An Exploratory Study of Augmented Reality and Mobile Games Examining *Ingress*

Player Motivation and Potential Educational Value

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This dissertation titled
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Player Motivation and Potential Educational Value

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Abstract

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An Exploratory Study of Augmented Reality and Mobile Games Examining Ingress

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The purpose of this dissertation is to explore the nexus of video games, mobile devices, and augmented reality in an educational light. This is accomplished in part by studying the self-reported demographics, attitudes, habits, and motivations of players of Google’s commercial augmented reality mobile game Ingress. An application of a review of the literature informs how games like Ingress can be leveraged for educational means.

Presented is a review of relevant literature, including the historical development of the nature of play and learning, the history and educational usage of massively multiplayer online games and simulations, the use of mobile devices in games and learning, how augmented reality is developing and being used in educational and non-educational settings, and what effects playing video games may have on the player, including problematic gameplay and addiction, gendered concerns, aggressive thoughts and actions, and physical changes identified in gamers or promoted using games. Also included is an examination of a theoretical framework of discovery learning that ties instructional design, learning, and games to Ingress.

Data is gathered with an online survey of Ingress players worldwide. A total of 2,276 cases from 59 countries were analyzed. The instrument used has been modified from an original aimed at other massively multiplayer online role-playing games.
(MMORPGs). The results presented here showed significant demographic and motivational differences between players and between games. Principle component and multiple regression analyses revealed a number of components that describe the motivations of players and related predictors. By comparing these components to scores on an addiction scale, self-reports on interpersonal skills and learning items, valid and reliable predictors emerged. The components identified differ from those found when surveying players of other massively multiplayer online games. Reliable scales for components, an addiction measure, an interpersonal skill measure, and a learning measure were identified. Implications for future studies and research in the field are provided, as well as suggestions for the use of Ingress and other commercial ARGs within the realm of education.
Dedication

For William, a pistol with a son of a gun, and for Constance, my rails.
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This has been a long and tiring road that I could not have traversed without the assistance of a number of people. First, my committee, all of my thanks to my esteemed advisor, Dr. Teresa Franklin, without whom I would not be writing this, much less finishing it. Her constant, unwavering support and belief that I could accomplish this has been an ever-present encouragement. Many thanks to Dr. David Moore, someone who makes it all look so easy and serves to act as an intellectual role model to me. Thanks also to Dr. Greg Kessler for mirroring my excitement about this topic when I first brought it up. Heartfelt thanks also go out to Dr. Seann Dikkers for making me feel welcome in the field and not afraid to jump in.

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Chapter 1: Introduction

I still manage to learn new things all the time. I love that about Ingress.

–Case 1030

Video games have become increasingly visible to the public eye for myriad reasons, including the use of games in classrooms (Bakar, Inal, & Cagiltay, 2006; Ferguson & Olson, 2012; Gee, 2007a, 2007b; Grove, Looy, Neys, & Jansz, 2012; Ke & Abras, 2013), associations with violence (Espinosa & Clemente, 2013; Hasan, Bègue, Scharkow, & Bushman, 2013; K. D. Williams, 2013), obesity (Bickham, Blood, Walls, Shrier, & Rich, 2013), mature content being considered immoral or corruptive (Allen, 2013; Nagourney, Cieply, Feuer, & Lovett, 2014; Nizza, 2007; Tasby, 2013), and links between playing and physical, neurologic changes (Belchior et al., 2013; Golomb et al., 2011; Hummer et al., 2010; S Kühn, Gleich, Lorenz, Lindenberger, & Gallinat, 2013; Simone Kühn et al., 2014; Weng et al., 2013). A great deal of research published on video game playing is negative (Elson & Ferguson, 2014; Ferguson, 2011; Mclean & Griffiths, 2013), which, when coupled with an average of 10,000 hours of online game play by the average United States citizen by age twenty-one (McGonigal, 2014), suggests an urgent need to expand the body of research. Additionally, the move to online worlds is increasing and shows no sign of slowing down (Castronova, 2008), bolstering the need to understand how these worlds affect players and why they make the move to virtual experiences (D. Williams, Yee, & Caplan, 2008). Virtual worlds are not the only type of
online games increasing in popularity, as demonstrated by the augmented reality game
Ingress (Niantic Labs, 2012).

The connection between video games and learning is established and growing
(Annetta, 2008; Jarmon, Traphagan, Mayrath, & Trivedi, 2009; Paraskeva, Mysirlaki, &
Papagianni, 2010; Petrukou, 2010; Sadler, Romine, Stuart, & Merle-Johnson, 2013; M. F.
Young et al., 2012). The inclusion of augmented reality and augmented reality mobile
games into the field is also growing (Facer et al., 2004; Kesim & Ozarslan, 2012;
Rosenbaum, Klopfer, & Perry, 2006; R. G. Thomas, John, & Delieu, 2010). The
following dissertation is an attempt to reconcile the ever-changing frontier of technology,
play, and instruction, in light of mobile augmented reality gaming.

