etc. While the signified is the representation of the idea of the thing; what it means to you. For example imagine a red apple. That apple is the signifier while everything it represents (red, sustenance, fruit) is the signified.
Using this theory all signs consist of these two parts.

Roland Barthes created denotative signs and connotative signs. Denotative signs are signifiers that lead directly to their signified, such as a word having a literal meaning. Connotative signs are signs that indirectly lead to a signified that is contextual or decided by culture. An example could be a green traffic light signaling 'go'. The important iteration from *signifier, signified* to *denotative, connotative* resides in the fact that they can be compounded. A photograph can *denote* something, while that something *connotes* something else [17].
Barthes introduces a new aspect of the signified signs it can connote. A chair signals that it is a chair, and also the obvious signified signs like *sitting down* or *relaxation* whereas if the chair were in a museum it would connote a more contextual message such as *design*. The green stoplight does not necessarily mean 'go'. That connotation is a cultural one.
This entails that the semiotic signals of narrative content can vary throughout an experience and must be supplemented with both relevant connotations in the narrative structure and signifiers must carry relevant signified in order to promote the author's desired interaction and understanding.

2.4 Measuring experience

In order to examine the relationship between narrative and interactivity and how the two connect and coexist in videogames it is important to first derive an area of interest. Within narratives and interactivity the user experience is the prime subject of examination. It is also highly prioritized in relation to the development and execution of game titles.
User experience has been mapped out using biometrics (Mcallister, Mirza-Babaei 2011) [20]. Charts representing the compound narrative-and-interactive experience is

drawn through using biometric analysis of galvanic skin response (GNR) and heart rate (HR). In correlation with qualitative analysis of the users' experience such as user drawn diagrams depicting their experience, this provides some information as to what happened during the play sessions both physically with the players and also their thoughts on both the experience and reflections on their physical behavior during the test. Though this was found to provide information useful to the "game producer", it does not provide a broader perspective in relation to the interdependency of narrative and the cognitive experiences acquired throughout gameplay.
In other research by Mcallister and Mirza-Babaei, tests of UX (user experience) consisting of GSR and HR are explored using two games. The game criteria being one game having a much higher *metacritic.com* score than the other. Both games were relatively new, on the same platform and shared the same genre (First Person Shooter). Their combination of biometric measurement and assessment of these measurements through post-test interview reviled details about events referred to as *micro-events* that were recorded using the GSR. In this way the interviews with the test users can be more punctuated by focusing on the parts of the experience where notable biometric events occur. This focuses the interview and reveals particular parts where excitement or frustration had occurred during gameplay. The biometric micro events give way to focus on the experience of several game aspects. These game aspects include cut scenes, weapons and game mechanics. The biometric events are used to gather constructive comments from the users about these aspects. The results reflect that user comments on biometric events were either due to excitement and enjoyment or frustration and confusion. It is established that GSR and HR can map out events that are useful for post-gameplay interviews. The interviews detail if the events are due to either positive or negative experiences. These biometric events point out areas of interest from a development standpoint, throughout gameplay [22].

In regard to the subjective interactive experience, Albæk & Baceviciute formulate a definition of *narrative intelligibility* as the user's ability to decode content encoded by the author, while *narrative closure*, in which the user generates her own understanding of the content independent of the intended understanding the author might have had, reflects the ulterior possibilities.
These definitions are important, since they take into account the author's intentions and also the intended level of intelligibility of the author's work (herein, *intelligibility* meaning level of desired intelligible narrative demeanor from a user standpoint). Perhaps a game can be confusing while playing it but afterwards there is a narrative closure that potentially brings just that, (closure) or satisfaction to the player?
Since the level of videogame narrative intelligibility may vary depending on genre, method or level of interaction and signaling, amount of intelligible or intrinsic story, etc. it is of interest to examine how a generally recognized narrative would fit into these areas of interest. In this case the game *Cantrip* is of use due to the fact that it holds a very traditional fairytale storyline.
It may not be possible to accurately measure an objective user experience, but it is possible to ask the user about their experience and measure phenomena during the experience itself. Since *Cantrip* is an action puzzle game, it is necessary to intrinsically learn some of the elements of the game in order to progress the narrative. This creates a relationship between the interactivity and the story and both supplement one another throughout the game. Whether or not one dominates the other in order to create an immersive effect is redundant, both the story and the interactivity rely on one another fundamentally, from the perspective the end user experience. It is

possible to tell the same story dramaturgically, without interactivity, just like it is possible to experience the puzzles, controls and game mechanics without a particular narrative structure. This leads to the questions of game, and play, their differentiation and core meaning. But the hybrid experience is that which is of interest from a narrative point of view. Is the narrative of *Cantrip* helped by the interactivity in any other way than allowing the progression of the narrative to happen? Is the interactivity only diluting the narrative and its intended message to the user from the author? Can a *flow* system [33] be reached through narrative enhancement rather than player feedback?

2.5 Project goal

Taking into account the above-mentioned topics the question that this project will attempt to answer is how can developers of interactive media take control of the user's experience of their narrative in relation to the degree of interaction that is afforded to the user? As mentioned before the degree of interaction greatly effects the amount of influence the user has on the narrative structure or at least their subjective interpretation of that structure. A framework must be created and tested in order to establish the relation between narrative structure and level of interactivity in interactive media. In order to test this framework the game *Cantrip* will be applied. *Cantrip* contains both a simple level of interactivity and a rigid narrative structure. The overall application of such a framework should be able to determine if and when throughout the gameplay of *Cantrip* there are limitations in either the narrative structure or the interactivity and how this affects the user. Furthermore, the framework should also establish how the interactivity and narrative of *Cantrip* complement one another. The framework should also explore the use of biometric event measurement to perform an analysis.

Being able to test games and monitor user play-tests are an important part of incremental game development. Although methods vary there is a particular focus on game mechanics and in-game events throughout the aforementioned literature. Examining these events from a more narrativistic point of view may give some insight not only to a collective summation of user experience, but also to the narrative structure's capabilities when attached to a certain level of interactivity.

3. Analysis

Having explained the ambitions of the project several more topics must be elaborated in order to create a framework for narratives and interaction in videogames. Throughout the analysis theories in narrative and interaction will be discussed and evaluated. The core aspects of videogames will be reiterated and used to determine a new path for theoretical expansion.

3.1 Game

Within the context of this project, the terms *game* and *videogame* will be used interchangeably. The difference is important to note when discussing their meaning, elements and the phenomena that is attached to their experiences. Clarification

between the two terms is important to distinguish since they can signify two very different constructs. A *videogame* is always a *game* but not all games are videogames. A videogame is a single instance of digital interactive media that holds elements found in games. Such as rules and goals. Throughout this paper videogames will be referred to when discussing ideas specific to games that fit within that category while games will be referred to when the discussion can be applied to a generalization of games. Such a generalization includes traditional sports, board games and videogames.

Games are ubiquitous and their definition and elemental structure are widely discussed. Games are not only a source of entertainment but can also be an integral part of consumer services or learning methods. Within this project the focus on games will be that of the entertainment form and not necessarily discuss the impact of gamification on different realms of human culture and everyday experience. In order to focus on the values of interactivity and narrative it must be considered that these two elements have a cultural value. It is equally important to discuss how these elements relate to one another and examine established theories in this field. Here it will be discussed what games can be and what games can be interpreted as.

3.2 Ludology

Within Ludology, the science that looks at games and play as two different aspects unbound by narrative, [3] there exists the notion of Ludus and Paidea. Ludus being a game experience, with rules and winning criteria while Paidea is play, the spontaneous act. Paidea is also mentioned to have the ability to become Ludus if the player applies rules etc. to their act of play.

Whereas it is not *difficult* to imagine these two experiences as separate it is not *easy* to imagine either coming into existence without a narrative being intrinsically applied by the player during the action [23]. Though this does not have to happen either for the game to be played or exist.

The notion of Ludus (playing within context of rules) and Paidea (play for it's own sake) may be used to determine how the same game is experienced within different contexts of play.
Narratives can also be added to play arbitrarily as part of one's own Paidea, one might intrinsically begin to apply a story to one's act of play. This also constitutes an act of play and does not necessarily undermine the playful act or change it onto something else than play. This is when considering a narrative construct of reality [23].
The Ludus Paidea duality is a helpful segregation of games since it insinuates that there is not a necessity for stories in games. This allows for other thoughts in regard to the relationship between interactivity and narrative. Ludology chooses to segregate the experiences by the notion that narratives and interactivity are borrowed against each other in order to provide the final experience. This is a dissection of games. Seeing narrative and interactivity as combatants fighting for the attention of the player provokes another analogy, that of being pulled in two different directions allowing yourself to be moved in a third direction. The third direction being the summation of the two influential tangents.

3.3 Flow

This coincides with the notion of flow in games. Flow is a concept created by psychologist Mihayli Csikszentmihalyi. It entails a space in which people enter when engaged where the amount of ability afforded to them is in balance with the amount of challenge demanded of them [26]. This area of engagement is called the flow zone and is thought of to be sought after when dealing with interactive experiences. Although later applied to games, the fundamental reason of establishment of the flow concept was constructed using working adults. What Csikszentmihalyi found was that interdependent of profession, people described their work as being a a "zone" where they felt content and challenged. This is what Csikszentmihalyi calls the flow zone and it exists in a state where a subject feel both challenged and able to continue.

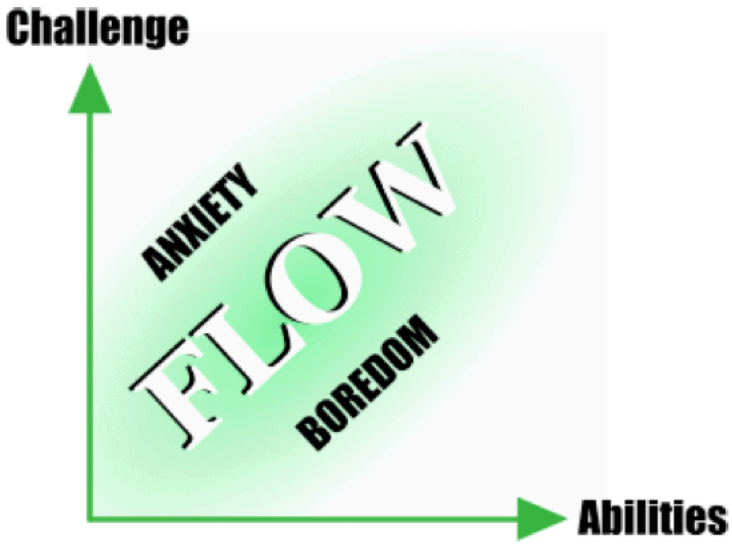


Figure 1 from Flow in Games, by Jenova Chen

3.4 Ludonarrative

Ludonarrative dissonance is when a player finds themselves conflicted in how they feel is the intended way they should act (intended interactivity) and how the narrative is communicated. If the narrative implies that the player should act in the opposite way than the interaction implicitly allows then this phenomenon can disorient the player and cause them to fall out of the game. The term is coined by game designer Clint Hocking and used to describe the game *Bioshock* (2007) (the first of the series). Hocking arguments how the storyline and ludic elements seem to work against each other. The dilemma lies in with characters called Little Sisters. The player can either choose to kill these Little Sisters and become more powerful, a tactic that is basically fundamental to the first person genre according to Hocking, or save them in exchange for a lesser reward [27].

