

Interacting with the General:
Studying the Effect of an Interactive Week-Long
Storyline on Engagement and Learning

Caleb Eno
Advisor Dr. Tom German

Senior Research Paper
Muskingum University
Department of Digital Media Design

Abstract

Interactive storylines have recently been at the forefront of research on interactivity. This project explores the effects of a week-long interactive storyline on both user engagement and learning. The project uses a custom designed interactive story utilizing a character called the General. Participants interacted with the storyline through the use of smartphones, QR codes, and YouTube videos. Limitations prevented any significant statistical findings, but the theory and backing research suggest overcoming those limitations will produce sound results. Options on adaptations to the storyline are offered to promote statistically significant findings in future research.

Introduction

In the last twenty years, a plethora of work has been published in an effort to define and explore the potential of the concept of Interactivity. This started as early as 1988 with Rafaeli's work to define interactivity, which had already become a popular term but had yet to be sufficiently conceptualized with supporting research. Interactivity is now a staple term in current communication circles paving the way into new fields of study, such as the massive research area of Human-Computer Interaction (HCI). As interactivity gained momentum, researchers measured its effect on other concepts, such as learning and engagement (Sundar, Qian, Bellur, Haiyan, Jeeyun, & Guan-Soon, 2010; Rieber, 1996). One of the proponents of interactivity research is the entertainment industry (specifically film, video games, and emerging media like the app/tablet generation). Researching the effects of interactivity in entertainment media is currently an influential area of study.

With so many directions to pursue, as new methods of utilizing interactivity both in the world of software and hardware continue to appear, there is always room for further research. This specific study focuses on interactivity and its effect on the user's engagement with and learning of a storyline. The significance of this study is the contrast between virtual and real world interactivity as well as short versus long term interactivity. Most studies of interactivity involve a virtual environment (ie. website, video game)(Cheong, Kim, Min, & Shim, 2008) or an artificial environment, (ie. museum) (Haywood & Cairns, 2005) and interaction is limited to a single instance or a series of similar instances. In this study, the participants interacted with a storyline throughout the course of week within the context of their normal environment.

The three main concepts for this study are interactivity, engagement, and learning. The measurement of interactivity is both a technological idea (McMillan, Hoy, Kim, & McMahan, 2008), a communicative idea (Rafaeli, 1988), and a perception idea (Bucy, & Chen-Chao, 2007). Technologically it is based on the kinds of technologies integrated which allow for interaction (ie. hyperlinks or touch screens). Communicatively, interactivity relates to a series of back and forth communications which continually rely upon the entire history of past communications to compose a relevant response. Perception focuses on how a user feels about the interactivity and if it appears interactive to them. This perception can be high or low regardless of how many elements of interactivity are present.

Engagement is a measurement of the user's experience of a medium (O'Brien, & Toms, 2008). This concept has tended to be a more ambiguous in its measurement. Generally, engagement studies have included a focus on other similar concepts such as flow and play (Nakamura, & Csikszentmihalyi, 2002; Webster, & Ho, 1997; Laurel, 1991). In contrast, O'Brien

& Toms (2008) proposed an engagement model totally separate from flow or play where levels of engagement can be broken down into separately measureable parts. This creates a comprehensive, measurable view of engagement.

Learning, for a while, was considered to occur if one could recall specific facts or details about a specific topic or event (Simon, 1996). A more recent definition broadens it to be defined as a measure of the cognition, mental process, and mastery of information as it is acquired (Brophy, 2004). This ability to see patterns in problems, recognize them for what they are, and utilize gained information in order to solve the unique problem is performance. Learning is the intake of knowledge while performance is the measurable usage of knowledge.

The driving force behind this process of engaging with interactivity to achieve learning is Self-Determination Theory (Bakar, 2010). It proposes two motivations which appeal indirectly to interactivity and directly to engagement and learning: intrinsic and extrinsic motivation. The former deals with internal desires and relates to the enjoyment and satisfaction of engagement with an activity. The later deals with external desires such as receiving an award or avoiding punishment.

Literature Review

Interactivity

Interactivity and interactive media continue to be at the forefront of communication research. Early usage of the term was very ambiguous and included various forms of communication and technology in its scope. Much of this period did not come coupled with empirical research studies. Rafaeli (1988), was one of the first to consider the wider implications of a unified, empirically supported definition of interactivity. He saw interactivity

as having a great deal of unexplored potential. This was followed by several empirical studies (Rafaeli, & Sudweeks, 1997; Rafaeli, & Sudweeks 1998) in an attempt to differentiate between what interactivity is, and what it is not. According to this model (Rafaeli, 1988), interactivity is not a reference to any type of technology. It is instead based on communication responsiveness and should contain these four ideas: First, communication is not by default interactive. There are forms of communication which include coherent responses which is non-interactive. Second, interactivity is not a medium characteristic. Technology and media can create the potential for interactivity to occur but the potential does not necessarily create it. Third, most communication is non-interactive and interactivity is only a product of the setting and situation. And, lastly, there is a difference between feedback and interactivity. Interactivity is like feedback in that it relates to the initial message. However, it takes into account all preceding messages and the relationships between them in order to formulate a response. Feedback relates only to the immediately previous message.

A more recent definition of interactivity summarizes it as the intersecting point of direction of communication, user control, and time (McMillan, & Hwang, 2002). These three ideas build a model in which user perception of interactivity becomes essential. Instead of measuring interactivity merely by its presence or absence, this allows for a measure of variance in the amount of interactivity present. The specific three dimensions which promote interactivity are: two-way communication, time to load/find, and control navigation/choices. This multidimensional definition allows for a more empirical study of interactivity and how it affects user's perceptions. It also helps to divide the technological idea of interactivity from the perceptual idea (McMillan, Hoy, Kim, & McMahan, 2008).

Most models of interactivity consider perception of interactivity a main concept to be modeled and measured (Rafaeli, 1988; Karat, Pinhanez, Karat, Arora, Vergo, 2001; McMillian, & Hwang, 2002; Bucy and Chen-Chao, 2007). User perception is a key ingredient to interactivity. Taking the user perception concept to the forefront, Bucy and Chen-Chao (2007) created a mediated moderation model of interactivity. In this model, interactivity is defined as the measurable technological and communicative features present. A moderator is present which delineates between individual differences in users by measuring self-efficacy, level of comfort in using a particular technology. The mediator is perception of interactivity. Though there can be high levels of interactivity, a user's perception of the interactivity, or their ability to use it, determines how interactive the medium is on the individual level. Subsequently, a single medium can have separate effects on different user's perceptions. Testing a user's competency of the technology therefore becomes an important factor in the discussion of interactivity. High levels of frustration will reduce the user's perception of interactivity, regardless of how many features there are. A conclusion that can be drawn from this is that, in the case of novel or unfamiliar interactive technologies, there should be an instructional segment to familiarize the user with the interactivity in order to increase the potential for high perception of interactivity. A possible ideal interactive system would be so intuitive that it would produce no frustration without requiring a training session.

This opens up the discussion of 'too much interactivity.' According to a study by Karat, Pinhanez, Karat, Arora, & Vergo (2001), users prefer interaction which leads to new information that does not require constant and repetitive interaction. The most satisfied users are those given the greatest control over the interactive experience through the use of various tools.

These same users also used the tools the least. Perception of interactivity must be considered.

A user needs to perceive that they are maintaining control over the interactive content. To accommodate this will add a great deal of extra time and cost to the development of interactive media, potentially for something the users will not even use much. However, it may be possible to have less interactivity but still provide the user with the perception of interactivity.

Designers must be extra cautious under this circumstance because if users perceive the situation to be interactive and then discover that it is not, their level of frustration with the interface could potentially be much greater than if there wasn't that level of perceived interaction in the first place. Though all the elements of interaction may be present, if the right circumstances don't surround the interactivity, the effect can be totally lost or even damaging to the user's experience (Laurel, 1991).

Another important distinction is target audience. Audiences with various educational backgrounds can have different results when experiencing interactivity media (Vorderer, Knobloch, & Schramm, 2001). Different educational levels, and possibly other factors, can impact Bucy and Chen-Chao's (2007) model. These other factors can influence the user's self-efficacy or ability to increase self-efficacy and thus reducing the ability for higher perceived interactivity. This can even have the result of reducing perception of interactivity inversely proportional to how many interactive elements are present (Vorderer, Knobloch, & Schramm, 2001). In example, those with less education preferred non-interactive or low-interactive experiences much more than the highly interactive experiences while those with higher education preferred highly-interactive experiences.