**Statement of the Problem**

In the growing field of gaming studies a few types of games receive a great deal
of attention, like mobile games (Pace, 2013) and massively-multiplayer online games
(MMOGs; alternately, massively-multiplayer online roleplaying games, or MMORPGs)
(Kiraly, Nagygyorgy, Griffiths, & Demetrovics, 2014). A newer addition to this
collection is augmented reality. While these games may have been studied heavily on
their own (an Academic Search Complete search for video games returns no less than
16,000 results, for example), research on the nexus between mobile gaming, commercial
MMOGs, and augmented reality is nascent, at best. For example, a search for augmented
reality and MMO in Academic Search Complete returns one result. As these respective
areas of study continue to grow and develop, the need for continuing research grows in
tandem. With the recent release of Google’s *Ingress* (Niantic Labs, 2012), a commercial, mobile, augmented reality MMOG, an opportunity to examine this presented itself.

**Purpose of the Study**

The purpose of this study was to explore commercially oriented, mobile augmented reality gaming, the motivations and qualities of those who play, and what potential it may have for learning and educational usage. The case study chosen is *Ingress*, an augmented reality, location-based commercial game designed for smartphones and tablets, released by Niantic Labs of Google, Inc. to the public in November of 2012. The present study seeks to determine if traditional means of assessing multiplayer gaming can be effectively applied to games like *Ingress* that combine the social aspects of multiplayer gaming with geo-location, the requirement to physically travel to play, and the potential for learning historical and cultural significance of locations, structures, and artwork. Player demographics, self-reported motivation, satisfaction, and potentially problematic behavior will be examined to better understand who plays games like *Ingress*, why, and can it be potentially leveraged for educational means.

**Research Questions**

The present study is an attempt to learn about augmented reality mobile game players’ natures and motivations, positive or problematic gameplay, and how these games can be used in education. ‘Problematic,’ in this context, refers to addictive-like behavior. The study consists of the analysis of the following research questions:
1. What are the characteristics of those who play augmented reality massively multiplayer mobile games?
   a. Are there significant differences in the demographic characteristics (age, education level, income, family size, and social tendencies) and motivations of Ingress players?
   b. Are there indicators of positive gameplay identifiable in Ingress players’ characteristics, motivations, or behaviors?
   c. Are there indicators of problematic gameplay identifiable in Ingress players’ characteristics, motivations, or behaviors?

2. Using Gee’s learning criteria, what characteristics of people playing augmented reality games like Ingress suggest it may be used for educational means?

   As commercial, augmented reality mobile gaming has not been studied to the same extent as MMORPGs, the results of the survey instrument may illuminate these research gaps and intersections to provide suggestions for further study. Research questions 1a, 1b, and 1c were addressed by surveying players of Ingress, the augmented reality mobile game produced by Google, Inc’s experimental development department Niantic Labs, formerly Google X. A detailed description of the game and how it is typically played can be found in Appendix M. The instrument consists of demographics and self-reported measures on a variety of domains established in the study of players of massively multiplayer online role-playing games (MMORPGs). The language of the original instrument has been altered to be relevant to Ingress-specific vocabulary.
Research question 2 is addressed by applying the review of the literature and the results of open-ended items from the survey instrument.

**Significance of the Study**

As there is little research in the field of commercial, mobile, augmented reality MMOGs (an EBSCOhost search in all available databases for the terms *mobile* and *augmented reality* and *MMOG* returns 8 results published in peer reviewed journals), the current study may significantly improve the body of literature in a growing field. First, is the potential for the educational benefit in the transference of skills from games to real life (Boot, Kramer, Simons, Fabiani, & Gratton, 2008; Brom, Šisler, & Slavík, 2010; Dede, 2009; Ely, 1990; Guillén-Nieto & Aleson-Carbonell, 2012; Haskell, 2001; Kirriemuir & McFarlane, 2004; Voulgari, Komis, & Sampson, 2013). The personal benefit is also apparent: simply the act of playing “constitutes an emotionally significant context through which themes of power and dominance, aggression, nurturance, anxiety, pain, loss, growth, and joy can be enacted productively” (Granic, Lobel, & Engels, 2014, p. 67). Second is the economic benefit to be gained. The video game market worldwide is expected to break $100 billion in 2014 with mobile gaming surpassing non-console computer gaming in 2015 (van der Meulen & Rivera, 2013). In terms of MMOs, in the first financial quarter of 2014, there numbered 7.6 million active *World of Warcraft* subscribers (Stastica, 2014), providing Blizzard with a profit of $239,000,000 (Makuch, 2014). While *Ingress* is free to download and play, the gain is found in the location and mapping data gathered, the worth of which may be hinted at with Google’s purchase of the navigation application *Waze* for $1.3 billion in 2013 (Lobello, 2013). With between 5
and 10 million installations of *Ingress* from the Google Play Store, the “opportunity to study what people actually do when they choose to be in a virtual environment with thousands of other people cannot be overstated” (Yee, 2006b, p. 310). The resultant information about *Ingress* players, how they play, why, and how and what they learn while playing potentially provides the groundwork for utilizing a commercial game like *Ingress* for designing and implementing instruction. In regards to learning, “studies have shown that immersion in a digital environment can enhance education” affording “educators with a novel and potentially transformative tool for teaching and learning” (Dunleavy & Dede, 2014, p. 736) The findings in the present study may provide the foundation for the analysis and use of commercial, mobile, augmented reality MMOGs both tangential to and steeped within educational settings.