The premise of this term is interesting because Hocking insinuates that the narrative and ludic elements must not conflict in order to secure a pleasurable experience. Though this analysis consists of a very personal view with many disclaimers in regard to Hocking's personal understanding of the game the basic rationale of the term

stands out. If the elements of the story and the elements of the interactivity contradict one another, even indirectly, then it may lead to an undesired state for the player. This term may also play a part in narrative coherence.

3.5 Emergent Narrative

Emergent narrative is a concept of allowing a player to have an influence on the unraveling linear narrative. Having a narrative partially dictated by the player allows for authors (game designers) to react to the actions of the player and attenuate or expand different aspects of the narrative experience to better suite the situation of the player. This can be seen in different games such as table top RPGs such as *Dungeons and Dragons*, where the 'dungeon master' dictates the story of the game while it goes on, having time to react to the actions of the other players. The game Left 4 Dead includes a system that analyses the prior actions of the player in order to orchestrate events suitable to their particular actions. These games however are not interactive-narratives. They still have a structure decided by an author that cannot be deviated from. Having player action influence the narrative is far different than having an *interactive-narrative* in the sense that a player can determine, not just by intended interaction, the narrative structure and events of the experience [17].

Emergence is part of what makes videogames a different medium than literature or film. An example of *emergent gameplay* is when a player finds a solution to a challenge other than that intended by the designer. If a player decides to dictate a new narrative goal within a game world, then they create their own *narrative closure.* This allows the experience of the narrative to take an insurmountable number of tangents within the scope of the afforded interactivity.
Because of this it is easy to postulate that videogames have over the years justified their narrative paths by including a heightened value of interactivity throughout their linear narrative structure. Tendencies such as acquiring more points to progress exemplified many times over in linear gameplay is a trusted standard in traditional modern video games. These acquisitions are seen across genre and game type; acquiring better weapons to tackle larger enemies, acquiring items that unlock new locations in order to progress, gaining access to areas in which new items reside. These examples all influence the predetermined level of interactivity created by the author and experienced by the player.

If interactive capability were to depend greatly on the eye of the beholder and narrative structure is superseded by this capability, the player must be fed more interactive capability throughout a game in order to adhere the narrative structure intended by the author.
This is of course a postulation that cannot be applied to all videogames, but is a way to view a tendency in narratively traditional gameplay. Progression can, but is not limited to, affording interactive capability and that capability-progression is tied to the narrative structure designed by the author.

If that heightened interactivity afforded to the user is then used as intended, realized and fully taken advantage of, is up to the player (*narrative closure*). Though an author will likely implement instructions in order for the player to realize the potential of the newly afforded capabilities (*narrative intelligibility*).
This perspective allows for narrative and interactivity to be placed within the same

realm. Considering this hypothesis, a narrative structure has an interactive slope that follows it. As the narrative progresses, the interactive slope is intrinsically climbing not only because of possible, intended, extensions provided by design, but also by the player continued interaction alone. The continued interaction affords the player more experience with the available interactivity, essentially teaching the player the limitations of the videogame and how best to utilize the possibilities afforded. This furthers the player's understanding and *interactive-closure*.
In this sense, *interactive closure* would be the parallel to narrative closure. Likewise *interactive intelligibility* could be considered and expanded upon.

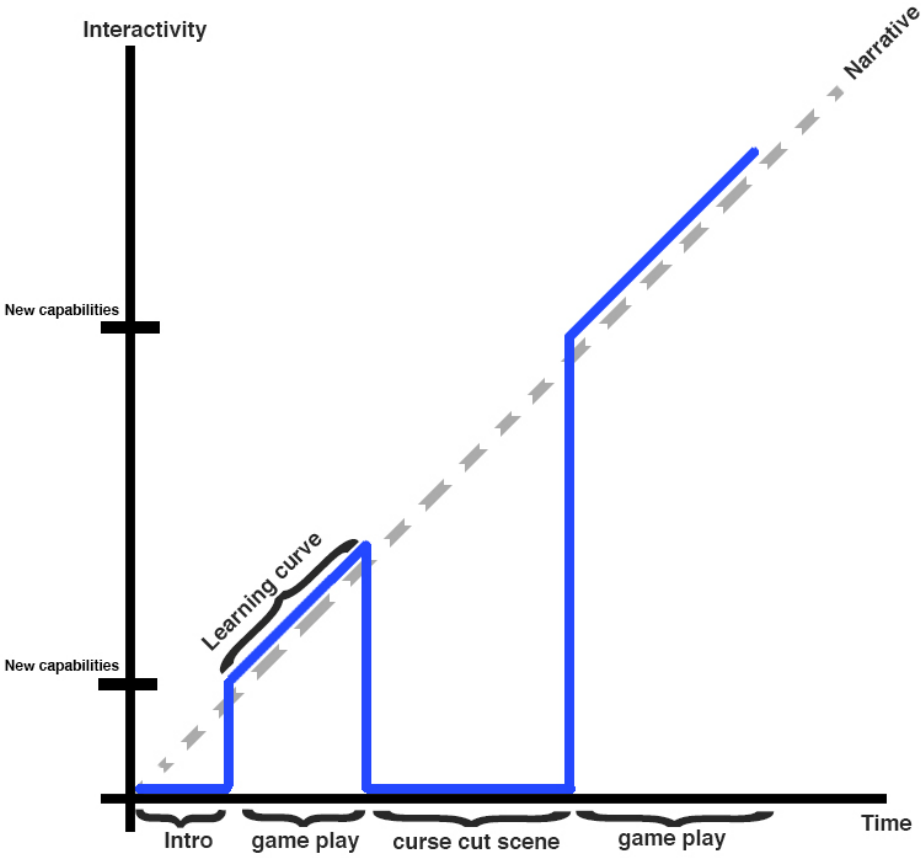


Figure 2: Interactive capability over time in the videogame *Cantrip*.

In the above figure 2, the blue line signifies the interactive capability of the player throughout the first level of gameplay of the game *Cantrip*. This Y-axis of interactivity over time is heightened by the intended allowance of interaction by the game's author. After the introduction cut scene, the player is allowed to move their avatar within the game world and by doing so they partake on an experience of learning the extent of their interaction with the game world. This is the reason for the interaction being heightened as the player progresses along the narrative path.
When the player meets the witch in the scrapyard who kidnaps their sister and places a magnetic curse on the player the interactivity is again zero due to the cut scene taking over the previously afforded controls.
This cut scene can be skipped, but for the sake of simplification, that interactive option is not represented on this graph. Just as the player has the interactive capability to turn off the game all together, or pause the game, these interactions have little to do with the intended narrative.

After being cursed, the player has been afforded a new game mechanic, the magnetic power of attracting and dispelling material within the game world. This is an addition to the previously afforded interaction and therefore the graph again gains interactive traction, following the course of the narrative.

Emergence is one of the key factors that exist within games. Whether within narrative or gameplay it is an imperative to videogame experience. A development or evolution must occur, whether that be a high score, a skillset (for the player or for the in-game avatar) or character development within a narrative.

3.6 Narrative Intelligibility

In order to further theorize interaction and the ways it can relate to narrative intelligibility lets revisit the theory of narrative intelligibility. Looking at the predetermined theories of narrative and its relation to human culture and behavior Albæk & Baceviciute note that the traditional ubiquitous understanding of narratives, together with the concerns in the form of all media having necessary relative narrative qualities to literature, in order to perpetuate the certain narrative theories, leaves room to expand on narrative understanding in order to encompass newer media [26]. While the subject of interest in this their work is Digital Interactive Immersive Representational Technology (DIIRT) these systems "inherit" narrative structure and connotations from older and more established media such as literature and classical art. This allows for the classification of narrative to be anything that "[…] evokes stories in the mind of the spectator." [26 p.15]. This leads to the segregation of possessing *narrativity* and possessing *narrative*. Where narrative is an intended story while narrativity is a connotation of a story with no particular intention attached.

While the notion of narrative intelligibility arises when looking at videogame and virtual world scenarios it is still formed in the context of a message rather than an experience. The *narrative intelligibility* arising when the intended message is decoded properly by a user according to the author while *narrative closure* entails that the message is not necessarily decoded in the way the author sees fit, but rather in a purely subjective manner created by the user. *Narrative closure* is, although subjective and void of potential scrutiny by the author, an unavoidable part of the process whereas *narrative intelligibility* can be discussed in a more tangible way. Does a certain videogame possess narrative intelligibility? And to what degree? If a box of Legos has an instruction booklet then it possess intelligible narrative intent by the author. Whereas if the booklet is not present there is still nothing stopping the user from gaining some narrative closure from whatever structure then would like to partake in building using the Legos. The Legos alone would possess narrativity yet only with the booklet would they have an intended story.

One could argue that the aforementioned notion of emergent gameplay, finding new ulterior motives or uses for functionality in a videogame that the author had not foreseen, amounts to *narrative closure* for the player but not necessarily dictates a lack of narrative intelligibility. Because of the vast complexities and possibilities available in videogames it is impossible to rationally argue if narrative intelligibility leads to a "good" or "successful" videogame. It seems rather that a videogame can contain high or low levels of both (narrative closure and narrative intelligibility, respectively) independent of one another. For example, the award winning game Minecraft might not have narrative intelligibility but provides the player with an

insurmountable level of narrative closure. Though Minecraft can still be analyzed using the above chart (figure 1) due to the constant affordance of interactive capability because of discovering capability over time along with the user's learning curve (the more time they spend playing the better their grasp of the controls).

Adding values to the terms *narrative intelligibility* and *narrative closure* is also an impossible feat. This is due to the fact that the level of abstraction chosen by the author of a videogame can be so diverse that it does not have to follow in the footsteps of non-interactive media. If it is the author's intention to provide a world with unlimited possibilities and the player discovers this aspect of that world, it can be argued that the player has then understood the intended message the author wished to convey. This would mean that the videogame in question possesses narrative intelligibility.

"[…]*it becomes clear that the notion of interactivity does not impose the directionality of narrative communication per se, but it is the extent to which freedom is granted to the user that defines whether the communication pattern is unidirectional or bidirectional."*[24 page 24]

It seems that the outcome of the user experience may depend on the relation between the two narrative aspects. *Narrative closure* and *intelligibility* seem to fill in for the possession of *narrative* and *narrativity* within videogames. Using these terms can also be daunting since they cannot be applied readily to all videogames in the same manner. *Cantrip* is a story driven game where narrative elements are established and relatable to none interactive media. This is due to the intent of the authors. While the videogame *Minecraft* may not include many of the same narrative elements it can still be established that both games posses narrative intelligibility and provide narrative closure to the player. Though the author's intended abstraction from traditional narrative within *Minecraft* promotes the player to focus more on their own narrative closure while intrinsically understanding the intelligibility of the game design (herein the possibilities available to you as a player).

It should be noted that the narrative of *Minecraft* is very much up for debate and has not been analyzed thoroughly in relation to this paper. Here it is solely used to argument that videogames differ in goal oriented structure and progression. In *Minecraft* you follow the narrative of your own interaction. Over time the amount of interactivity rises through experience and new affordances. What you then do with the capabilities within *Minecraft* is entirely up to you, while in *Cantrip* every new affordance is intended to further enable you to get the boy to save his sister.