As conceptualization research has risen for interactivity, increasingly more studies are being conducted on the implications of interactivity on storytelling. With storytelling, interactivity ceases to be only a tool which augments a medium and becomes a medium itself through which something is communicated (Laurel, 1991). The ultimate goal is to achieve a higher quality of human action through this medium. This can be labor intensive to produce as there are nearly limitless possibilities that a user could choose within a fully interactive storyline (El-Nasr, 2007). Most of these studies focusing on storyline appear similar in design to video games (El-Nasr, 2007; Thue, Bulitko, Spetch, & Wasylshen, 2007; Cheong, Kim, Min, & Shim, 2008). There are two predominant types of models for creating interactive storylines: branching graphs and AI planning. Branching graphs are pre-defined paths taken based on a user's choices. The AI planning method seeks to generate content through an artificial intelligence unit that melds together supplied content in new ways for the player as the story develops in real-time (Cheong, Kim, Min, & Shim, 2008). Content combined with story branches and an artificial intelligence unit could produce uniquely generated storylines in real-time. This experience would create storylines with high replay value. The danger with real-time generated content is a loss of control over content.

For the purposes of this project, the model of interactivity used is from Bucy and Chen-Chao's (2007) mediated moderation model (Figure 1.1). The greatest emphasis is placed on the concept of perceived interactivity. This project diverges from other interactive storyline research as it does not offer a truly interactive sequence in which the storyline responds and changes due to the user's actions. Rather, this storyline has a non-interactive linear storyline which is progressed by interactions of the participants. This influences perception of

interactivity by making the user believe their actions have in some way advanced the storyline.

Since there is only one choice, to scan or not to scan, there is only one level of interaction.

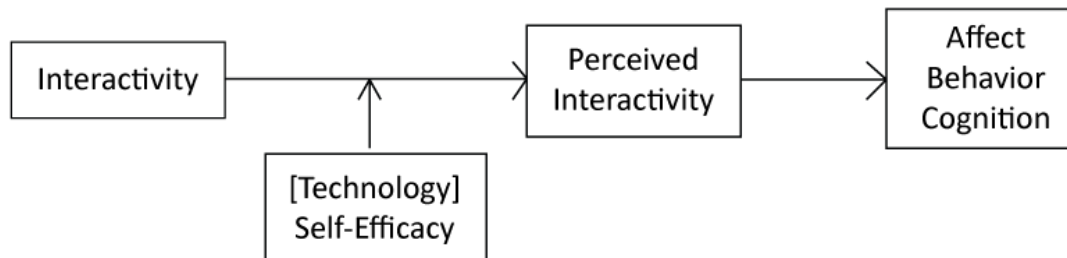


FIGURE 1 The mediated moderation model of interactivity (Bucy and Chen-Chao, 2007).

Engagement

Engagement has been an even more ambiguous term to define than interactivity. Other terms, such as flow (Nakamura, & Csikszentmihalyi, 2002) and play (Rieber, 1996), seem to overlap much of the same ideas as engagement. Yet, those terms don't fully encompass engagement (O'Brien & Toms, 2008).

Laurel (1991) describes engagement by using the theatre phrase "willing suspension of belief" where the user intentionally forgets that the content is not real. By doing this, the user can experience the characters and storyline in the content without the fear of potential pain associated with those emotions. A character might be about to be struck down by an assailant and the user experiences the fear of the character. However, the users are not truly concerned for their own lives or the life of the actor. In this definition of engagement, the user intentionally sets aside the notion of reality for the sake of connecting with the content. This engagement also allows the user to experience "what if" scenarios without the fear of negative effects. A detriment to engagement occurs when there is an actual effect on something in the

user's life. For instance, engagement with a computer program can be threatened if the potential for loss of data is present. The term "willing" also implies that the users must also choose to suspend belief. Otherwise, they will not entertain the content as "real."

"Willing suspension of belief" is an essential concept when considering the development of an interactive storyline. Storylines and their corresponding interactivity should be designed to help encourage user engagement. This view on engagement, however, offers too broad a perspective. Another model, attempting to create an empirically measurable structure of engagement, pulled from the concepts of flow and play (Webster & Ho, 1997). Only the concept of control sets them apart.

In a more recent model of engagement, O'Brien and Toms (2008) compiled much of the past research, separated engagement concepts from flow and play, and synthesize the ideas into one cohesive, measurable concept. This model for engagement suggests a re-occurring cyclical system involving point of entry, engagement, disengagement, and re-entry. During each of these stages various attributes, those studied in depth in past research, occur at different points in the process. Each of these attributes can be individually identified and, to a degree, their presence can be predicted by studying the stage of engagement. Under this model, users are continually cycling through the stages of engagement as they come into contact with content. In the example of a website, a single site might engage a user for a long time or provide the means to disengage into a new website which will then bring the user back into an engaged state. By compartmentalizing engagement into the various stages, it becomes more easily quantifiable. It also suggests that those designing for engagement should consider how the content provides means for re-engagement should the user experience

disengagement. Ultimately, user engagement is all about how the user feels about the interaction rather than the interaction itself (O'Brien & Toms, 2010). This results in a multi-dimensional model of engagement divided into six factors: Perceived Usability, Aesthetics, Novelty, Felt Involvement, Focused Attention, and Endurability. These factors encompass all of the attributes and are measured in tandem to produce an empirical value of engagement. These factors have predictable effects on each other (Figure 1.2).

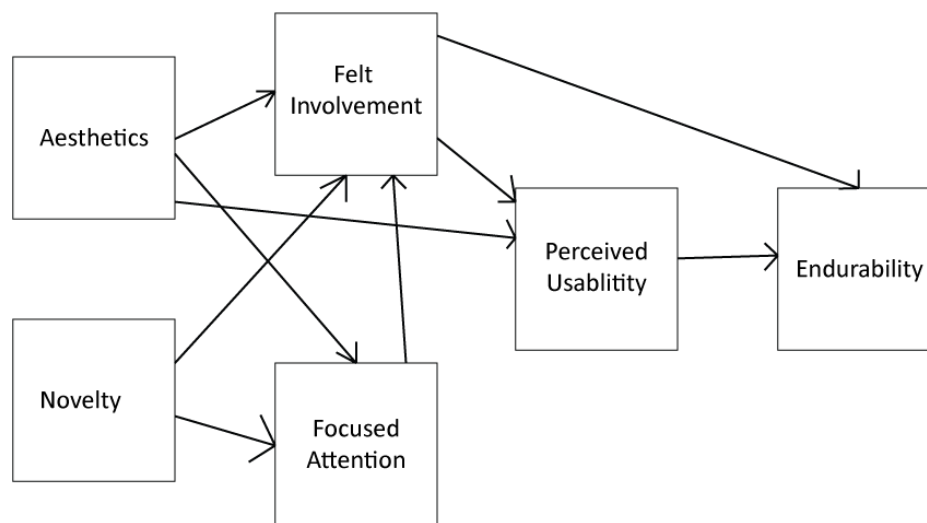


FIGURE 2 O'Brien and Toms measurement of engagement model

The relationship between interactivity and engagement is very closely knit (Laurel, 1991; O'Brien & Toms, 2008; Sundar, Qian, Bellur, Haiyan, Jeeyun, & Guan-Soon, 2010). When considering two outcomes, learning and engagement, interactivity can play a different role for each (Sundar, Qian, Bellur, Haiyan, Jeeyun, & Guan-Soon, 2010). High interactivity can produce greater engagement, but that engagement takes up all the mental processes of a user and ultimately reduces learning outcomes. Contrarily, medium interactivity produces less engagement, but allows for greater learning capacities. The design of the content and

corresponding interactivity should be considered in terms of desired outcome and the levels of interactivity planned accordingly.

The interplay between engagement and learning is an important consideration. Engagement has overlap with learning in three areas: participation, narration and co-presence of others (Haywood & Cairns, 2005). Participation is necessary for engagement and learning because, without it, there is no possibility of connection with the content. The narrative is a powerful tool used to encourage participation. Using narrative structure, users are much more likely to experience higher levels of both engagement and learning. However, narratives can also be distracting if they are not crafted to promote the specific learning objective. The co-presence of others has both positive and negative effects. With others present who are engaged in the content, a user is more likely to engage but the reverse is also true; a user surrounded by uninterested or distracted users is more likely to exhibit the same behavior. It is also possible that learning could occur of unintended content. Interactivity allows for unpredictable behavior and so special consideration must be taken in the design of the interactive features and of the engagement process so that users are led to learn the intended content.