**Scope of the Study**

The players of *Ingress* are worldwide and on every continent, including Antarctica (Badger, 2013). The precise numbers are unavailable from Google and individual accounts do not imply distinct individuals as there may be unused, fake, and/or mule accounts (secondary accounts used solely for holding excess inventory, as individual accounts are capped at 2,000 items). The only limitation on who may participate is the terms of service instituted by Google. Respondents need not be currently and actively playing *Ingress*, only that they have actively played at one time. Little to no direct personal researcher-to-participant communication was performed, as it was distributed via a link through the social networking accounts of the researcher and other *Ingress* players. The link was published publicly in October of 2014 and data
gathered throughout the October to November months. Relevant personal communications involved in the development of this study are located in Appendix C.

**Limitations & Delimitations of the Study**

The following is a description of the limitations and delimitations in the present study. Limitations are aspects and influences over which the researcher has no control. These may be shortcomings, issues with the research design or implementation of that research, problems with the instrument, and so on. Delimitations are interesting or influential decisions the researcher made that should be included for proper understanding of the study. This may include actions the reader may expect the researcher to have taken but that the researcher did not, or actions the reader did not expect but the researcher did take.

**Limitations.** The present study was limited by some constraints, most notably technological considerations. The confinement to smartphones and tablets (collectively referred to as *devices*) possibly presented an issue of connectivity, as a working Internet connection is required to play. In remote locations where cellular signals are difficult to find and vary by cellular plan provider, some players may find it difficult or impossible to play, even if the devices are available to them.

The study was not a ‘true experiment’ and therefore cannot be said to claim causation between variables, only correlation. Participation is also voluntary and participants received no direct compensation. As the game is still actively in development, the gameplay and features present at the time of this study may be different from those at the time of its publication.
Being an open study available on the Internet, the results run the risk of being influenced by garbage, multiple, or intentionally misleading responses. Though the consent for plainly stated the respondent must be 18 years old or older to participate, a total of 23 participants responded with an age of 17 or younger. To reach players who are only identified by an agent name and cannot be otherwise contacted outside the game, the survey was distributed via social networks; therefore, if Ingress players did not watch social networks they may not be aware of the survey’s existence. Some resistance was experienced by the researcher by participants due to a number of other Ingress-related surveys being posted online with unfulfilled promises of results.

Participants’ interpretations of items and responses may vary regardless of instruction. One respondent may answer the “How many hours do you play Ingress weekly (give an estimate)?” question with how much time they’ve played on average since beginning, how much time they’ve been playing recently, or even respond with zero if they haven’t played in a few months.

Delimitations. The instrument itself is a variation on a pre-existing survey directed at players of MMORPGs but not a particular game. The language in the instrument was changed to reflect the nature and vocabulary specific to Ingress (though left in its original state when possible), and may or may not be considered a completely new survey. A very small number of respondents reported having issues with the web-based instrument. Due to the near infinite permutations of device, operating system, web browser, and potentially impactful browser extensions, this was considered unavoidable and given the sample size, acceptable. While the application is available worldwide and
is played on every continent, the survey instrument was available in English, only. Localization for further studies may be considered.

**Definition of Terms**

The nature of augmented reality, mobile gaming, and emerging technology suggests a vocabulary that may be unfamiliar to some readers. Likewise, some terminology may be used in the context of this study differently in other fields. The following is a list of such language, as well as *Ingress*-specific terminology.

*Affinity group:* “[The] group of people associated with a given semiotic domain… [the members of which] can recognize others as more or less ‘insiders’ to the group” (Gee, 2007b, p. 27).

*Augmented reality:* Sometimes referred to as “hybrid reality…, augmented virtuality” (Wu, Lee, Chang, & Liang, 2013, p. 42), “alternate reality” (Whitton, Jones, Wilson, & Whitton, 2012, p. 243) or even simply virtual reality, augmented reality is the overlaying of computerized data onto the real world via devices like smartphones or wearable technology (such as Google Glass). It allows for relatively inexpensive and accessible devices like smartphones to reap all the benefits of a fully 3D world without the need for massive computing power. McGonigal (2011) uses the phrase *augmented reality game*.


*CALL/MALL:* Computer-assistant language learning and mobile-assisted language learning is a method of secondary- or foreign-language instruction using, respectively,
computers or mobile devices. This is in contrast to traditional means of language instruction like worksheets and repetition drills in classrooms.