Both games possess narrative intelligibility due to the fact that they can communicate the author's intent successfully to the player. Narrative closure on the other hand can be achieved through one path within *Cantrip* and many paths within *Minecraft*. In *Cantrip*, narrative closure comes from defeating the witch, saving your sister and winning the game. In *Minecraft* the player decides if they want to build a castle or make a farm or try to forge the best tools for mining.

3.7 Narrative Coherence

Focusing on the relation between narrative closure and narrative intelligibility I would like to propose a hybrid of the two, *narrative coherence*. Because of the level of narrative abstraction away from none interactive media that videogames are capable of, there is need for a singular plane on which interactivity and narrative reside. The intended message of the author does not have to be in a narrative structure recognizable from non-interactive media, but must communicate the necessary level of interaction to the player and provide either room for narrative closure, or guidance towards interactive evolution throughout gameplay.

The definition of narrative coherence is within the above chart (figure 2). To what extent the interactivity and narrative are aligned with one another on an outward path. The narrative in this sense is either intelligible by authorial design or subjective closure. The interaction is bound by the same guidelines, either consisting of intended design or emergent gameplay.

The combination of the interactive capabilities whether intended or not by the author, and the narrativity whether intended or not by the author, can output four different scenarios and uphold narrative coherence.

1. Intended narrative, intended interactivity
2. Intended narrative, unintended interactivity
3. Unintended narrative, intended interactivity
4. Unintended narrative, unintended interactivity

These four scenarios are structures by which a player can interact with an interactive videogame and possibly still uphold the desired levels of challenge and ability to necessitate flow.

3.8 Cognitive Closure

These assessments of the diversity of structure available in videogames in regard to narrative and interactivity leave questions in regard to how players mentally assess the messages provided by videogames. The cognitive processes that occur during gameplay rely greatly on the subjective understanding of the player.
The mental processes that occur when the mind is exposed to information and the methods by which the mind digests this information is of great interest when attempting to understand narratives, their structures and their role in games. From Merriam Webster's dictionary cognition is defined as: Cognitive mental processes or a product of these processes [25].
These processes have been examined by Choi et al. into a term applied to consumer habits examining the need for cognitive closure. This need, although approached from a product-marketing point of view, is applicable to the context of videogames. This is due to the theories presented take into account the understanding that this need varies greatly in consumers. The basic search strategy can be related to an interactive narrative. For example lets imagine in a game there are three roads the player can explore. Will the player go halfway down all the roads before deciding which to take all the way, or will they decide to walk all the way down one road from the beginning? Alternative based search (one path at a time) and attribute based search (equal exploration of all paths) are the two segregations [16].

This need can correspond to interactive capability and narrative story independently. Players can choose to explore the narrative elements or interactive capabilities afforded to them based on their own mood or by the connotations afforded to them by the game design.

Throughout the analysis the basic principals of narrative communication have been presented and built upon taking interactive capability into consideration. Flow and narrative intelligibility have been discussed and the concept of narrative coherence has been established. Cognitive closure has also been mentioned alluding to the individuality of videogame players and their unforeseeable habits and desires.
It is now of interest to create a framework wherein narrative coherence can be determined within the game *Cantrip*. By attempting to apply the theory to *Cantrip'*s interactive and narrative elements, assessment of areas possibly containing weakness or strength in coherence may be established.

4. Implementation

Having access to the source code and assets of *Cantrip* videogame it is possible to manipulate the game so that possible test criteria may be taken into account. Besides adhering to a fairy tale narrative structure, *Cantrip* relies on in game cut scenes and a non-diegetic narrator to inform the player of important points in the story. These are the elements that currently push the narrative onto the player besides the connotations of sounds and visual aspects of the game, these are the only two intrusive aspects that exist solely to fulfill narrative gaps that a player may or may not have acquired otherwise. Furthermore, there are sound effects that are meant to "reward" the player, for solving a puzzle situation or progressing past a certain point. These non-diegetic elements also help the player understand and progress the interactive capability of the game.
For example, in the beginning of the game the narrator states that the children enter the scrapyard, this does not happen and the control of the children is then relinquished to the player. Lets stop here and take into account the four scenarios of narrative coherence. It seems that the only scenario available to the player is the first.

1. Walk into the scrapyard.

The player utilizes their interactive capability in the intended manner in order to submit to the intended narrative. This scenario seems like a stringent linear narrative. The only other outcome for the player would be to walk into the electric fence, rather than through the gates of the scrapyard. This would align with the third scenario of narrative coherence.

3. Walk into the electric fence.

Namely, unintended narrative, intended interactivity. This is due to the fact that the narrative path requires the player to enter the scrapyard while the interaction allows for an alternative outcome.

These are the only two scenarios available at this point in the game. In review,

unintended interactivity is used to describe a method of interactive capability that in unintentional by design. So if it were possible for the player to climb the hill to the left of the scrapyard entrance, it would be possible for the player to engage in the 4th scenario of narrative coherence. Perhaps if climbing the hill entailed pounding the jump button down in succession, while holding down the forward movement button, and traversing the hill took more than a minute, the player would realize that hill climbing was not necessarily the intended interactivity of the game. This however would not necessarily make the player stop their attempt, nor fall out of flow.

The second scenario would be the least likely to occur at this stage in the game (intended narrative, unintended interactivity). This is due to the low amount of experience the player may have during this time in the game as well as the capability afforded to the player at this time. Neither capability nor experience has matured enough for there to be a way for the player to continue the narrative path using affordances in an unintentional manner.

Perhaps conducting such investigations at pivotal points throughout the game may reveal constrictions or expansions of narrative coherence. In collaboration with user testing these points could be more closely examined.

4.1 Analysis of Cantrip

Cantrip is an action adventure platform game. The game contains three levels in which you play a boy that must save his sister from an evil witch.

Storyline

In the beginning of the game you and your sister are in front of a scrap yard. You are hungry orphans looking for collectable cans that you can exchange for deposit so that you can buy food. You enter the scrapyard which the narrator exclaims "..looks like a dangerous place". You are accompanied by your sister, who is a non-player character that is humming a tune. After traversing the scrap yard you encounter an "old bag lady" that turns out to be a witch. The witch accuses you of stealing cans the rightfully belong to her and hastily kidnaps your sister and puts a curse on you. Because of your label as a thief, the witch gives you a curse that suits your crime. The curse is that all metal objects will stick to you. Once the witch has disappeared deeper into the scrapyard with your sister. The boy must try to save his sister by following a trail of cans that the sister has left behind.
Throughout the game you must use the boy's curse to your advantage, carrying metal objects to and fro in order to set off pressure switches, kill guard dogs, avoid dangerous metal objects and use magnetic cranes to transport you from A to B. Along the way there are relics from a forgotten past littered around the scrap yard and dangerous machines that must be avoided. Eventually after traversing the scrap yard the recognizable humming of your sister becomes audible and you know you are close to your goal. Once you find the witches house, you see that it is entirely made up of cans. You use your curse to destroy the house and caste the witch into a fiery pit, saving your sister.

Game mechanics

During the introduction of the first level, you play an un-cursed boy. The only interaction available to you at this point is movement and collecting the cans around you that eventually lead to the witch, where she curses you. Once cursed you have achieved the main game mechanic of the game, magnetism. By pressing the left mouse button the player is able to dispel the curse for a limited amount of time. This means that once the left mouse button is pressed, all metal objects attached to the boy's body will go flying away from the boy.
When the boy "demagnetizes" he is able to avoid potentially dangerous objects flying towards him, such as saw blades and scissors. All metal objects glow with a recognizable shadow indicating that they will fly towards the player when the player gets close. If the player is very close to the objects they will begin to make a rustling noise indicating that their flight towards the magnetic boy is imminent. Some metal objects are larger and therefore require a prerequisite amount of mass before they can be influenced by the boy. This means that in order to activate a particularly heavy switch the boy must first gather lots of small metal pieces, slowing him down, before larger metal objects will react (such as a refrigerator).

Gameplay structure

During gameplay there are several different elements that help progress the game's narrative and force the player to use their acquired capabilities. After acquiring the magnetism curse the boy is sucked onto a magnetic crane. This forces the player to use their demagnetization power in order to free themselves from the magnetic grip of the crane. This is also the only time where the non diegetic narrator breaks the fourth wall by instructing the player to "press the left mouse button" if the player is stuck on the crane for a prolonged period of time.
The enemies throughout the game are guard dogs. The player must be quick to get past them so they add a sense of urgency to the player and also a good reason to use you demagnetization power, so that all the metal will fall off you and your speed will be unhindered by the burden of carrying metal around with you.
There are switches on the ground that act as pressure plates. These switches activate different things and require different weights to do so. There is a sign on a pole next to each switch that indicates the minimum weight necessary to activate the switch. In order to get past the first level of the game the player must activate such a switch that requires a heavy weight and then dispel their metal weight in order to get through a door way in time.
Furthermore there are heavy metal objects in place hindering the completion of the level. This creates a situation where it is necessary for the player to learn that a larger metal mass is required of the player before these large metal objects can be moved.

4.2 EEG

As seen in previous work [22],[29], biometric analysis of test participants playing videogames can provide useful data regarding user experience. Different biometric measurement and analysis have been used in the past to assess and record test participant reaction to videogames and interactive systems [20].

Electroencephalography (EEG) is a source of biometric feedback that has been discussed to some extent as a possible accomplice to galvanic skin response (GSR) and Facial electromyography (EMG) [28] [29]. The field of EEG analysis is common in the study of epilepsy and seizures [31]. Without exposing the full medical potential of EEG analysis the basic background of the field will be presented here along with the possible applications using obtainable hardware and software.

What are EEG signals

In the human brain lie the controls for the nervous system. These controls are managed by neurons (nerve cells) that are able to send signals throughout your body. Because of this there are constant measurable electrical signals happening in your brain. The amplitude and frequency of the brain waves varies depending on the actions of the subject.

The human brain consists (conservatively) of four lobes, the frontal lobe, parietal lobe, occipital lobe and the temporal lobe. Different sections of the brain perform different processes within the body. The frontal lobe is associated with attention and planning. The parietal lobe is associated with special understanding, the occipital lobe processes visual sense and the temporal lobe has to do with functions associated with smell, sound and complex stimuli, such as recognizing faces [31].

There is a standard practice involved with the placement of EEG sensors on the scalp to ensure that experiments can be recreated accurately. This method of sensor placement is called the 10-20 set up. The name refers to the distance between the placement of the sensors. Each sensor will have a distance of 10% or 20% of the length of the skull of the subject measured from the bridge of the nose to the center of the back of the skull. Each sensor has a specific name that is representational of the area of the brain over which it resides.

F = frontal
Fp = frontopolar
T = temporal
C = central
P = parietal
O = occipital
A = auricular (ear electrode).