Engagement is a densely complex topic of multi-dimensional depth. This research uses O'Brien and Tom's (2010) model of engagement to study the user's engagement levels various times throughout the study. The interplay which this research seeks to identify is between perceived interactivity of a linear storyline and the user's engagement with that storyline (Figure 1.3). The original survey questions (O'Brien and Tom, 2010) have been condensed in a

similar fashion to Levesque, Oram, MacLean, Cockburn, Marchuk, Johnson, Colgate, & Peshkin, (2011) in order to reduce the chance for participant fatigue.

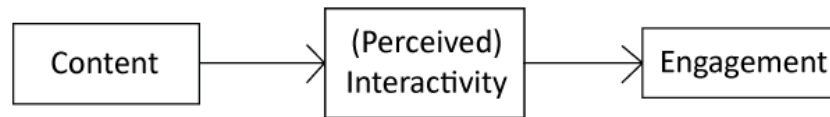


FIGURE 3 Relationship of content, perceived interactivity, and engagement

Learning

Learning refers to the process by which information is gained, stored with understanding, and then is able to be accessed and used in a given unique situation (Brophy, 2004; Simon, 1996). Over the years, two important shifts have occurred in the development of learning research. The first shift changed the standard of “learning” from one of recall, being able to regurgitate information, to one matching the definition stated here (Simon, 1996). The second shift moved from a model in which learners are talked to in favor of a model in which learners actively engage with the material (Garris, Ahlers, & Driskell, 2002). Though learning models have moved away from recall as the sole determinate, recall still plays an important role in the learning process. Brophy (2004) defines learning as the act of acquiring and storing information and performance as the ability to utilize that information. Performance is, essentially, recall combined with analysis.

Another important aspect of learning is motivation (Brophy, 2004). Motivation is the part of the process which explains why people do certain activities. The three parts are motive, strategy, and goal. A person may experience hunger, the motivation, plan to go to a restaurant, the strategy, and get food, the goal.

Motivation is important to consider because it also has implications for engagement. Engagement is a characteristic of motivated learning (Garris, Ahlers, & Driskell, 2002). This also connects with the idea of “willing suspension of belief” (Laurel, 1991). In order to experience, engage with, and learn about the storyline or content of a given situation, the users must place themselves in a somewhat artificial mental environment so that new information can be recognized and stored. Based on these models, both engagement and motivation play off of each other to induce a learning situation. A motivation is a personal need which the users feel they require (Brophy, 2004). Engagement is the level to which a medium attracts the users’ attention (O'Brien & Toms, 2008). Those motivated to learn are often engaged and those who are engaged are more motivated. In addition, repeated engagement causes increases in learning (Hengst, Duff, & Dettmer, 2010).

Learning, being an essential aspect of human life, has enjoyed a great deal of research. A plethora of learning models exist along with various methodologies and conceptualizations of learning paths (O’Neil, Wainess, & Baker, 2005; Holley, & Dobson, 2008). An interesting development considers the impact of video games as a learning tool (Garris, Ahlers, & Driskell, 2002; Bayles, 2002; O’Neil, Wainess, & Baker, 2005). Robertson and Howells (2008) tested the idea of a video game which allowed for individual exploration and learning to occur at a rate determined by the individual’s motivation and engagement. In this situation, a teacher would shift from a provider role, giving the information directly to the learners, to a facilitator role in which the teacher would guide the learners down different paths of exploration. In this switch, the teacher allows the learner to spearhead the learning process by exploring the content as they choose. This is an important concept in exploring the learning of an interactive system.

Providing interactivity to a system allows the user to take control of the learning environment but only to the degree of which the interactivity allows. Since control is a primary factor in the learning process (Holley, & Dobson, 2008), the perception of interactivity should create feelings of control and, therefore greater engagement and greater learning. This is the basis for this research's model (Figure 1.4)

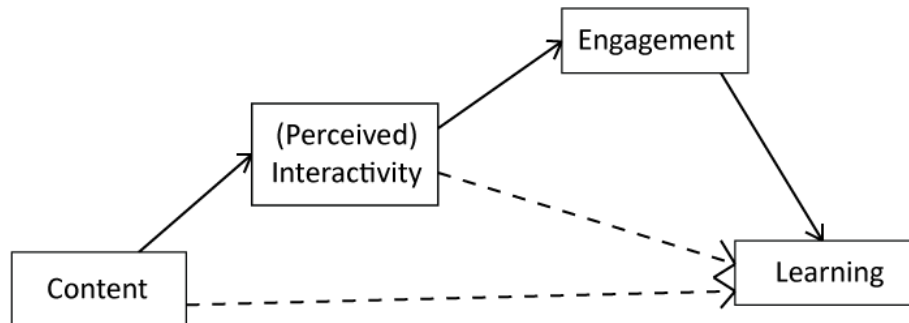


FIGURE 4 A model of interactivity's mediation on engagement and learning.

Self-Determination

Creating the core of the interactivity, engagement, and learning models discussed is the Self-Determination Theory. Self-Determination Theory is a psychological theory relating to the ways in which a person is motivated to pursue learning goals (Ryan & Deci, 2000). The predominant model for measuring an individual's level of self-determination looks at three specific areas: autonomy, competence, and relatedness.

Autonomy defines the contrast between whether a person chooses to participate in an activity by their own volition, an internal locus of control, or if their motivation comes from an outside for, external locus of control (Moller, Ryan, & Deci, 2006). In the first case, if one pursues the goal of cleaning the house because they like to have a clean house, that is an example of internal locus of control. If one cleans the house because of societal expectations

or because a parent forced them to then it is a result of an external locus of control. Internal locus of control contributes to a greater level of autonomy while external reduces it.

Competence is similar to Bucy and Chen-Chao's (2007) concept of Self-Efficacy. It is the level to which an individual feels capable of learning a specific subject or engaging with a certain task (Comanaru, & Noels, 2009). In one circumstance, an individual may be placed in front of a computer to code a website. If that individual has had training in website development then they will have a high level of competency. However, if the individual has not had that training and has no idea where to start or begin, they will have a significantly low level of competency.

The third concept, relatedness, refers to a social structure within the environment (Comanaru, & Noels, 2009). As learners are attempting to learn the content material, or as those engaged in an activity continue through the process, the relationships between participants have an effect on the other participants. When individuals relate well to one another, it tends to increase Self-Determination because of extrinsic motivation (Ryan & Deci, 2000). This can be described as an encouraging atmosphere of mutually supportive collaboration. The opposite situation, in which participants are facing off against one another in a negative context or the general motivation of the other participants is overall low with high levels of complaining, leads to alienation and inauthenticity. A participant who feels removed from the group will ultimately have a low level of relatedness.

The synthesis of these three ideas leads specifically to forms of motivation (Ryan & Deci, 2000). If an individual experiences autonomy, the ability to choose their own actions, competency, the ability to do a task, and relatedness, a supportive connection with others in

the process, then they will achieve higher levels of Self-Determination. However, the environment of the learning or engagement process is similarly very important. In the study by Comanaru, & Noels (2009), participants began the learning process to learn a Chinese language. Environment played an important part in how the other learners around them engaged with the learning process. The more others enjoyed it, the more they did themselves. In addition, the environment outside of the classroom affected their use of the language. Most did not have real-world opportunities to participate in practicing the language or, if they did, the other speakers preferred to speak English. This environment, being a negative learning environment, took away from the learner's motivation.

Research indicates three primary forms of motivation which exist on a continuum scale (Ryan, 1995)(Ryan & Deci, 2000)(Comanaru, & Noels, 2009)(Moller, Ryan, & Deci, 2006)(Bakar, Sulaiman, & Razaai, 2010). The first on the scale, and the level ranked as the lowest form of motivation, is amotivation. This state occurs when there is no level of motivation present. It is described as having an impersonal locus of control/causality because there is no internal or external force encouraging engagement or learning. The result is a lack of interest from the participant and any level of engagement is simply due to a process of "going through the motions" (Ryan & Deci, 2000)(Noels, Pelletier, Clément, & Vallerand, 2003).