*Design grammar*: “[The] internal design grammar [is] the principles and patterns in terms of which one can recognize what is and is not acceptable or typical content in a semiotic domain [and the] external design grammar [is] the principles and patterns in terms of which one can recognize what is and what is not an acceptable or typical social practice and identity in regard to the affinity group associated with a semiotic domain” (Gee, 2007b, pp. 28–29).

*Flow*: A form of immersion, or “a positive psychological state that is challenging, intrinsically rewarding and enjoyable” (Bressler & Bodzin, 2013, p. 506).

*Game*: “A game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome” (Salen Tekinbas & Zimmerman, 2003, p. 93).

*Gamification*: The application of game-oriented rules and concepts to otherwise non-gaming fields, for example health-oriented websites like Fitocracy in which users level-up by performing workouts or exercises, or Classcraft, a World of Warcraft-type game in which students receive awards or are penalized for good or poor performance in class.

*GBL*: Games-based learning can be considered any formal or informal means of education delivered by playing a game. This ranges from professionally produced serious or educational games to a mock Jeopardy! game in a classroom.

*Machinima*: Short films created by manipulating video game environments and characters with new (and often humorous) scripts. Popular examples include Portal: A
Day in the Life of a Turret (Smooth Few Films, 2007) and Red vs Blue (Rooster Teeth Productions, 2014).

MMOG/MMORPG/MUD/MMO/etc.: Acronyms for, respectively, massively-multiplayer online game, massively-multiplayer online roleplaying game, multi-user dimension, multi-user dungeon, or massively multiplayer online (insert implied game/environment/etc. here). MMO and MMOG have come to be a catch-alls for games of this sort, which range from more explicit MMORPGs like World of Warcraft (Blizzard Entertainment, 2004) to more general MMOGs like Second Life (Linden Lab, 2003).

Mobile gaming: Portable, handheld devices can be used to play games, and these games are referred to as mobile games. Devices can range from personal digital assistants (PDAs) to cell phones to tablets.

PC/NPC: Player Character or Non-Player Character. Used to differentiate between computer-generated and controlled identities in MMOs and avatars controlled by humans. When PCs are permitted to attack other PCs, the game is referred to as being PK or player-killing, the act of which may or may not be punishable, depending on the game and context in which it is performed.

Pinching: A method of manipulating touchscreen displays or augmented- or virtually-realized objects. It “can be used to grab a virtual object” (Kesim & Ozarslan, 2012, p. 300).

Semiotic domain: “Any set of practices that recruits one or more modalities (e.g., oral or written language, images, equations, symbols, sounds, gestures, graphs, artifacts, etc.) to communicate distinctive types of meanings” (Gee, 2007b, p. 19).
STEM: A Congressional Research Service report defines STEM as referring to “teaching and learning in the fields of science, technology, engineering, and mathematics. It typically includes educational activities across all grade levels—from pre-school to post-doctorate—in both formal (e.g., classrooms) and informal (e.g., afterschool programs) settings” (Gonzalez & Kuenzi, 2012, p. 1).

Video game: Any activity participated in that is both bound to a set of rules and played for entertainment using a screen, be it television, computer, or mobile/wearable device.

VW/MUVE/VLE: Respectively, these acronyms refer to virtual worlds, multi-user virtual environments, and virtual learning environments. Virtual worlds may or may not involve multiple players (The Sims (Maxis, The Sims Studio, & EA Maxis, 2014), for example). MUVE (a primarily British English acronym) requires multiple users. VLEs are virtual worlds primarily designed to be used for education.

Wearbles: Catch-all term for any computing device that is worn on the user’s body (like Google Glass), as opposed to one that is simply held or possessed (like a smartphone or laptop computer), praised for potentially “new ways to augmented human abilities, such as assisting the speaking-impaired, and helping remember important information that is perceived” (Pan, Cheok, Yang, Zhu, & Shi, 2006, p. 21).

Official Ingress-specific terminology. There are terms that are specific to Google’s augmented reality game Ingress that, when defined, give the reader a better understanding of this study and the game as a whole. The language used in its gameplay is particular, specific, and fluid. A compendium of the official and unofficial terminology as it was at the time of the present study can be found in Appendix O.
Organization of the Study

This study is organized into five chapters. Chapter one briefly introduces the present study, intended research goals, and how the author planned to go about the study. Chapter two contains the review of relevant literature in the fields of educational technology, mobile gaming, augmented reality, the study of commercial video games as educational tools, and the theoretical framework utilized. Chapter three consists of methodologies used to perform the present research (results of the initial pilot study used to inform and refine the final research instrument are found in Appendix N), and the details and the timeline by which the instrument was publicized and relevant data was collected. Chapter four contains the analysis of the findings, including results of specific statistical tests and their significance. Finally, chapter five presents a summary of the study, findings, interpretations, implications for further study in this field, and a conclusion.
Chapter 2: Review of the Literature

This chapter presents the collection and analysis of available literature surrounding the topics of video games and play. It includes an analysis of what it is to ‘play,’ the history of both the notion of play and online gaming, the types of games that are played, the methods by which games are presented to players, and what impact playing may have on the players. Additionally, it contains an analysis of the ways in which game playing and learning are connected. It concludes by connecting the literature to a theoretical framework used to scaffold the present study. While the topics covered in this literature review may seem disparate, when addressing cultural artifacts like video games and their use in learning and education, one must be aware of all aspects therein.