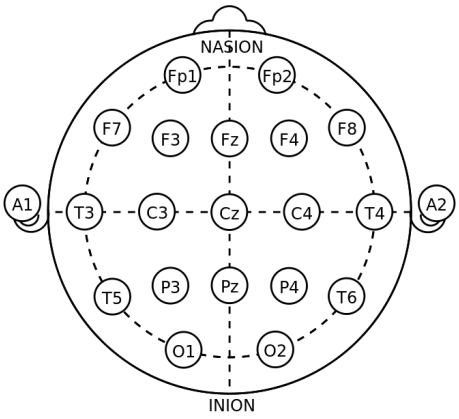


Figure 2 10-20 EEG sensor placement. [32]

Wave length differentiation

Delta, Theta, Alpha, Beta, Gamma waves make up the spectrum of brain

waves most commonly referred to. Beginning with Delta waves, which are waves present in very deep, or dreamless, sleep. They are represented by waves at frequencies from 0.1 to 3.9 Hz.
Theta waves are mostly present during REM sleep and meditation and have been associated with learning and memory. Frequencies from 4.0 to 7.9Hz are considered Theta waves.
Alpha waves from 8.0 to 13.9 Hz represent relaxed and reflective states while Beta waves are associated with alertness and concentration are from 14 Hz to 30 hz.
Gamma waves represent 30 Hz and above and do not necessarily reflect normal brain functions to a degree which deems them necessary to further analyses within the scope of this document [30].

Previous, and possible applications

Based on previous model [29] of flow, boredom, emersion and wave pattern mapping, in which researchers Nacke and Lindley conducted an experiment using modifications to the first person shooter game Half Life 2, it is interesting to expand on that approach. Using *Cantrip* as a constant, psychophysiology that represent certain areas or experiences of the game. Though as noted by Nacke and Lindley that a *"cross-correlation of all measurements is fundamental to discover the emotional meaning of different patterns in the responses."* [29].

An EEG signal is basically a change in voltage over time. Usually one can measure events using ERPs "event related potentials".

Diegesis

Depending on if elements of a game are located within the world of the game itself they are considered diegetic elements. The narrator in Cantrip is non-diegetic.
It is of interest to determine if the non-diegetic elements provoke certain behavior while playing Cantrip and if these non-diegetic elements may influence the narrative coherence of certain key scenes, or areas.

5. Pilot Test

In accordance with the findings from the analysis a test will be conducted in order to further investigate certain aspects of the *Cantrip* game. In particular the non-diegetic aspect of the narrative voice over and how players respond to it while experiencing the game. This test will use an Emotiv Epoc EEG reader in order to record EEG signals from the player during gameplay. These EEG readings will be studied for particular events or peaks and it will be determined if the events can be correlated to specific events during gameplay using player feedback. The gameplay will be recorded so that the EEG signals can be compared side by side.

Design:
The test should assess the non-diegetic element of the narration during gameplay. The EEG readings in comparison with the gameplay video recordings and questionnaire answers will correlate an opinion of the non-diegetic responses of the narration to the player's actions. This will be done by recording EEG signal from the

test participant using the Emotiv Epoc hardware and the Mind Work Station software.

Procedure:

A test subject will be asked to sit in front of a computer and place the Emotiv Epoc device on their head. The subject will then be instructed to play *Cantrip* for a 10 minute period of time. During this time the Emotiv Epoc device will be recording EEG signals from the subject and the on screen gameplay will be recorded in order to document the subject's actions within the game. During gameplay observational notes will be taken of the subject's actions both physically and in the game. After the 10 minute period of gameplay the subject will be asked to stop playing and the EEG recording will be stopped as well. The subject will then be asked to fill out a questionnaire about their experience during gameplay. This questionnaire includes several questions about the state of the narrative during their experience and also questions with written answers regarding their personal thoughts on the experience.

Execution:

The execution of the test proved time consuming mostly due to poor EEG signals picked up from the Emotic Epoc device. The signals varied throughout the test and also differed in strength from subject to subject. This is partly due to poor conduction of the electrodes and varying hair lengths of the subjects. It was common that subjects with longer hair would have difficulties getting the electrodes close enough to their scalp in order to obtain a suitable signal. This problem was solved for the most part by wetting the hair of the subject in order to allow for more conduction and better signal strength. Furthermore there were only 10 test participants recorded.

6. Results

The following will first be the scaled results of the likert scale question presented as averages. Then an analysis of the qualitative answers will be presented. Thereafter a discussion of biases shortcoming and issues will be presented.

The narration during the game was important.
Average answer 3.7 out of 5.0
The narration was very informative throughout the gameplay.
Average answer 3.4 out of 5.0
The narration was unnecessary for me to progress throughout the game.
Average answer 2.8 out of 5.0
The narration was unnecessary for me to understand the game.
Average answer 2.5 out of 5.0

The narration helped me progress throughout the game.
Average answer 3.4 out of 5.0
The narration was vital to understanding the story in the game.
Average answer 4.7 out of 5.0
The narration helped me understand the player controls.
Average answer 3.0 out of 5.0

Qualitative question review.

What information did the narrator inform you of during gameplay?

find sister

why i need to go on and what the whole thing was about

The skills, task and story throughout the game

General story line.
Important things your char. could use. e.g demagnetize.

Gave the information of how to use the powers boy had.

He told me to what my goals where - and told me the story at the same time. Also what I could die from

The storyline of the game. The reason

The narrator told me that I was a boy in a junkyard who had to save my sister from an evil witch, who was angry with me and my sister because we had taken some cans from her shopping cart. The witch then kidnapped my sister and laid a curse upon me where all metal objects, would suddenly be attracted to me. I guess I became some sort of magnet boy.

Setting up (adding) a story context outside of/on top of the gameplay as such, and offered cues as to the core gameplay mechanic (magnetization/demagnetization).

There were two orphans and their livelihood depended on picking up scrap metal; one day they reached a scrapyard and started collecting empty cans there

All answers refer to the receiving of practical information either concerning the story or the reasons for continuing the game and thereby information regarding how to progress or interact. This correlates with the theory that the story supports the intended interactivity and guides the player towards the intended narrative.

When did you feel most in control of the game?

while antimagnetizing the boy

while being magnetized and able to control that

In the end after getting familiar with the controls

After the witch took the girl, and you became a magnet.

The moment boy was cursed by the witch.

When I have learned all its functionalities

Never. There was continuous learning curve throughout the game (or at least throughout the part of the game I managet to get).

I felt most in control when I didn't have to try to kill the dogs, I had some difficulties getting that to work and it was a bit frustrating.

When I reached the first sign posts with indications of the weight required to trigger the pressure plates; that's when I first found a way to concretely use my ability to demagnetize myself (other than to lose weight to be able to run faster past the dogs), which was to spread the metal objects out in a way that enabled me to gather the correct amount of objects needed to trigger the pressure plate.

At the last bit, after electrocuting the little boy twice

All answers refer to late in the experience and concern using the magnetism game mechanic or that their feeling of control was at its utmost at the end of the experience, this collates with the assumption of a constant learning curve and the heightened form of ability as the challenges of the game progress.

When did you feel you understood the capabilities of your character within the game?

after I picked the first can

as soon as i hit the left mouse button

just after they were explained by the narrator

Same as above. After you became a magnet, and with the ability to de-magnetice.

At the point when I had to have exact weight on the boy to lift the container with magnet.

Instantly - I mean it didn´t take me long

When I managed to kill a dog using the scrap metal when demagnetizing the character.

It was pretty straight forward from the narration that I was able to attract the cans. Being well versed in video games in general it was intuitive to use the standard WASD control option and then click the left mouse button to interact/attack, so I understood the capabilities from the start.

As stated above, it was the sign posts with indications of the required weight - this deepened my understanding of how and in what ways my capabilities were going to be used/challenged by the game.

About midway, but I am not sure I managed to explore all of their amazing powers

Here the answers begin to merge between interactive affordances and narrative cues. Two test subjects responded that their understanding was first solidified when underlined by the narrator, five refer directly to a point during gameplay where they discovered a game aspect earlier unfamiliar to them. Most answers include a description of the subjects understanding of the main game mechanic, the magnetism. This game mechanic was first available to player's after varying amount of time (because of the amount of time spent playing before meeting the witch and becoming cursed).

What was your character capable of during gameplay?

picknig, jumping, walking

magneto powers: lifting, killing, conquering

he was magnetic. but also had the ability to turn of the magnetic capability

normal controls (inc. jump). Draw metal to you, and de-magnetice.

Atracting metal things like a magnet, he could also demagnetize himself to release things he had on himself.

He is a magnet so he could discarge as long as i kept the button down.

Collecting cans, attract metal objects, use crane magnets to cross obsticles.

Attracting metal objects, disengaging the magnetism super power to launch attracted objects away, getting pulled up by magnets and nullify said magnets by disengaging the magnetism, killing dogs by launching attracted metal objects at them, moving heavy refridgerators slowly, and also activating buttons by carrying enough metal objects and in turn open new passageways.

Aside from the standard running and jumping, the ability to temporarily override my character's magneticality (this is now a word) offered ways to shed weight to better escape dangers, to be deliberate in how much I weighed (see; pressure plates), and to use the large, moving magnets as means of transportation (demagnetize when you want to get off of it). I didn't get very far in the game, so these are just the capabilities/uses I discovered before the test ended.

walking back and forth, picking up cans and making feeble little jumps

This question is asked in relation to how far the test subjects progressed throughout the game. It can be compared to the video footage of their gameplay and be assessed how much of the game they have actually experienced. It seems that all but one (participant 10) of the subjects mention the magnetic capability in some sense.

Please list the elements were displayed on the H.U.D. (heads up display) during gameplay?

cans, caves, cars

magnetic power
current weight
(health)

weight, health and a third one

On top, a bar showing for how long you could de-magnetice.
Below that, how much metal you could carry, in 3 steps.
And health if you took damage.

Demagnetization bar, to see how long it could last. Bar for indicating weight according to how much stuff boy had on him. Health bar if boy would get hit.

Jeg kan ikke forstå hvad det er - og det er ikke noget jeg kan huske [translation: “I cannot understand what it is – og it is not something I can remember”]

Lifebar, demagnetizing bar, carring weight bar, framerate,

health bar
level of weight
magnet power bar
frame rate

Health meter, weight meter, "concentration"/demagnetization meter (indicating how for how long I could keep the magnetization turned off)

Some numbers?

The answers provided indicate that some of the subjects were not familiar with the term *heads up display*. Although 7 test subjects answered correctly and had understood what all three elements expressed were meant to communicate. This is an important factor since is indicates how the understanding of the interactive elements of the game are represented as different values. These values feedback the consequences of the subject’s interaction with the game to the subject.

Comments:

very sensitive mouse control (disorienting)

-

Interesting concept with the curse of attracting metal, and being able to de-magnetice for some time.

-

Meget nice [translation: “Very nice”]

-

-

It was a little unclear to me where I was supposed to be going, and I was a bit unsure how to kill the dogs efficiently.