Extrinsic Motivation is a category of motivation specifically relating to how external forces motivate the participant (Ryan & Deci, 2000). These forms of motivation are the most commonly found forms in the real world. It is divided into four sub-categories, each with varying levels of locus of causality and relative autonomy. External Regulation refers to a type of regulation which forces the participant to engage with the material, usually on a strictly

reward/punishment motivation. Introjected Regulation covers activities which are not personally fulfilling to the participant but which they engage in because of some external expectation such as achieving acceptance or avoid guilt in other's eyes. Identified Regulation begins to enter into the realm of Internal Motivation. The activity begins to have some level of personal vested interest to the participant. At this point, Relative Autonomy takes a positive turn and the participant begins to have a desire of participation due to their own interests. Integrated Regulation is a level of even higher autonomy when the activity is viewed as being in line with the participant's personal interests and values. This provides high autonomy but still maintains status as an External Motivator because there is still a degree to which the activity is being engaged in to obtain some externally motivated goal. For instance, the material one learns in a classroom could be very relevant to the student who wants to learn it but is still under the pretense of receiving a grade.

The final form, and considered the highest form of autonomy and Self-Determination, is Intrinsic Motivation (Malone, 1980; Ryan, 1995; Ryan & Deci, 2000; Brophy, 2004). Intrinsic Motivation is considered the ideal form of learning and engaging with an activity because the participant is engaging only out of a personal desire to engage without any external forces dictating that desire. A great example for this type of motivation is hobbies. Hobbies are typically activities which one engages in that give satisfaction directly to the participant because they simply enjoy doing the activity. Intrinsic Motivation is unique in that the learning or engagement happens due only to the individual's personal desire to learn or engage with it.

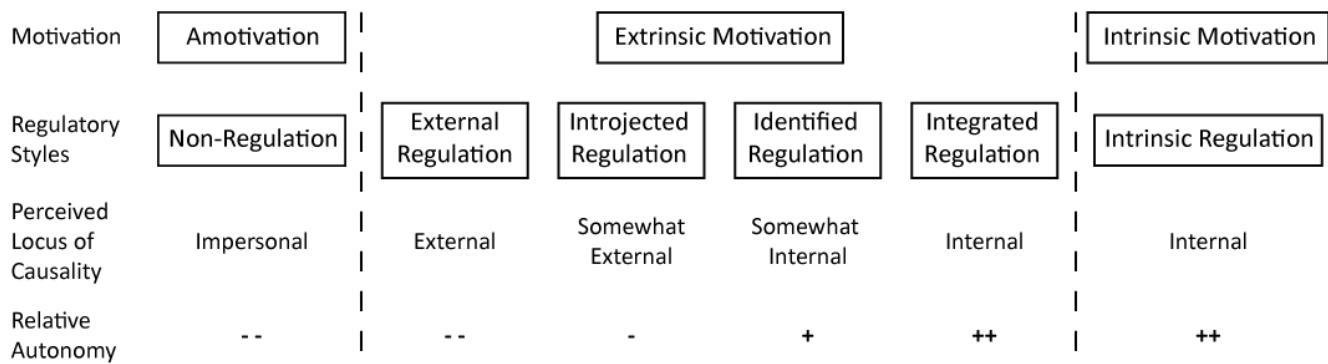


Figure 5 Self-Determination Motivation Continuum (Ryan, 1995; Ryan & Deci, 2000).

Self-Determination has strong implications for an engagement-learning model. Based on this model of Self-Determination, greater autonomy has a strong correlation to learning. Ryan & Deci (2000) note how the effects of greater autonomy help many achieve motivated goals in terms of some forms of education, health, and sports. However, Comanaru, & Noels (2009) suggest that autonomy may not be the primary factor of learning in relation to language. Learning a language is more about entering into and being accepted by a new community, namely the community which speaks that language. The greatest predictor of learning is through relatedness. This follows that the support of the community into which one is trying to become a part of is actually of greater significance than the ability to individually pursue goals. Bakar, Sulaiman, & Rafaai, (2010) also note an interesting point along these same lines. They indicate that religious motivation gave Arabic language learners a strong motivation to learn the language. The association with a specific religion is a subset of the relatedness concept as learning the language has drastic influences on how one could participate in certain religious traditions.

In terms of gaming and storytelling, Self-Determination can determine a lot about the engagement and learning process (Brophy, 2004). The perception of learners' locus of control can impact the level to which they learn storyline information. If the storyline holds no level of motivation, and likely no level of engagement, learning will not result. In terms of this project, the interactive storyline is designed with several motivators built into the process. First of all, the material is relevant to the community in which they reside. The storyline and interaction all takes place on the campus of Muskingum University and all of the participants are students there. Though they are engaging with the material individually, the relatedness of the community in which the storyline takes place should encourage learning (Bakar, Sulaiman, & Rafaai, 2010; Noels, Pelletier, Clément, & Vallerand, 2003).

In addition to the relatedness factor, participants are given the tasks over the course of a day in which they have the freedom to participate in the storyline as they choose. This freedom to choose should provide higher levels of perceived autonomy (Moller, Ryan, & Deci, 2006). However, the ultimate interactive choice is to either participate in the project by proceeding with the tasks or to not participate. Leaving participants with only one choice reduces autonomy as they don't have the greater freedom of a truly interactive system (as would be the case if the storyline involved real people and not pre-recorded messages). Ultimately, if the users' proceed with the tasks, they have no control over the outcome of the storyline. This is why perception of interactivity is so important. If they perceive the storyline to be adapting to their actions then the system appears to be giving them free control over the storyline. This should cause greater sense of control and autonomy.

The real question of interactivity, engagement, and learning is a question of Self-Determination. This is especially true in the environment of this research where participants must seek out the interactive elements on their own without being in a controlled situation with the researchers closely at hand. It is a movement from the model of being told a story or taught a subject to a model of experiencing a story or subject. With this movement towards experience, intrinsic motivation becomes a possibility because, if a participant is used to the idea of being totally engaged with a perceivedly interactive storyline, they are more likely to find intrinsic motivation because they find the process enjoyable regardless of external motivators. A highly Self-Determined individual should find interactive learning environments more engaging and should result in more learning of the material.

Research Questions

The goal of this project is to note the relationships between Interactivity, Engagement, and Learning. Specifically, there are three questions:

RQ1. Does interactivity in a week-long storyline have a positive or negative correlation with engagement?

RQ2. Does engagement with a week-long storyline have a positive or negative correlation with learning of the storyline?

RQ3. Does interactivity in a week-long storyline have a positive or negative correlation with learning of the storyline?

Relating to these questions are three hypotheses based on previous research:

H1. Interactivity has a positive correlation with engagement because the group with the higher levels of interactivity will experience more engagement than the group with lower interactivity.

H2. Engagement has a positive correlation with learning of the storyline because higher levels of engagement will lead to more learning of the storyline.

H3. Interactivity has a positive correlation with learning of the storyline because higher levels of interactivity will lead to more learning.

Method

Storyline Development

As the research pursuit of this project developed, it became clear that the development of a storyline to meet specific needs was necessary. Though various forms of virtual-reality storylines already exist with great success in testing, such as the work of El-Nasr (2007), there has been little research which studies a storyline progression advanced by interacting with objects in the users' real world throughout an extended period of time. Most studies take place in a single session encounter with the storyline. In this case, the user interacted with the storyline over the course of a week (five days, Monday through Friday). As they went about their day, users sought out and found interactive items which advanced the storyline. This was intermingled with their normal activities.

The storyline was developed to be relevant to the participant population to assist in the believability of the storyline. This is for the purpose of encouraging Laurel's (1991) idea of "willing suspension of belief" and the Self-Determination Theory idea of relatedness (Comanaru, & Noels, 2009). If the storyline is more relevant to the participants, they should

have an easier time of entering into that state of mind which should then have a greater perception of interactivity, more engagement, and, ultimately, more learning.

This specific storyline was based on a character named “The General.” For the sake of believability, the General was modeled after an actual United States Air-Force General (See Appendix B, Figure B4). Using the Air-Force logo as a reference, a special logo was developed to create a fictional top secret branch of the Air-Force to try and limit the level to which users have prior knowledge, prejudice, or bias (Note: The Logo of the United States Airforce belongs in its entirety to the United States Airforce and this research claims no rights or ownership of it). Participants were introduced to the General via pre-recorded messages posted to YouTube. The participants played the role of specially selected individuals which the General needed for specific tasks in order to capture a man named Carlos Trippleton. Carlos had stolen technology that he intended to use to hurt people. The design of the storyline was in an attempt to present a very clear good vs. bad scenario so that participants would not feel torn in a moral dilemma.