Play

One plays video games. To study video games, one must understand the concept of play. The works of three writers regarding play and how the final writer’s concept of self-contained realms of literacy tie them together. Follows is, first, an examination of Johan Huizinga’s 1938 treatise *Homo ludens* that attempts to create a working conceptualization of what it means to play and, importantly, the boundaries thereby. Next is an explication of two works by Roger Caillois that serve both as an appreciation of and reply to Huizinga’s work that pave the way for future studies. Finally, the work of James Paul Gee, who ties play in the form of video games to learning, is examined.

**Johan Huizinga.** Dutch historian Johan Huizinga presents his work heavily couched in culture and language. Centrally, Huizinga saw play as an end unto itself: there was no reason to play other than the experience. In *Homo ludens* (Huizinga, 1949) play is
condensed into a single form: *agon*, from the Greek ἀγών, meaning *struggle*. To Huizinga, *play* had only one type though multiple qualities.

To Huizinga, play is not and cannot be a serious pursuit. Though he defines the only type of play as a competitive struggle, he decries the seriousness of it. The lack of clarity regarding gambling (to which Caillois addresses a response and critique) or sports games where participants abide by all Huizinga’s rules of what defines play but take it very seriously is problematic (H. Rodriguez, 2006).

Huizinga’s concept of play is broken down into five inherent qualities: it is voluntary, it is contra reality, it exists in its own agreed-upon space, it pits desire against arbitrary rules, and it creates ad hoc cliques or tribes.

**Play is voluntary.** Huizinga claims “all play is voluntary activity” (1949, p. 7), free in that it has no extrinsic goal or end; it is both the means and the end, and once play is required to accomplish something, it ceases to be play. He draws an important distinction between *play* and *playful*. While a child’s play may be voluntary, Huizinga claims that play occurs because it *must* occur. Accordingly, he belabors the point that while play may be instinctual, it is not *instinct*. “The term ‘instinct’ … introduces an unknown quantity, and to presuppose the utility of play from the start is to be guilty of a *petito principia*. Child and animal play because they enjoy playing, and therein precisely lies their freedom” (Huizinga, 1949, p. 8). Play can be paused and return to with no warning or preparation and is never obligatory. This leads to the second part of his definition of play: its separation from *work* or reality.
**Pleasure.** Play can never be work because play lacks an end (Huizinga, 1949). By example, a worker completes tasks—playful, though they may be—to reach a goal for the sake of reaching that goal, whereas, a player plays for the pleasure. This is not to say that play must preclude beneficial results: improved hand-eye coordination may result from playing video games, but this is not why people play them (van Dongen, Verleisdonk, Schijven, & Broeders, 2011). As pleasure is both the reason and result of play, it is not bound by external constraints and exists in its own contra-reality space. Since there is no end or way to determine it, part of the enjoyment comes from the ignorance. Consider a game of roulette: part of the enjoyment is the anticipation as the ball bounces around the wheel, its resting place unknown to the players. It is that segregated moment between player and game, that leads to Huizinga’s next aspect of play: the “magic circle” (Huizinga, 1949, p. 10).

**Use of the term ‘magic circle’**. Huizinga used the phrase magic circle in 1949; the phrase has been applied to games like World of Warcraft and the popularity of the phrase has grown in tandem with the game (E. Castronova, 2005). By magic circle, Huizinga suggests play exists in solitude. It has its own important, arbitrary rules. It is essential in the magic circle that arbitrary rules are followed in a sense of fair play. Those in a magic circle make an agreement: abide by the rules if you wish to remain inside. Cheaters are dealt with harshly, whether being shot in a saloon poker game or being banned from a World of Warcraft server or even prosecuted, as in the case of Ceiling Fan Software in 2013 (Handrahan, 2013). It is this tension between fair play and cheat-to-win that is described in Huizinga’s fourth part of the definition of play.
**Rules.** Play plots desire against arbitrary rules. While it may seem contradictory that “it creates order, *is* order” (Huizinga, 1949, p. 10) and is also freedom at its core, the order is necessary. It is not enough to simply have arbitrary rules; they should confine or hinder to create tension. Consider a game of hide-and-seek. If the seeker wished to win regardless of the rules, she could simply watch where the others hide. Likewise, if the player being sought wished to win in spite of the rules, she could keep moving. Play requires the abiding by rules in the face of the desire to win, maintaining fair play. This portion seems similar to the previous but with one important distinction: following the rules is not always an option. Blackjack, for example, is a game wherein the player has no power over the dealer, the dealt cards, or if and how rules are enforced. To Huizinga, this is where instinct becomes problematic (1949, p. 50), as it can break down rules by allowing the desire to win to overcome the restraint of fair play. If all players involved do manage to maintain fair play it leads to the final portion of Huizinga’s definition: the teams or tribes.