The game has fun riddle/problem solving mechanics :) With regards to my disagreement with the statement "The narration helped me understand the player controls" what I mean is, the narration only stated that I my character could "concentrate" to temporarily turn off magnetization, and I understood what I needed to do to do that (left mouse button), but only because I checked out the "controls" menu before playing the game, which stated something to the effect of "left mouse button: turn off magnetization". The control scheme as such was intuitive, as it followed an established "WASD space and left click" tradition, but the narration didn't directly address this, only hinted at the demagnetization capability. When the controls are as intuitive as they are (to an "experienced" gamer in the Western gaming tradition, at least), this isn't really a problem, and allows the narrator to stay "in fiction", as he does, instead of addressing the player with statements like "press P to pause" or whatever.

by the end of the game I felt more and more compelled to fry the orphans on the electric

wire as it felt more entertaining than watching them picking up their silly cans

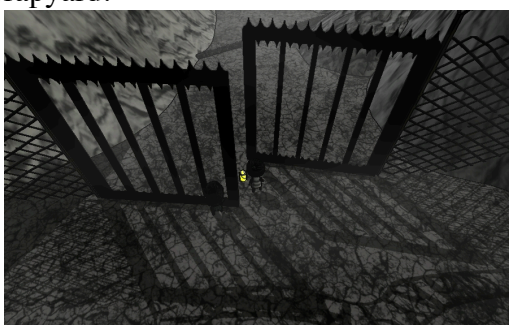
The concerns of the 9th test participant are interesting due to the fact that the narrators comment on concentration could easily been affiliated with the test subject's wearing of the Emotiv Epoc device. This aspect could have been misinterpreted at a control mechanism which is possible for the Emotiv to do, after recording basic commands from a specific user these commands can be mapped to. Also the lack of specific instruction in regard to the control mapping of the game is apparent. Each test subject was told to use WASD buttons on the keyboard to move and the mouse to look around. Other information was available from the pause menu, which they were not able to access without asking the test supervisor. This happened several times due to mouse sensitivity (as mentioned by subject 1).

EEG and video result analysis

The Mind Work Station software has been setup to record signal from the different sensors of the Emotiv Epoc from amplitudes from 8 – 12 Hz. This indicates that the produced signals are not EEG waves which are normally measured in voltage over time but rather measure amount of EEG waves found in the 8 -12 Hz spectrum over time. This means that the recorded data refers to amount of Alpha waves present during gameplay. This entails that peaks on the results of the readings recorded with the Mind Work Station software indicate amount of waves found in the spectrum from 8-12 Hz over time, rather than traditional EEG readings which are voltage over time. See appendix for Emotiv EEG data charts.

Test participant 1:

The EEG results show many peaks of alpha wavesvoltage experienced (see appendix 1.1) within the first 2 minutes of gameplay. At the 2 minute mark during gameplay, the player has explored the controls of the game and managed to pick up the first can at the entrance to the scrapyard.



At the 2:30 mark the player is electrocuted for the first time, having walking into the electric fence. This event is represented by a low number of Alpha waves. This may indicate that beta waves were more predominant at this time. Continuing the game, the narrator continues telling the story during the progression and the subject manages to pick up more cans. At 3:23 the player walks into another electric fence killing the boy and playing the loud electrocuting sound.

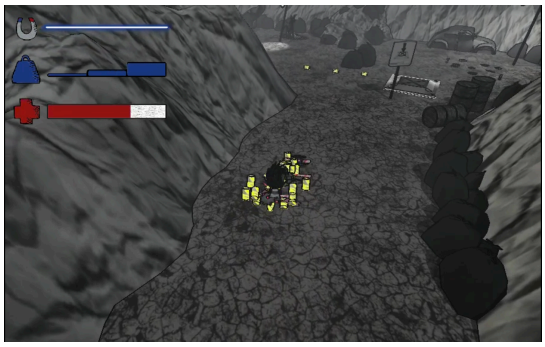
The signal, indicating amount of alpha waves begins to pick up after the death.

During this time the player is re-spawned and traverses the areas already explored previously. Thereafter another spike in amount of alpha waves occurs while seeming to explore. Another spike in alpha waves is experienced while walking across a part of the level already explored. Once the player finds some more cans to pick up and begins to have difficulty using the third person camera the amount of alpha waves fade again.
During the rest of the gameplay there are no more spikes in amount of alpha waves, indicated that for the rest of the test the user is concentrated and therefore producing beta waves with amplitudes above 13 Hz rather than alpha waves below 13 Hz.

Test participant 2:
The second test participant output a larger amount of alpha waves during gameplay. It should be noted that the signal strength of the connection of the Emotiv Epoc device was better than the first participant.
During the first minute of gameplay, the introduction narration and first moments of exploration contain high amounts of alpha waves. The second minute has a much lower amount, indicating possibility for heightened concentration. The next peak in amount of alpha waves is present during the second minute of gameplay. At this point the player has attempted to get past a large container, which is not the intended path. After some time the player realizes they cannot continue in that direction and must reevaluate their choice of direction. This may be the cause of the second peak in alpha waves.

The next peaks in alpha waves occur from the third to fourth minute of gameplay. This is during the witch cut scene.
There are several spikes in alpha waves during the sixth and seventh minute of gameplay. These are broken by several lulls in alpha activity. During gameplay the player is collecting cans during this time using the magnetic ability. During the periods with low alpha activity, the player is collecting dangerous objects, lowering health. This new aspect of gameplay may account for a heightened level of concentration. The player must assess what is happening in the game and try to cope

with the outcome of their actions. In the seventh minute of gameplay the player has collected many metal objects and is traveling forward through the level at a very slow pace and is out putting a high amount of alpha waves again.



The next peak in alpha waves happens at 8:40. During this time in gameplay the player has been killed by a dog and respawn. The player backtracks through the level and must regain their bearings in order to progress in the right direction. There is also a very high peak in alpha waves at 10:40. This is wear the player seems to be observing the magnetic crane and deducing how to use it to progress.

Test participant 3.

The obtainable connection with the Emotiv Epoc was weak during this test participant's gameplay there seems to be only one area where the player experienced a very high level of alpha wave activity. This was during the first minute of gameplay. During this time the player went into the controls menu on the title screen and read the controls of the game thereafter the player experienced the first cut scene of the game. There was also a slight increase in alpha waves during the witch cutscene.

Test participant 4.
No EEG data recorded.

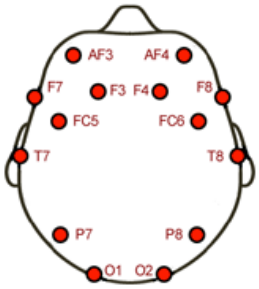
Test participant 5.
No EEG data recorded.

Test participant 6.

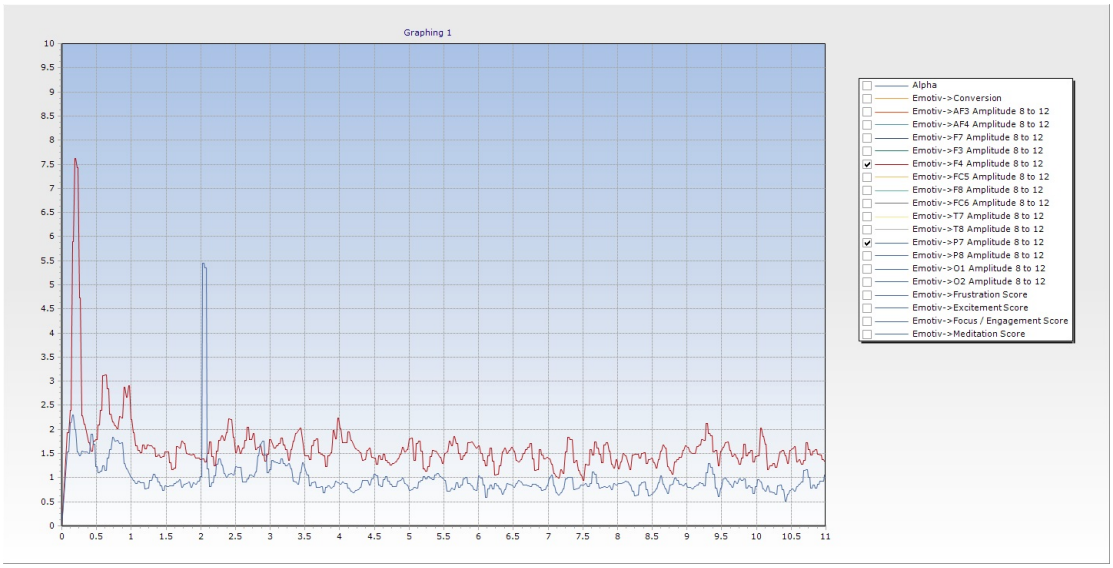
Because of issues recording gameplay, the test participant starts first playing the game four minutes into the EEG recording. This can been seen on the EEG recording of this session. The largest amount of alpha waves are present during the middle of the 4th minute of recording and the first 15 seconds of the 5th minute. During this time the player is experiencing the first cut scene, collecting the cans in the beginning of the level and continuing to collect the cans along the intended path. Having understood the introduction and narration the highest spike of alpha waves seems to be occurring during the beginning of the 5th minute where the player seems to be collecting cans continuously, does not have any issues with the controls and does not have any issues with seeing the next objective (can) in front of them.

Test participant 7

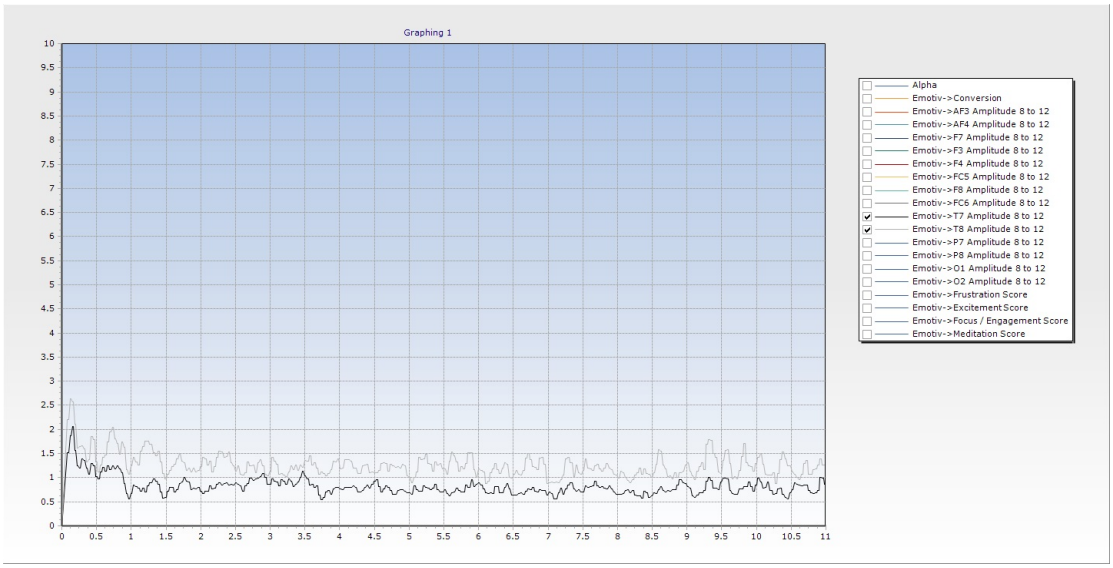
The video of this test participant's session seems to be without audio. Though there was a good EEG connection during this session, the amount of alpha waves is scarce during this session. At only two times during the session are there peaks in alpha wave activity and this is only for two specific sensors at specific points in time.