Advertising Scheme

In order to obtain participants, several advertising schemes were put into place. The target group for this project included any Muskingum University student of the ages of 18 and above who have access to a smartphone. To that end, posters were hung up around campus in heavy traffic zones to draw attention to the project. It featured an image of the General to provide an understanding of some of the content they encountered. It included information that it was a senior seminar project with the name of the researcher, who was eligible, and where they had to go to take part in the project (See Appendix B for example). Along with the

poster, an email with the same information was sent out via the daily Student Activities email. Word-of-mouth participation was also encouraged.

Experiment Process

An initial meeting was held on Sunday at 4 o'clock to start the experimental process. This meeting was the one primarily advertised. At that meeting, no participants attended. Two more meetings were then scheduled on Monday, one at 4 and one at 5:30, in order to gather participants.

Participants were divided into two groups: an experimental group and a control group. Both groups met simultaneously and were aware that there were multiple groups though the natures of the groups' "assignments" were not revealed. A total of 10 participants signed up. First, participants were given a brief overview of the project and what they were exposed to during the week. They were asked to sign a consent form giving permission for their answers to be used in the project. All users also provided an email address. After signing the waiver, each participant received a folder which contained an assignment card, a contact information card, and a unique ID card (Figure 4.3). The ID cards were randomly distributed so that the researcher did not know who has was given what card in order to maintain a level of identity protection. Next, a technology check was made. All students went through a process of installing a generic app which allowed for the scanning of Quick Response codes or QR codes. Once that part of the technology check was completed, they were asked to scan a QR code which took them to a short test video. Under the description of that test video was a link to a Survey Monkey questionnaire of control questions (See Appendix A). This allowed each participant to walk through the whole process in order to promote self-efficacy.

Once all the control questions were answered and the participants confirmed they were able to scan the QR codes, watch the videos, and answer the survey questions successfully, the project moved to the next phase. A video introducing the General played on a screen and projector for the participants. The General gave an overview of the storyline, including backstory, a detailed description of what the participants would find as they looked for QR codes. Once the intro video finished, a QR code was provided for participants to scan on their phones.

Each day consists of three QR code scans. QR code scans were available from 10:00 in the morning till 10:00 at night. The first scan was sent via email. Between each QR code were several clues that provided some additional content to the storyline. After the third scan of each day, participants filled out a short survey which measured their engagement levels (See Appendix A). The exceptions to this were on Monday and Friday. On Monday, since the participants couldn't begin till the evening, the QR codes were available till midnight. On Friday, there were only two QR code scans because another meeting for debriefing took place that evening.

There were two distinct groups during the project: The experimental group and the control group. The experimental group, or the group of higher interactivity, was the group which followed the General's instructions and physically sought out the clues and QR codes in order to advance the storyline. The control group, or the group of lower interactivity, received all of the same content as the experimental group but only through emails sent throughout the day. The difference with the control group was that they did not receive the actual pictures included on a clue; they only received the textual content. This was due to size limitations on

emails. All of the clue locations for the experimental group were on the main campus area.

The QR codes were removed each night and the new ones put up each day.

Friday's debrief session took place at 4:00 in the evening. Participants received a final message from the General via projector. A QR code was provided as a link to the final survey. This final survey tested for learning of the storyline content as well as provide a means for feedback on the experience. After participants completed the final survey, debrief information about the nature of the project was provided and the focus of the study was disclosed.

Measurement Definitions

Interactivity was the independent variable of this study. It was manipulated into two variants: High and Low interactivity. Low interactivity was measured by the presence of scanning QR codes via emails, watching the videos, and storyline advancement being done through the videos and provided text. High interactivity was measured by the presence of scanning QR codes through a process of physically seeking out those codes. Storyline advancement was done through the videos and the individual's experience of searching for codes.

Engagement was measured every day using a ten item survey. The ten item survey was measured once per day. The answers were based on a five point Likert Scale. Each answer was averaged for a total level of engagement. Questions focused on the 6 factors of engagement from O'Brien and Toms (2010) model, such as:

Novelty: *I felt involved in this storyline.*

Perceived Usability: *I felt in control of my storyline experience.*

Felt Involvement: *I felt interested in the storyline.*

Learning was measured through a combination of recall and synthesis questions in a survey taken at the conclusion of the week. The questions were in the form of short answers. They were graded against a rubric to determine learning. Two examples of questions are:

What is one reason that the General believes Carlos Trippleton must be stopped?

Name five locations of QR codes and what you found/scanned/did there.

Results

A total of 10 participants signed up for the week long experience (7 female and 3 male). The average age of the participants was slightly over 19 years old ($m=19.3$, $sd=1.41$). All but one participant used Android based smartphones. The one other used an iPhone. All participants were either neutral to or liked the United States Airforce. All participants but one indicated they were comfortable using their smartphones. The one other indicated very low confidence and was using an Android based smartphone.

On each day, including the Monday of the initial meeting, participants filled out a survey measuring their engagement once completing the daily tasks. The responses were collected and averaged for each group for each day. The averages of the level of engagement for each day were higher for the experimental group (the group with higher interactivity) than for the control group (the group with lower interactivity). However, after running T and F tests via SPSS and examining the Standards of Deviation, there is no statistically significant data. The Standards of Deviation are too high, leaving too much overlap between the two groups.

For the control group on day one with four participants, the average was 3.32 with a standard of deviation of .94 ($m=3.32$, $sd=.94$). On day two, with four participants, the average was 3.10 with a standard of deviation of .97 ($m=3.10$, $sd=.97$). Day three, with four

participants, had an average of 2.75 with a standard of deviation of 1.01 ($m=2.75$, $sd=1.01$).

Day four experienced a drop in participants with only three taking the survey. The average for day four was 3.20 with a standard of deviation of .78 ($m=3.20$, $sd=.78$). Day five also had three participants with an average of 3.06 and a standard of deviation of .91 ($m=3.06$, $sd=.91$).

The experimental group started out on day one with five participants and an average of 3.80 in engagement with a standard of deviation of .33 ($m=3.80$, $sd=.33$). Day two had four participants, one dropping, with an average of 4.02 and a standard of deviation of .33 ($m=4.02$, $sd=.33$). Day three had four participants, an average of 4.10, and a standard of deviation of .47 ($m=4.10$, $sd=.47$). On day four, dropping to three participants, the average was 3.80 with a standard of deviation of .10 ($m=3.8$, $sd=.10$). Day five had three participants with an average of 3.87 and a standard of deviation of 1.13 ($m=3.87$, $sd=1.13$) (Figure 6).

On the final day, Friday, both groups returned for a second meeting during which they were given another quiz intended to test their learning. In the case of learning, the experimental group experienced slightly more learning on average than in the control group. However, once again, the T and F tests were inconclusive, and the Standards of Deviation are even higher than those for engagement. For learning as well, nothing statistically significant was found. On a fifteen point scale, the control group, with two participants, scored an average of 8.50 with a standard of deviation of 3.53 ($m=8.50$, $sd=3.53$). The experimental group, with four participants, scored an average of 9.50 with a standard of deviation of 3.87 ($m=9.50$, $sd=3.87$) (Figure 6).

Throughout the week, the number of participants decreased. Of the initial group of ten, only six participants made it through the week long experience. Several participants also