**Play-based groups.** The magic circle of play creates boundaries of us-and-them and creates tribes or what Huiznga calls “phratria…e.g. clans, brotherhoods, etc.” (Huizinga, 1949, p. 12). As people play they create ad hoc cliques that frequently exist only as long playing continues. This is why play cannot exist generally in the public: the player/non-player demarcation is ever present. Players may move in and out of these groups in a variety of trajectories and can exist in multiple groups simultaneously (Oliver & Carr, 2009), but the conflict always exists. Though these qualities of play that
Huizinga describes may seem thorough, they must be applied to understand what play truly is.

**Play as a concept.** Play is a wholly unique concept. It transcends age, biology, culture, geography, and any artificial domain established (Huizinga, 1949). Even animals play. To illustrate its uniqueness, Huizinga says it cannot be an alternative to something else, reflecting upon his issue taken with play being *instinct*. This can be illustrated by a game of touch football. While improved health may result, the players did not go into the game with this as the *sole purpose*. That would make it *work* as the end is separate from the means. Work has a desired result that is external to itself; in play, that result must be incidental, though it may exist (a doctor tells her patient that more exercise is needed, so that patient joins the touch football team because he enjoys playing football; if exercise were the only goal, a treadmill would suffice). Huizinga has been subsequently criticized for failing to support this notion (Caillois, 1960, 1961; Henricks, 2010).

**The ‘otherness’ of play.** Play also concerns itself with the *other*. That is, one cannot play alone (Huizinga, 1949). Even though a child may be solitary, playing make-believe with dolls, without the projection of her own imagination onto those dolls, it could not be *play*. One possible way to understand this idea is to imagine thinking of nothing, or eating a meal that does not exist. There is always an antecedent: one thinks *something*, one eats *something*. If one is playing, there is an *other* present, even if that other is an extension of the self.

Even though play can be imaginary, Huizinga suggests it is the experience that is at the core of all play, not the concept or the method. If the experience is bad then the
play will halt, much as if two children are rough-housing and the fun turns to violence (Huizinga, 1949). Once the pleasurable experience ends, so does the playing. It appears that the only line between the playground and the battlefield is one drawn in the sand (Caillois, 1960).

Huizinga’s analysis of play preceded more complex research and theories. His definition of play was only slightly altered in the following years, though a number of different types of play—as opposed to his singularly identified agon—have been brought forth, most notably in the 1960s by Roger Caillois.

**Roger Caillois.** Roger Caillois, a mid-21st century French sociologist, was to take Huizinga’s *Homo ludens* (1949) and both exalt and critique it in his two best known works, *Man and the Sacred* (1960) and *Man, Play, and Games* (1961). The following discusses his updated definition of play and will examine both texts in relevance to Huizinga’s writings and on their own merit. In some ways, Caillois supports Huizinga wholeheartedly, while in others he differs wildly.

One way Caillois differs from Huizinga is in his definition of play, for which Caillois has six parts rather than five. According to Caillois (1960), play is: free (optional and voluntary); separate (exists within the magic circle); has an unforeseen end (the result is unknown to the player); there is nothing to gain (it is not work); it has arbitrary rules; it is unrealistic (it exists outside of real life). The difference is that Caillois believes the inability to know how play ends is vital enough to promote it to being part of the definition of play, rather than being relegated to just a vague descriptive addition.
Secondly, Caillois differs from Huizinga in that he thinks play to be the dichotomous relationship between the *sacred* and the *profane*. While Huizinga believed play was antithetical to work or seriousness, Caillois was more interested in the tensions between the *sacred* and the *profane* (Henricks (2010) suggests this is mainly because of the great deal of influence Durkheim’s work had on Caillois). It is this difference that is the main crux of his argument in *Man and the Sacred* (Caillois, 1960). This text is discussed briefly before moving on to his most well-known text, *Man, Play, and Games* (Caillois, 1961), in which Caillois breaks types of play down into four distinct partitions in stark contrast to Huizinga’s sole type, *agon*.

**The sacred and the profane.** Due to Caillois’ heavy influence by Emile Durkheim, another French sociologist, and Durkheim’s concept of the sacred and the profane, a new look at *play* was developed. Caillois (1960) compares the magic circle and the arbitrary rules of play to the rituals and taboos in sacred spaces. He does believe they can mix at times and up to a point, but unlike Huizinga who practically conflates the two, Caillois believes there is a fundamental difference between play and ritual.

To illustrate the difference, Caillois (1960) draws a distinction between *form* and *content*. To him, play is all about the form: how people are playing, the experience, and so forth. He maintains that play is “an activity that is an end in itself, rules that are respected for their own sake” (Caillois, 1960, p. 157), agreeing with Huizinga. He further agrees that play equally the moment as the event, both the means and the end. In contrast ritual is “pure content—an indivisible, equivocal, fugitive, and efficacious force” (Caillois, 1960, p. 157).
Caillois (1960) emphasizes the difference between play and ritual, that in playing people maintain control over the happenings inside the magic circle, while in ritual they relinquish that power. While playing, players are allowed to determine how seriously they want to take the rules; in ritual, belief in transubstantiation is mandatory, for example. Play is internalized while ritual is externalized.