These two sensors are F4 and P7



These two sensors are located over the frontal lobe (F4) and parietal lobe (P7). These areas of the brain have to do with processes attention, planning (frontal lobe) and understanding (parietal lobe). This may indicate that the test participant did not experience any sound from the game during the test. Though alpha waves supposedly represent a relaxed state rather than that of an excited state, the lack of sound could cause certain parts of the brain to react differently and therefore output different amounts of alpha waves independently of one another. In this case the sensors placed on the scalp over the temporal lobe, that which functions are associated with sounds, are not putting out many alpha waves. Though the lack of sound could be accounted for by malfunction of video recording software, these results leave room for speculation of the overall influence of auditory input on EEG readings.



The two areas where there was a high amount of alpha waves recorded from the F4 and P7 sensors correspond to the player experiencing the cut scenes during gameplay. Being the introduction cut scene and the witch cut scene.

Test participant 8.

This test participant claims to have played the game at an earlier date than on that which the test was conducted. There is an extremely high level of alpha waves during the first minute of gameplay. Having played the game before the test participant does not collect cans but rather experiences the introduction cuts scene and hurries on towards the witch. After the first minute has passed the player is at the witch cut scene. During the witch cut scene, the amount of alpha waves drops except for several peaks for sensors on the temporal lobe. The next noticeable peak for the majority of sensors is at the 2:30 minute mark. During this time the player is engaged in playing the game and experimenting with the magnetism game mechanic. This is however stopped by being caught by the first dog in the game. The player dies and respawns. At this time it is apparent that this happens at the same time as alpha waves drop in the EEG readings.
Following these actions the next spike in alpha wave activity is at the 4:30 minute mark. At this time the player has gotten to the first puzzle, where the player must obtain a certain amount of weight in order to press a switch that moves a container out of the way so that the player can progress. At this time, the player has obtained the correct weight to activate the switch, but is killed by the 3rd dog. This could possibly point to a level of concentration relief. After having tirelessly attempted to provoke the switch and progress, the player is thrown out of the experience by death, relaxing their concentration.

Test participant 9.

This test participant has also played the game at an earlier date. Though there was a satisfactory connection with the Emotiv Epoc hardware there are not many areas throughout the EEG recording that contain many alpha wave readings. During the first minute of gameplay there is a flat line of activity that may be caused by poor signal or movement of the Emotiv Epoc device. During the first spike mostly

punctuated by one sensor, the player has already witnessed the introduction scene and is collecting cans. The next spike in alpha wave activity happens around the 5:15 mark. During this time in gameplay the player has obtained the magnetic power from the witch and is now not moving their avatar around in the game but simply moving the camera around their avatar observing the character of the boy. A similar "break" is taken during a slight increase in alpha waves at 8:30 – 9:00 where the player is experimenting with the magnetism game mechanic and the pressure switch that activates the container. During game play outside these two areas it seems that the test participant may have been concentrating on playing the game causing low levels of alpha waves and higher levels of beta waves which are not represented in this test.

Test Participant 10.

This test participant spent their time wandering around the level. The test participant never reached the witch cut scene. The connection to the Emotive Epoc device was very good. The spikes in amount of alpha waves throughout their gameplay seem to correlate to events rather than relaxation periods throughout the gameplay. The highest alpha wave reading was at 6:45, during this time the player has seemingly spotted a can for collection and is moving towards it.

6. Conclusion and delimitations

After having expanded upon the current narrative theory and elaborated on existing terms in regard to narratives in interactive media it has been established that current theories in regard to narrative, interactivity and their internal relations have many compounded areas of study. Gameplay within a traditional narrative context is but one area of inquiry narratologists may focus on. Other areas may include more "open" narratives that allow for more player influence by way of interactive capability. These areas focus on coherence and the subjective view of the player experiencing the interactive media. However these areas and the notion of narrative coherence remain largely a theory without conclusive evidence to back up the applicability of the term in controlled tests.

The test of non-diegetic narration and its role in EEG alpha channel reading is also inconclusive due to several reasons. Firstly the amount of test persons affiliated with the test was too low to be able to determine any quantifiable quantitative results. Instead the test functioned as a preliminary guide that assesses possible tendencies and points out areas of further interest. An area in need of more focused study would be signal processing techniques as well as the consistency of alpha and beta waves in normal human adults who play videogames. Research in these areas would insure more reliable EEG results.

The test itself was met with restrictions and a large amount of error. These include a large amount of malfunction within the EEG recording (EEG signal was too weak for results for two test participants to show any reading at all). Furthermore there is evidence that such signals are subject to many factors of disruption. Movement of the Emotiv EEG hardware along with inconsistencies caused by constant sensory input may influence EEG readings. This makes EEG reading for experiential experiments extremely unreliable unless accompanied by alternative measurements and simplified

to a degree where event documentation can be established without prejudice.

Creating a framework for biometric analysis of interactive media requires a high level of simplified criteria, very controlled media and a high level of quantifiable test data. Simplified criteria in this sense would mean games that are not very complex in neither their graphical appearance nor their interactive capability. This would allow for researches to test very specific criteria rather than having unwanted feedback attenuated.
The media in question should not necessarily be a finished product, such as *Cantrip* or game titles readily available such as in previous research [22]. A more simplified videogame would not necessarily contain the same amount of connoted signs as a complex and highly polished videogame. This may prove to show biometric tendencies faster than with more complex media.
Because of the variety of subjective interactive choice afforded to players and the subjective physical reactions players are capable of, a high level of test participants would be preferable when involving biometric data if the intent is to use this data to create generalizations in regard to habitual player activity.

This paper is segregated into two sections one section where the focus is on the current placement of narrative within a growingly interactive world, while the second section pertains to examining *Cantrip* by use of EEG measurement. The reason for this fragmentation is largely due to problematic limitations with both hardware and software affiliated with the project. Having attempted to use alternative recording software such as EEGLAB, BCI2000, OpenViBE and Emokit as recording and computational frameworks for analysis of EEG data recorded from the Emotiv Epoc device, the overall limitation being the lack of the necessary Research Software Development Kit that enables communication with most of this software. The Developer SDK that accompanied the Emotiv hardware available was sufficient in activating and using the proprietary software available from the Emotiv control panel but does not allow one to record raw EEG signal for further analysis. This limitation caused resources to be spent attempting to find a work around. The Mind Work Station software was sufficient within this test but further investigation may yield evidence that it may not suffice when conducting a more substantial test.

Overall the pilot test has shown that EEG reading in correlation with analogue data accumulation is a plausible methodology for use in user experience measurement.

Design alterations to the Cantrip game were also problematic. Due to specific shader options only found in the pro license version of Unity 3D (with which the game was developed) caused an assortment of bugs when attempting to manage the project on a free license. These issues caused major flaws to basic elements such as the magnetization mechanic and assets such as metal assets, Dog AI and the third person camera. This too caused a drain in resources that could have been spent elsewhere within the project more fruitfully.

During the test there were several participants that attempted to surpass a puzzle, not by activating a switch but by jumping over the debris surrounding the puzzle. This was the only reoccurring event witnessed during the test that resembled the narrative coherence scenario involving intended narrative and unintended interactivity.

Future Perspectives

Focusing on the core aspects of the project, testing for narrative coherence scenarios and their influence on the user experience may still yield interesting results enabling videogame developers to produce more enhanced narratives in their games.

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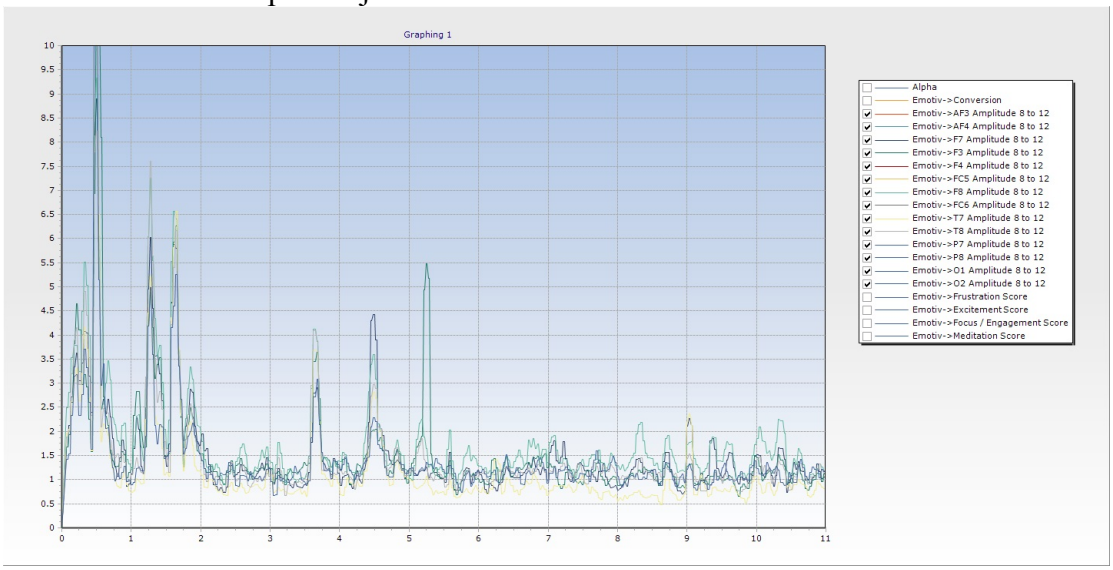
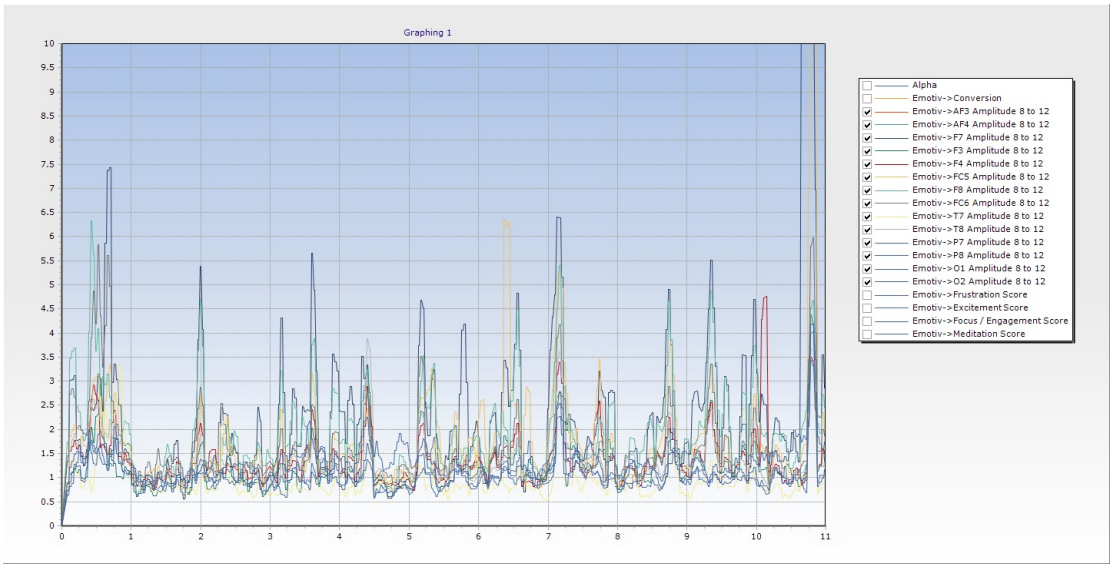
8. Appendix