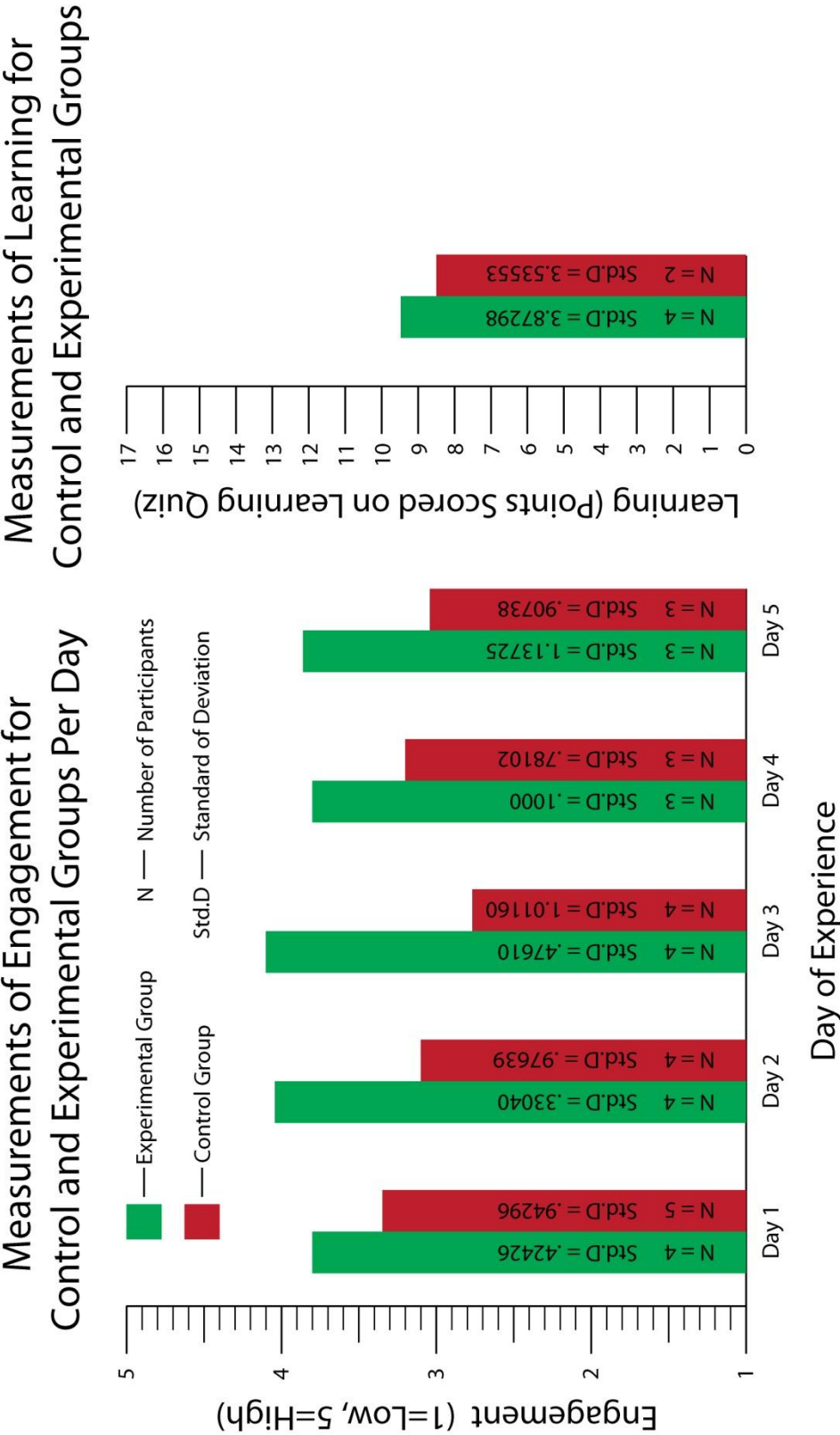


Figure 6 Graph of data collected on engagement and learning.

missed one of the days. The participant indicating the low level of comfort with the smartphone quit the experiment after the first day.

Discussion

Though nothing statistically significant was found in the data, the supporting research suggests the possibility for significant findings once this research is reimaged. Bucy and Chen-Chao's (2007) model suggests that higher perceptions of interactivity should produce a greater affect in participants. In this case, that affect is measured in terms of Engagement. Linking Bucy and Chen-Chao's work with the work of O'Brien & Toms (2010), it should be possible to identify significant statistical data indicating greater engagement with greater interactivity. Likewise there should be connections between engagement and learning. The research indicates the potential for these findings. However, due to a number of limitations, both in the genesis of the research material and during the execution of the research, the data collected did not produce these findings.

Self-Determination Theory supports past research and offers possible reasons for why no significant data was found in this particular project. SDT is primarily a theory about individual's motivations. Autonomy, relevancy, and competency are the three main key points of SDT. Autonomy, or how free one feels to participate of their own self-motivation, is especially important for this research as the project requires participants to engage with the material without the continual influence of the researcher. The project was intended to be relevant to the participant population as it was designed with Muskingum University students in mind. Competency was tested for with the technology check that occurred during the opening meetings. In these ways, the project was designed to promote positive motivation.

Initially, ten participants felt motivated, in whatever category of motivation, to be a part of this project. By the end, only six remained. There is a possibility that this is due to changes in or loss of motivation. One of these possibilities is that participants felt compelled to take part due to external motivation. This seems a reasonable possibility as most participants attended due to word-of-mouth advertising. That external motivation could cause skewed results, either by lowering what could have been high engagement or raising what could have been low. There is also the possibility that those with external motivation also became the ones who dropped out of the project altogether.

Though past research indicates that user engagement and learning should increase with a more interactive experience, the limitations of this particular research prevented any findings. The most important limitation is the lack of participants. Due to the nature of this research, there were technological limitations. Only smartphone users were able to participate because interacting with the storyline required the ability to scan QR codes. The limitation immediately removes from the pool of potential participants all of those without smartphones. The second limitation is that the storyline required the participants to be familiar with the layout of Muskingum University and to be on the campus continually for the course of the experimental week. The most natural participants for this project were Muskingum University students. Unfortunately, this provided yet another limitation. Muskingum University does not require its students to participate in research projects as part of their grade. This means that all participants must come on an almost totally volunteer basis. Traditionally, asking for participants in even simple surveys or focus groups that meet only once for half an hour to an hour has been very difficult. Asking for volunteer participants to spend a week working on

research should therefore be, and proved to be, very difficult to find and keep. Though poster advertisements, personal invitations, and school-wide emails were sent out, not a single volunteer participant showed up on the Sunday meeting. It took several more personal invitations and two meetings on Monday to get ten participants, a fraction of the desired number. This was the primary limitation of the project. The best way to overcome this is to conduct it in a different setting where participants are more easily accessible, such as a large school which requires its students to participate in research projects.

Another primary limitation to the research was the presence of an uncontrollable variable: the user's life. A 'bad' or a 'busy' week is a potential difficulty when melding an interactive storyline into the daily fabric of a user's life. Indeed, one of the participants indicated that the experience would have been better if it wasn't during a busy week. If the future of storyline development, in entertainment, education, or otherwise, expands to include a more mobile, long-term interactive storytelling approach (as advances in mobile phone, pad, and app technology seem to indicate) the factor of the users' personal life and its impact on the process must be included. The engagement model by O'Brien & Toms (2010) takes this into consideration under the Focused Attention factor. The world around the users as they experience the storyline is an essential item to measure as that may have drastic effects on their level of engagement. The future of storytelling should consider these effects and how intentionality in the design process might counter or reduce the effects of a 'bad day.'

A third primary limitation is a derivative of another: Group contamination, the control and experimental group's awareness of one another. It was difficult to keep the groups unaware of one another because the number of participants was so small and they mostly

knew each other personally. Also, the control group saw the codes around campus. This could have influenced the control group to rate the experience lower because they felt they were left out of the better experience. However, according to the data, there was no significant difference between the groups, even with group contamination. This might simply be due to the lack of numbers but it also leads to the possibility of an unaccounted for variable.

Considering Self-Determination Theory leads to the “missing link:” motivation. As mentioned earlier, motivation has a role in engagement and learning. Even though the project was designed with the intention of encouraging positive motivation, motivation levels and types were never measured. It might be possible that there are influences of motivation on engagement and learning that are separate from engagement. A model for measuring motivation should be included in the model of this research. To address the original issue of group contamination, giving the two groups separate meeting times would help to prevent errors in the data. The control group should have their experience a week prior to the experimental group to prevent discovery of the clues around campus.

A number of other limitations exist, primarily in the design of the storyline itself. Should this project be reimaged, several changes to the design should be made. An issue to consider is tampering. Though there was no significant tampering during the experience, it is something that could benefit from preventative measures. The clues and QR codes were simply printed on cardstock and duct taped to their locations. All someone had to do was remove them in order to mess up the entire process. Though no instances of this happened during the relevant days, one department on campus, where clues were located, removed the clues and QR codes at some point. This may not have interfered with the experience but it became very evident that

tampering was a real possibility, either by those in the experience or not. The development of a mechanism to seal or protect the clues and QR codes might be an effective preventative measure.

Another issue is weather. On several of the days, QR codes were located outdoors. Luckily, during those days there was no precipitation. However, on one of the days where the QR codes were all indoors, it rained a great deal. A QR code which had been left outside from the previous day was damaged nearly beyond recognition by the rain. Either QR codes should always be inside, or the mechanism designed to prevent tampering could also help shield against weather.