**Defining play differently.** Caillois’ most famous work, *Man, Play, and Games* (1961) (Fr., *Les jeux et les hommes* – note that in French the noun *jeu* (pl. *jeux*) refers to both *play* and *game*), focuses on the idea that play is multifaceted and more complicated than Huizinga’s notion that it is simply agonistic, and thus deserves to be redefined and reviewed. To illustrate this quickly and simply, Caillois chooses gambling. He believes that gambling crosses enough lines to make Huizinga’s definition of play incorrect (or at least incomplete), as “games are not ruled and make-believe. Rather they are ruled or make-believe” (Caillois, 1961, p. 9), to which he believes gambling applies. He describes children mimicking adults playing chess so as to have the appearance of playing a game, but not actually following any of the rules. (Interestingly, Caillois is essentially, in his explanation of why Huizinga’s definition of play is too confining, describing John Searle’s (1980) artificial intelligence thought experiment of the Chinese Room more than twenty years ahead of time.) Caillois’ (1961) expanded vision of play describes activities that are, as ordered in his text, free, separate, uncertain, unproductive, governed by rules, and make-believe.

**Types of play.** Beyond simply the definition of play, Caillois suggests that there are more than Huizinga’s single agonistic type of play and expands the list to four:
competition (*agon*), chance (*alea*), roleplay or simulation (*mimicry*), and balance- or vertigo-driven play (*ilinx*). It is important to note that Caillois (1961) is simply making the point that *agon* insufficiently covers all types of play, not that his list of four types is exhaustive. If the four types of play are imagined on two axes, any activity deemed *play* would fall somewhere on that graph, but Caillois adds yet another dimension to this.

**Paidia and ludus.** In addition to his tetrad of play types, Caillois (1961) devises a continuum upon which each instance of play will fall between a carefree extreme (*paidia*) and being wholly rule-based (*ludus*). After all, “ludus and paidia … are not categories of play but ways of playing” (Caillois, 1961, p. 53). He claims that the closer a game *naturally* is to the paidia extreme, the higher the difficulty and more skill required as ludus is applied. A modern example to illustrate: video games are often created with ‘normal’ difficulty levels and other levels of higher difficulty beyond that. For some extremely skilled or dedicated players, even this is not enough, so they may add arbitrary constraints to their playthroughs: for example, a “low level” playthrough of a role-playing game (RPG) or a “pistol or knife only” playthrough of a first-person shooter (FPS). By creating these artificial and arbitrary rules on top of the rules of the game, players are moving the experience closer to the ludic extreme, increasing the relative difficulty. Interestingly, Caillois dismisses the idea that the difference between mental and physical requirements of play is relevant at all: difficulty is difficulty, regardless of the domain.

**Agon and alea.** To explore the new types of play Caillois established, he compares agon (struggle) with alea (chance) by way of gambling (*alea* is Latin for a sort
of dice game). He suggests that alea signifies a complete relinquishing of control (Caillois, 1961). As such, there is no amount of skill or preparation involved. Agonistic play is by definition competitive, but a game of dice is also competitive. Is there struggle in dice games, as agon requires? Some games like rugby or boxing are surely rife with struggle, but there is none in a game of dice. It is for this reason that Caillois makes the distinction.

**Mimicry and ilinx.** Mimicry, though, is different from either agon or alea partially because it relies on the person becoming the *other*. It is also different because there is, unlike agon, no preparation or skill that must be honed, nor, unlike alea, is it a game of chance. One example Caillois provides is children playing make-believe, such as policemen. A game of Cops n’ Robbers illustrates: the child who plays the robber has no thieving skills, skills unrequired for pretending to be a robber. Nor is the robber competing against other robbers to determine who the better thief is. She is simply playing the part of the robber as best she can. Imagine a festival: clearly those dressing up in costumes are engaging in mimicry, but there may be a level of overlap with agon: it may be a point of pride for some festival-goers to have the flashiest or most accurate costume. In this way, mimicry and agon *can* overlap at times. By contrast, Caillois says there is no overlap between mimicry and alea, as there can be no roleplay or simulation that is all up to chance (1961, p. 21). By definition, mimicry requires planning and forethought.

The fourth type of play is ilinx, which comes from the Greek for *whirlpool*. It is the type of play that is actioned by moving the body around as the end, not the means.
For example, ilinx could be identified as children spinning to become dizzy or adults enjoying the disorientation caused by riding rollercoasters. Caillois describes it rather beautifully as “an attempt to momentarily destroy the stability of perception and inflict a kind of voluptuous panic upon an otherwise lucid mind” (1961, p. 23).