1. Sensor output from pilot test

1. Emotiv sensor output subject 1:



Emotiv sensor output subject 2:



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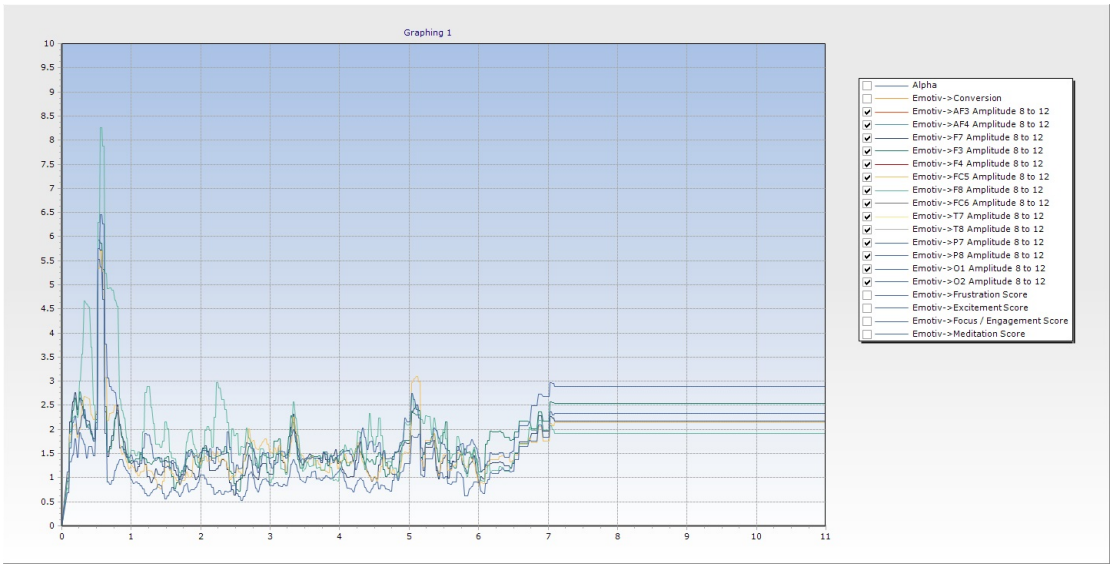

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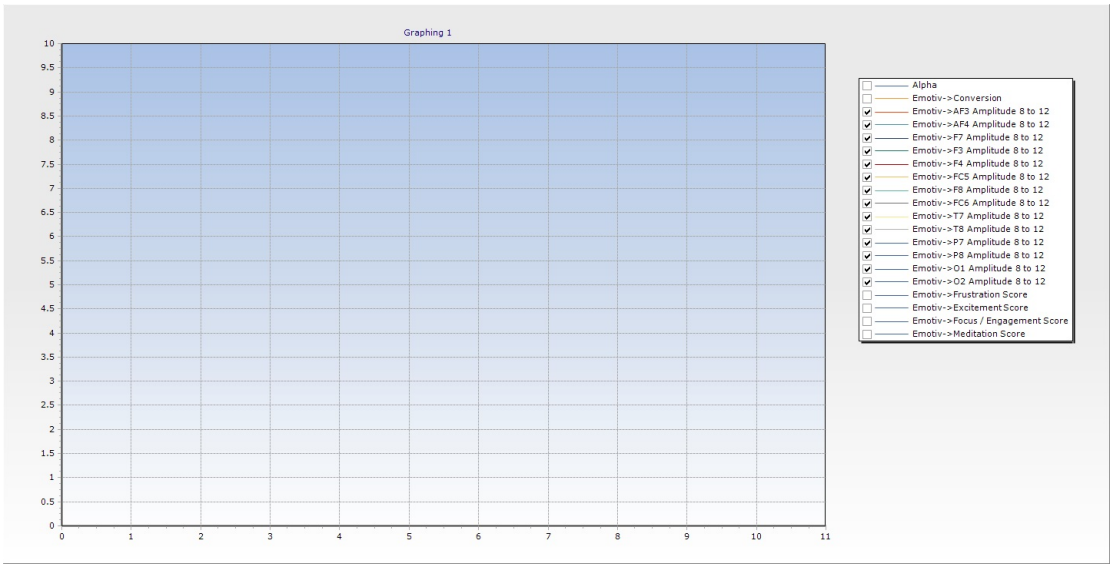

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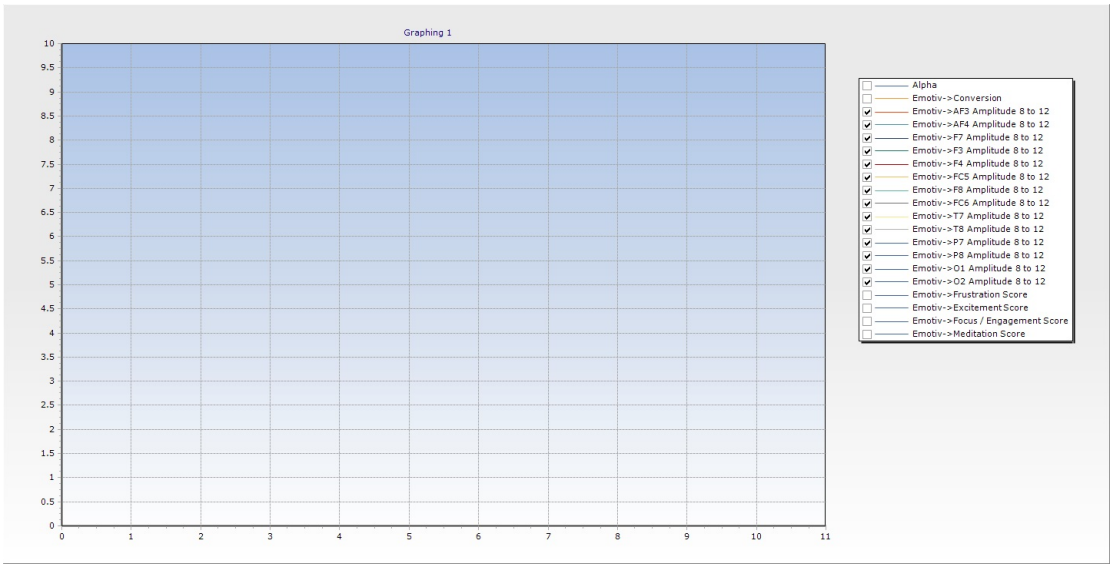
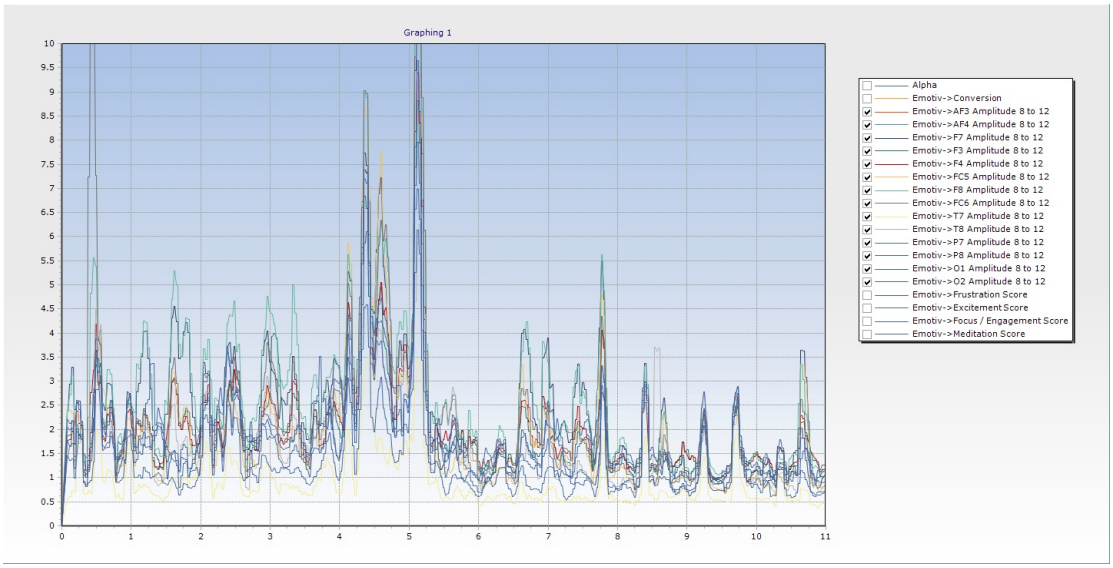
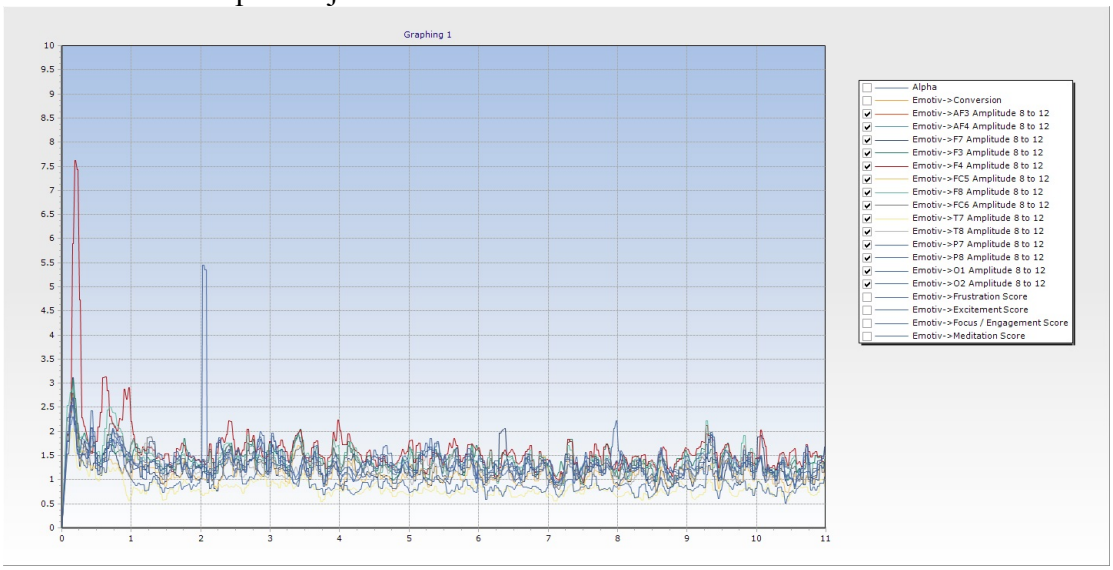