In terms of the actual storyline, the videos would have to be entirely remade for a different location. Re-mastering the locations should not be a very difficult task. A new actor for the General would need to be chosen. Since the United States Air Force seems to be generally respected, using the character of the General doesn't seem like it would be an issue. However, this branch of research should also explore many different plots in order to test for deviations in a particular plot structure. Though the physical design of the project tended to get high marks by a majority of the participants, based on the data from the Aesthetics Factor of engagement, more time spent on developing the storyline look and feel could only add to the experience.

Concerning the measurements, the engagement measurements were altered from the original 31 questions developed by O'Brien & Toms (2010). Levesque, Oram, MacLean, Cockburn, Marchuk, Johnson, Colgate, & Peshkin, (2011) condensed those questions into ten. This research project followed suit with that method with the intention of preventing

participant fatigue. Future research should consider returning to the original 31 measures as participant fatigue still occurred with only the ten measures. The 31 measures on a Likert Scale would be easy to answer and produce more complete results. This would also maintain the integrity of the original measures and prevent any possible errors that changing it might cause.

Conclusion

Though the study came with a number of limitations which ultimately produced no significant results, there is potential for possible expansion. The main problem to overcome is to gather a greater number of participants. Once that is accomplished, the research behind this project suggests that significant results indicating a connection between interactivity, engagement, and learning should be found. There are other potential changes to this research which could be made to improve it. The most significant change is to include a measurement of motivation based on the Self-Determination Theory. Other changes to the storyline could also be made to improve the chances of findings. At this point, the idea of extended period storylines has not been closely examined. This leaves open doors for further exploration as technology continues to move in a more mobile direction.

Appendix A: Questions

Demographic and Control Information (Issued before experiment)

1. What is your ID number?
2. Gender:

Male Female
3. Age:
4. What kind of Smartphone are you using?

(Please include model, operating system [ie. Android, iOS], and name of QR scanner app)

Please read each statement and indicate how much you agree with it:

5. I like the United States Air-Force.

Really Agree Agree Neutral Disagree Really Disagree
6. I feel confident using my smart phone.

Really Agree Agree Neutral Disagree Really Disagree

Engagement Measurement Questions (Issued at the end of each day)

Please state whether how much you agree or disagree with each statement

(5 point Likert Scale) Really Agree, Agree, Neutral, Disagree, Really Disagree

Novelty

Curious I would have continued to interact with this storyline out of curiosity.

Interested I felt interested in the storyline.

Focused Attention

Absorbed I was absorbed in my storyline task.

Perceived Usability

Control I felt in control of my storyline experience.

Confusion I found this storyline confusing.

Endurability

Recommended I would recommend this storyline experience to my friends and family.

Felt Involvement

Fun This storyline experience was fun.

Involved I felt involved in this storyline.

Aesthetics

Appealed This storyline was aesthetically appealing.

Liked I liked the images used in this storyline.

Learning Measurements (Issued at the final group meeting)

Learning

1. What is the name of the General's organization and why was it named that?
 - X-Air Force
 - To prevent soldiers/agents from registering a lie on a lie detector
2. What is Quintantium being used for? - Develop weapons
3. How Old is the General's wife? - 65
4. What is one reason that the General believes Carlos Trippleton must be stopped?
 - To prevent Carlos from selling the weapons to other countries, or
 - To prevent the world from being destroyed
5. What is one reason that Carlos believes his actions are right?
 - The United States will cover up the quintantium project, or
 - Only true/strong governments are the ones who will use the quintantium to achieve their own goals
6. What is the major advantage you had over Carlos?
 - The General and his team, or
 - Carlos is alone
7. Name five locations of QR codes and what you found/scanned/did there (Not including morning emails).
8. What was your favorite part about the experience?
9. What was your least favorite part of the experience?
10. Other comments?

Appendix B: Storyline Materials

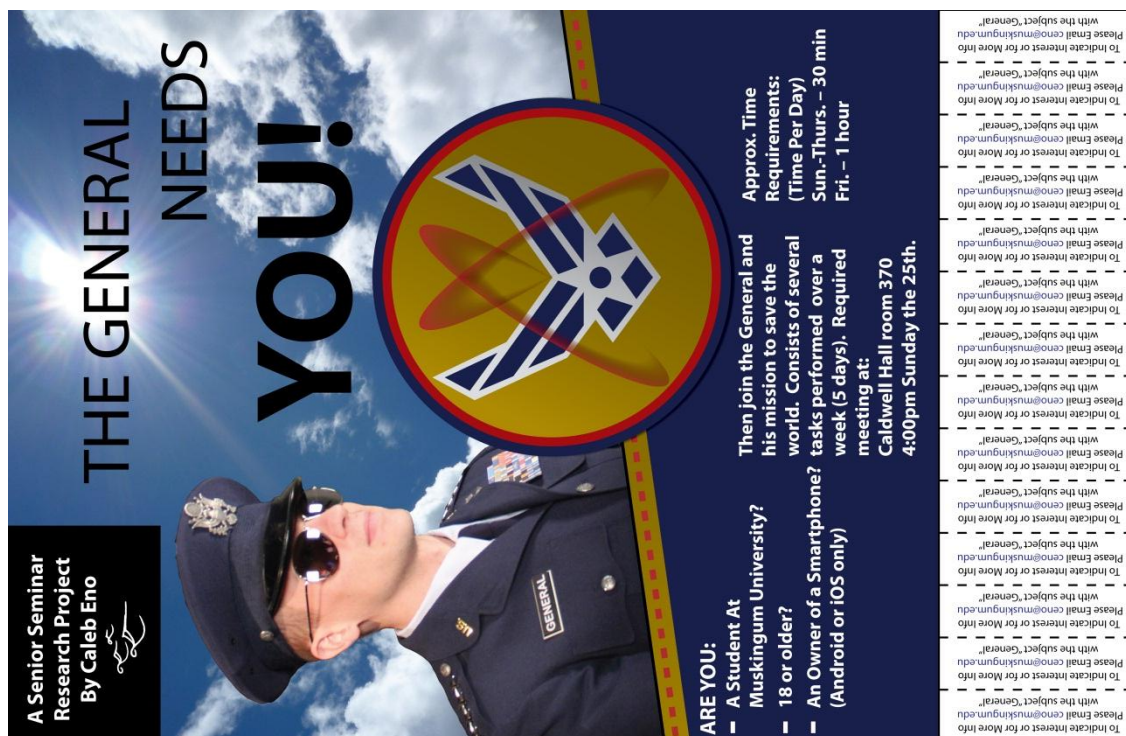


Figure B1 The poster used for advertising of the research project



Figure B2 A Clue Example. QR Codes appeared in the same format.



Figure B3 A Front and Back example of the ID Badges.



Figure B4 The General at his Desk

Link and QR Code to General Videos

<http://www.youtube.com/playlist?list=PLF05A397AAF2A40A1>



References

Interactivity

Bucy, E. P., & Chen-Chao, T. (2007). The Mediated Moderation Model of Interactivity. *Media Psychology*, 9(3), 647-672.

Considers a mediated model of interactivity. Also addresses the issue of too little vs. too much vs. just right in levels of interactivity.

Cheong, Y., Kim, Y. Min, W. and Shim, E. (2008). PRISM: A Framework for Authoring Interactive Narratives. *The 1st Joint Intl. Conf. on Interactive Digital Storytelling: Interactive Storytelling*, ACM Press, Erfurt, German.

El-Nasr, M. (2007). Interaction, narrative, and drama: Creating an adaptive interactive narrative using performance arts theories. *Interaction Studies*, 8(2), 209-240.

Looks at a model of interactive storytelling using drama theories to compose adaptive storylines.

Karat, C.-M., Pinhanez, C., Karat, J., Arora, R., Vergo, J. (2001). Less clicking, more watching: results of the interactive design and evaluation of entertaining web experiences. In: *Proceedings of IFIP TC.13 International Conference on Human-Computer Interaction*. IOS Press, Amsterdam, pp. 455-463.

Considers the negative impacts of too much interaction. Also discusses the relationship between the users wanting interactive options but tending to use them less to achieve their own engagement satisfaction.

Liu, Yaping and L.J. Shrum (2002). What Is Interactivity and Is It Always Such a Good Thing? Implications of Definition, Person, and Situation for the Influence of Interactivity on Advertising Effectiveness. *Journal of Advertising*, 31 (4), 53-64.

Suggests problems with the current thoughts of interactivity at the time of the articles, especially in inconsistencies in definitions, and promotes possibilities of empirical study.

McMillan, Sally J. and Jang-Sun Hwang (2002). Measures of Perceived Interactivity: An Exploration of the Role of Direction of Communication, User Control, and Time in Shaping Perceptions of Interactivity. *Journal of Advertising*, 31 (3), 29-41.

Address the idea of perceived interactivity vs. real interactivity.

Considers an approach to an interactive storytelling framework.

McMillan, S. J., Hoy, M. G., Kim, J., & McMahan, C. (2008). A Multifaceted Tool for a Complex Phenomenon: Coding Web-Based Interactivity as Technologies for Interaction Evolve. *Journal Of Computer-Mediated Communication*, 13(4), 794-826.

Considers an approach to interactivity from multiple angles to make it more adaptable for future technologies.

Rafaeli, S. (1988). Interactivity: From new media to communication. In R. P. Hawkins, J. Wiemann & S. Pingree (Eds.), *Advancing communication science: Merging mass and interpersonal process*. Newbury Park, CA: Sage. pp. 110–134.

An early seminal work on interactivity which helped establish the groundwork for current and future research.

Rafaeli, S., and F. Sudweeks (1997). Networked Interactivity. *Journal of Computer-Mediated Communication*, 2(4).

Study of computer mediate communication interactivity and how it affects the user's level of disclosure and comfort.

Rafaeli, S. & Sudweeks, F. (1998). Interactivity on the nets. In: *Network and netplay*, edited by F. Sudweeks, M. McLaughlin and S. Rafaeli. Cambridge, MA: MIT Press. pp. 173-189.

An empirical research study on web-based interactivity measurments.

Thue, D., Bulitko, V., Spetch, M., and Wasylishen E. (2007). Interactive storytelling: A player modeling approach. *The Third Conference on Artificial Intelligence and Interactive Digital Entertainment (AIIDE)*, Stanford, CA, pp. 43–48.

Examines an interactive game storyline creation model for the purpose of creating a branch of research into the effectiveness of interactive storylines.

Vorderer, P., Knobloch, S., and Schramm, H. (2001). Does entertainment suffer from interactivity? The impact of watching an interactive TV movie on viewers' experience of entertainment. *Media Psychology* 3(4):343–363.

Considers the view that interactivity does not always produce greater connection with the storyline.

Engagement

Haywood, N. & Cairns, P. (2005). Engagement with an interactive museum exhibit. In *Proceedings of HCI*, Vol. 1, Springer-Verleg.

Study of engagement with children in an interactive museum.

Laurel, B. (1991). *Computers as Theatre*, Reading, MA: Addison-Wesley.

A book which considers theatre as a metaphor for engagement and interactivity.

Levesque, V., Oram, L., MacLean, K., Cockburn, A., Marchuk, N. D., Johnson, D., Colgate, J. E., and Peshkin, M. A. (2011). Enhancing physicality in touch interaction with programmable friction. *Proceedings of CHI'11*, 2481–2490. ACM.

A study which used O'Brien and Toms (2010) engagement model in a simplified form.

Nakamura, J., & Csikszentmihalyi, M. (2002). The concept of flow. In C. R. Snyder & S. J. Lopez (Eds.), *Handbook of positive psychology* (pp. 89–105). New York: Oxford University Press.

A compilation of results from research on the concept of flow.

O'Brien, H.L., & Toms, E.G. (2010). The development and evaluation of a survey to measure user engagement in e-commerce environments, *JASIST* 61, pp. 50–69.

A survey to measure engagement which could be used to extrapolate ideas.

O'Brien, H.L., & Toms, E.G. (2008). What is user engagement? A conceptual framework for defining user engagement with technology. *Journal of the American Society for Information Science and Technology*, 59(6), 938–955.

Continuation of idea to unify engagement and develop a framework for engagement with technology.

Rieber, L. P. (1996). Seriously considering play: Designing interactive learning environments based on the blending of microworlds, simulations, and games. *Educational Technology Research and Development*, 44, 43-5.

A look at a topic called “play” that is commonly associated engagement.

Sundar, S., Qian, X., Bellur, S., Haiyan, J., Jeeyun, O., & Guan-Soon, K. (2010). Click, Drag, Flip, and Mouse-Over: Effects of Modality Interactivity on User Engagement With Web Content. *Conference Papers -- International Communication Association*, 1.

Looking at engagement specifically applied to web interfaces.

Webster, J. & Ho, H. (1997). Audience engagement in multimedia presentations. *The Data Base for Advances in Information Systems*, 28 (2). 63-77.

Gathers several concepts of engagement and starts to explore the greater possibilities of empirical study of engagement.

Learning

Bayles, M. (2002). Designing online banner advertisements: should we animate? In: *Proceedings of CHI 2002 ACM Conference on Human Factors in Computer Systems*. ACM Press, New York, NY, pp. 363–366

Focuses on the recall and recognition of banner ads in video games to see if animations affect them.

Brophy, J. (2004). *Motivating Students to Learn*. New York: Routledge

A book which details learning in terms of motivation.

Garris, R., Ahlers, R. & Driskell, J. E. (2002). Games, motivation, and learning: a research and practice model, *Simulation & Gaming*, 33, 441–467.

Formulates a model based on learning models to explore how motivations in video games can influence learning.

Hengst, J. A., Duff, M. C., & Dettmer, A. (2010). Rethinking repetition in therapy: Repeated engagement as the social ground of learning. *Aphasiology*, 24(6-8), 887-901.

An interesting take on learning which considers the results of repeated engagement and its effects.

Holley, D., & Dobson, C. (2008). Encouraging student engagement in a blended learning environment: the use of contemporary learning spaces. *Learning, Media & Technology*, 33(2), 139-150.

Study at the collegiate level which looks at engagement and learning through an attempt to get students involved with the academic material as quickly as possible.

O'Neil, H., Wainess, R., & Baker, E. (2005). Classification of learning outcomes evidence from the computer games literature. *Curriculum Journal*., 16(4), 455–47.

Uses already established educational learning models and applies them to computer games.

Robertson, J., & Howells, C. (2008). Computer game design: Opportunities for successful learning. *Computers and Education*, 50, 559–578.

Takes a look at games as a learning tool for younger minds.

Simon, H. A. (1996). Observations on the sciences of science learning. Paper presented at the Committee on Developments in the Science of Learning for the Sciences of Science Learning: An Interdisciplinary Discussion, Carnegie Mellon University, Department of Psychology, Washington, DC.

Considers the idea of If Then Statements in problem solving and learning. Provides an overview of how learning is no longer just about recall.

Self-Determination Theory (SDT)

Bakar, K., Sulaiman, N., & Rafaai, Z. (2010). Self-Determination Theory And Motivational Orientations Of Arabic Learners: A Principal Component Analysis. *GEMA Online Journal Of Language Studies*, 10(1), 71-86.

Using learning a second language as a platform, this study looks at the theory of SDT.

Brophy, J. (2004). *Motivating students to learn*. (2nd ed ed.). New York : Routledge ; Mahwah, NJ: Lawrence Erlbaum Associates.

A book dealing with intrinsic and extrinsic motivations in the classroom.

Comanaru, R., & Noels, K. A. (2009). Self-Determination, Motivation, and the Learning of Chinese as a Heritage Language. *Canadian Modern Language Review*, 66(1), 131-158.

A psychological look at SDT as a motivator and how that affects learning.

Malone, T. (1980). What makes things fun to learn? Heuristics for designing instructional computer games. In *Proceedings of the 3rd ACM SIGSMALL Symposium and the 1st SIGPC Symposium* (pp. 162–169). Palo Alto, US.

A study of a branch of SDT specifically dealing with Intrinsic Motivation Learning.

Moller, A. C., Ryan, R. M., & Deci, E. L. (2006). Self-Determination Theory and Public Policy: Improving the Quality of Consumer Decisions Without Using Coercion. *Journal Of Public Policy & Marketing*, 25(1), 104-116.

Discusses SDT and motivation plus ideas of autonomy and choice.

Noels, K. A., Pelletier, L. G., Clément, R., & Vallerand, R. J. (2003). Why Are You Learning a Second Language? Motivational Orientations and Self-Determination Theory. *Language Learning*, 53, 333-64.

Another study using learning language to explore SDT and motivation.

Ryan, R. M. (1995). Psychological needs and the facilitation of integrative processes. *Journal of Personality*, 63, 397-427.

Early work on the model of SDT.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55, 68-78.

Follow up work to the 1995 article.