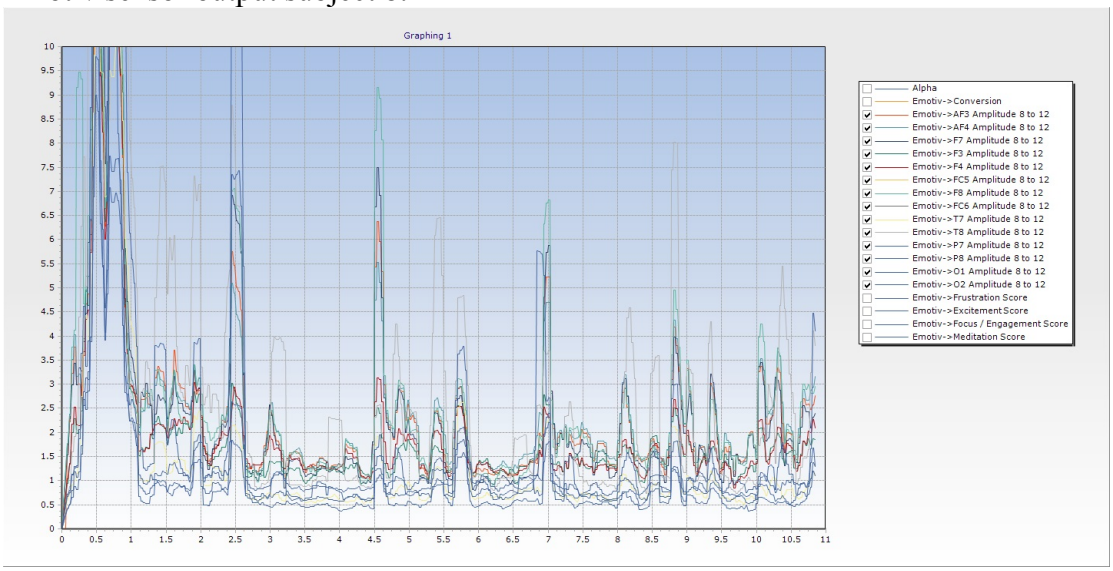
Emotiv sensor output subject 6:



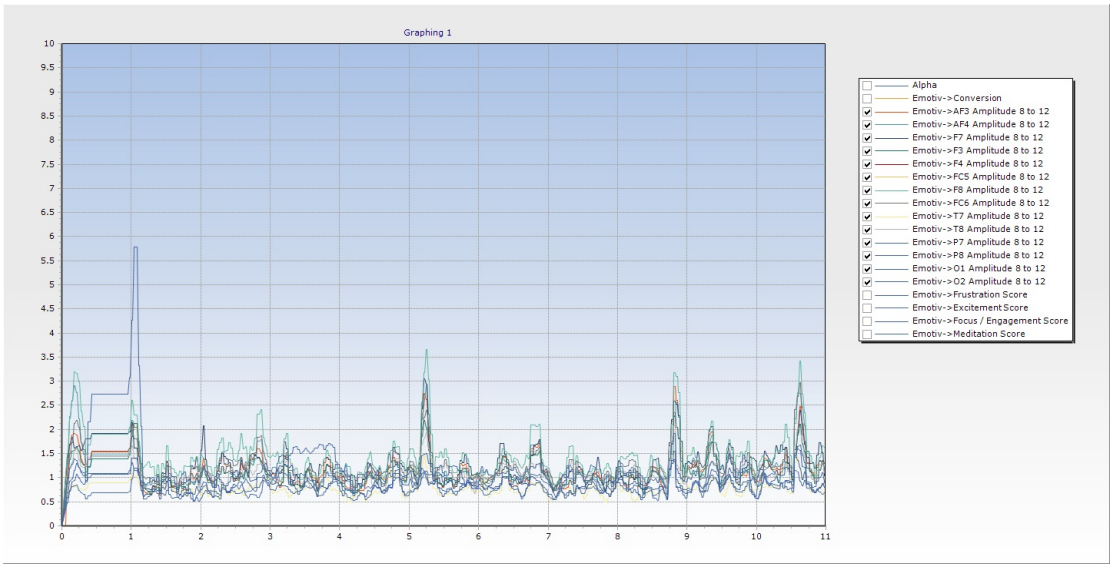
Emotiv sensor output subject 7:



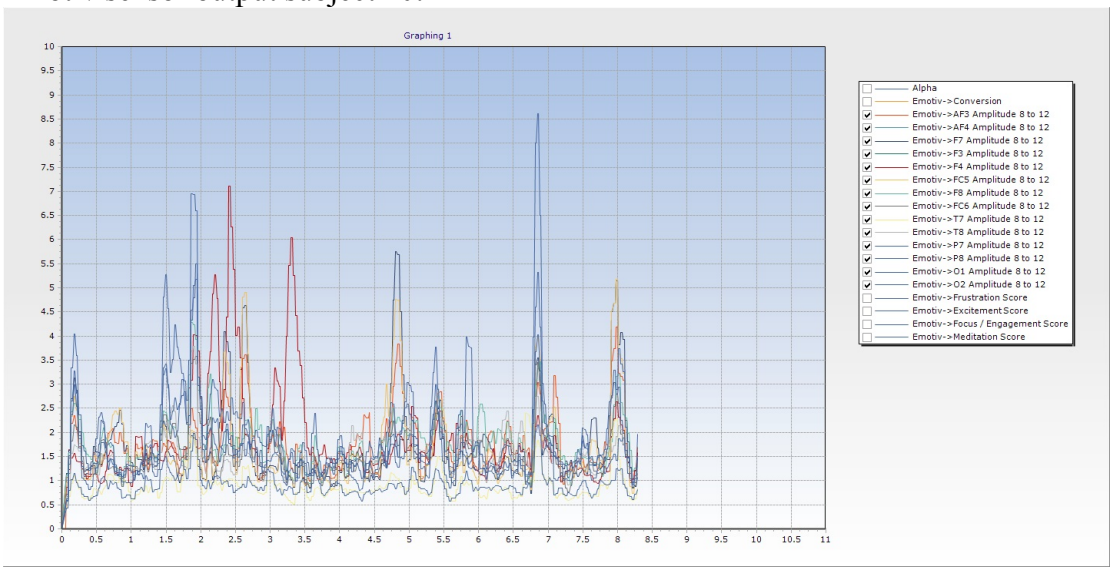
Emotiv sensor output subject 8:



Emotiv sensor output subject 9:



Emotiv sensor output subject 10:



2. Observations from test

1st test participant
bad connections with emotiv. Collecting lots of cans, lots of exploring. Died 2 times on electric fence.
Mouse too sensitive. Got to the witch at 7 min.
Boy died dog food.
Died of sharp objects
Died of dog
Back tracked towards shopping cart

2nd Test participant
Good connection
Complaints of mouse sensitivity again.
At 4:30 there was a break where I asked to close eyes while I deleted some files.
Recording stopped suddenly resumed after tester noticed.
Collects many cans.
Back tracking after death towards witch area.
Died twice by dog

3rd test participant

Poor connection due to hair even though hair was wet.
Adjusted mouse to not very sensitive for user
User collects cans throughout
Gets to witch at 2:20
Started at 15:08
Presses mouse button alot
Trying magnetism game mechanic
Got damaged a lot by dangerous objects. Kills 2nd dog.
Cannot find switch after
Does nor seem to understand switch wieght objective is stuck at this section for minute.
Still trying to figure out switch puzzle at min 8
Tried to go above container, hits hidden wall cannot progress.
Died at electric fence.
Got through the container puzzle.
Death by electric fence narrator: “And suddenly the boy was electric”.trying to get through the puzzle again.

4th Test participant
Issues with sensors even though subject has short thin hair.
Issues with recording video
User at witch (end) 3:00 min
User gets past first magnet
Has not died yet 5:18
Died at second dog due to dangerous object
Second dog death bug
On top of containers to try to get by first puzzle hits invisible wall
Switch does not work properly during min 8-10

5th Test participant
Poor signal mostly red sensor feedback.
Witch at 1:00 min
Stuck on first magnet narrator tells him how to progress.
Died by 3rd dog at 4:21
Second switch doesn't work like it is supposed to.
Now it does but he does not make it to begin with
Obsessed with getting "correct "amount of weight for switch, not alone sufficient weight.
Gets past fridge
Dies at meat pounder "sigh" says participant
Second level.
Dies at electric fence, participant visibly shutters.

6th Test participant
Really good signal
Looked at controls in menu before playing
After 4 min EEG recording, he starts playing.
He collects all cans in the beginning.
Witch at 1:30
Stuck at first magnet and sighs.
Laughs at first death by dog. Chaotic
Dies by dog again "fuck".
Narrator “And suddenly the boy was dog food!” He was surprised when 3rd dog appeared and kills him.
Dies again at next dog by container switch
Confused about how to get past container.
Tried to hop over container. Hit invisible wall.
Mistakes start cans for cans that little sister left.
Dies at fence at end
Gets through container puzzle after respawn.
Beats level 1.

7th test participant
Good signal
Collects cans
Witch at 1:22
Death by first dog
Killed dog
Got to puzzle but is backtracking
6:18 min at 18:31
Completed puzzle but cannot get through
"Am i stuck?"
Gets puzzle does not make it in time
Gets through puzzle

8th test participant
At witch before 1 min
Has played game before
Watching cut scene 1:50
Died at first dog "aahh"
And suddenly the boy was dog food
Killed first dog
Got hurt at 3:06
Killed 2nd dog
Died at third dog and killed dog simutaniously
Killed at 3dog again.
Killed at 3rd dog again
Killed dog got through level at b4 5:50
2nd level
Died at electric fence.
Suddenly the boy was all electric.
Died at 2lvl dog
Suddenliy the boy was dog food
Again and narrator again.
3rd time died at 9:00
Died on electric fence on left diviation teice on second leel
Takes right way.
Dies on fence.

9th test participant
Collects cans
Has played before
Good signal
Pauses for audio
At witch at 1:55
Camera is very close to caracter
Takes damage after forst dog
Dies at second dog "no"
Backtracks to shopping cart area where the witch was after dying
Presses first switch
At second seitch at 7:33
Tries to get past container without hitting seitch
Physical reaction to fence death at 8:30
Tries out seitch with wieght level 2
Observes what happens
Tries switch again it does not reset
Accidental death by dog

10th test participant

Good signal
Hasnt played before
Not avid gamer
Woman
Not used to WASD controls.
Cannot pick up cans
Now picking up cans after instructed to use mouse left click
Using arrow keys. As stopped using mouse at 4;30
Got zapped by fence at4:55
Subject is laughing at their death

Subject has not reached witch at 6:00
Stuck behind barrel cannot get out (bug?)
Got out at 6:40
Zapped at 7:00
Laugh

Sex *MF
age *
Occupation / Study *

How much do you agree with the following statement? *The narration during the game was important.

	1	2	3	4	5	
Strongly disagree						Strongly agree

How much do you agree with the following statement? *The narration was very informative throughout
the gameplay.

	1	2	3	4	5	
Strongly disagree						Strongly agree

How much do you agree with the following statement? *The narration was unnecessary for me to progress throughout the game.

	1	2	3	4	5	
Strongly disagree						Strongly agree

How much do you agree with the following statement? *The narration was unnecessary for me to understand the game.

	1	2	3	4	5	

Strongly disagree						Strongly agree

What information did the narrator inform you of during gameplay? *in your own words

When did you feel most in control of the game? *

When did you feel you understood the capabilities of your character within the game? *

What was your character capable of during gameplay? *

How much do you agree with the following statement? *The narration helped me progress throughout the game.

	1	2	3	4	5	
Strongly disagree						Strongly agree

How much do you agree with the following statement? *The narration was vital to understanding the story in the game.

	1	2	3	4	5	
Strongly disagree						Strongly agree

How much do you agree with the following statement? *The narration helped me understand the player controls.

	1	2	3	4	5	
Strongly disagree						Strongly agree

Please list the elements were displayed on the H.U.D. (heads up display) during gameplay? *

comments