Though Caillois does point out a number of flaws in Huizinga’s definition and adds a considerable amount to what play is and how it is performed, they agree wholeheartedly that when play and reality come into contact, bad things happen. Both agree that forcing play to be something else is a bastardization that forces it into a limbo between work and play: while it is neither, it is an affront to both. Tricking school children into thinking work is play, for example: “what was an escape becomes an obligation, and what was a pastime is now a passion, compulsion, and a source of anxiety” (Caillois, 1961, p. 44).

To summarize that portion of his treatise on play, Caillois calls for a balance of paidia and ludis. Too much ludus and there is not enough freedom to play; too much paidia and there is not enough constraint to keep the play within the magic circle. Ironically, play, which is typically thought of as something that is unbound and carefree, relies, according to Huizinga and Caillois, firmly on constraint. Play, contemporarily, has come to be associated with video games, environments that are essentially constrained in virtual worlds or simply the programmed boundaries. It is this relationship that is examined next.

James Paul Gee. James Paul Gee, linguist and games scholar, brings play into the digital age by introducing video games to the notion and connecting it with learning. Part
of his work includes the 36 learning principles (Gee, 2007b, pp. 221–227), reproduced in Appendix A. Though Gee’s work covers many areas relevant to this topic (his “probe, hypothesize, reprobe, rethink cycle” (Gee, 2007b, p. 87), learning principle #15, being essentially a video-game-centric Constructivist epistemology), the focus is on the semiotic domain and its nexus between play and learning.

If concession can be made that video games exist in the realm of play, then Gee brings Huizinga, Caillois, and those after into the 21st century. Huizinga and Caillois claim play is active engagement, to which Gee contrasts schooling, which he says is a traditionally passive experience: teachers present knowledge and students accept it (Gee & Hayes, 2011). Conversely, Gee (2007a) aligns the notion that players must master something slightly harder than they’ve done before to progress with Vygotsky’s zone of proximal development and the idea of scaffolding. To Gee, there are learning principles embedded in every video game. The better the game, the better the learning principles, and vice versa. His book, Good Video Games + Good Learning (Gee, 2007a) focuses on this. Good to Gee is an attempt to engage players to promote persistence, to always strive for that next challenge that is slightly harder than the last. One six-year-old said to Gee in an interview, “Hard is always better, easy is not” (Gee, 2007b).

Gee spends a great deal of time in his various works discussing how learning can and does occur by playing video games, but the focus in this context is on his semiotic domain, as it most closely follows the path set out by Huizinga and Caillois. The reason is simple: any and every instance of play exists within a semiotic domain, Gee’s literacy-driven magic circle. The borders around play’s arbitrary rules and the secrecy that
Huizinga and Caillois discuss exist equally within Gee’s notions. The terms must be defined first: Gee identifies a conceptual triad for play and learning, being the semiotic domain, the *design grammar*, and the *affinity group*.

**Semiotic domains.** Gee provides some examples of semiotic domains: “cellular biology, postmodern literary criticism, first-person-shooter games, advertisements, Roman Catholic theology, modernist painting, midwifery” (Gee, 2007b) and more. The semiotic domain is essentially a multimodal, cordoned-off realm in which a particular set of things happens, though this set is not limited to anything in particular. Writing novels or journal articles would be semiotic domains, for example. They exist everywhere and in every context, the matryoshka dolls of literacy. To use a video game example, while real-time strategy (RTS) games and first-person shooter (FPS) games would both have their own semiotic domains, they would both fall under the general *video game* domain. Games may even have sub-domains within them like the navigation of race, gender, or heteronormativity, even domains linked to the embodied performance of the player as their avatar (Hutchinson, 2013). Gee also points out that much of schooling is its own semiotic domain. For example, sophomore chemistry is its own domain because the associated design grammar is wholly unlike any chemistry design grammar outside the school (Gee, 2007b).

**Design grammar.** Design grammars come in two forms: internal and external. The internal design grammar of a semiotic domain consists of “the principles and patterns in terms of which one can recognize what is and what is not acceptable or typical content in a semiotic domain” (Gee, 2007b, p. 28). Gee describes this as essentially pattern
recognition: being able to identify the qualities existent or lacking that evoke membership or exclusion. The external design grammar consists of “the principles and patterns in terms of which one can recognize what is and what is not acceptable or typical social practice and identity in regard to the affinity group associated with a semiotic domain” (Gee, 2007b, pp. 28–29). Part of the design grammar is a specialized vocabulary or language or signs used to communicate within the semiotic domain. A raised hand in class signifies that a student wishes to respond or ask a question, while a raised hand in an auction means something quite different. Knowing and interpreting the meaning behind the gesture is the crux of the design grammar.

**Affinity groups.** The existence inside a semiotic domain and the proper use of its design grammar then places someone within that domain’s *affinity group* (Gee, 2007b), Gee’s version of the secrecy and us-and-them notions of Huizinga and Caillois. He identifies the affinity group as the insiders of a given domain. It allows for this population to share various cultural standards and norms, regardless of individuality (Gee, 2007b). Once these are established, literacy can be explored and learning becomes authentic (Gee, 2007a).

**Establishing literacy.** Literacy in a particular domain allows movement deeper within the domain and its associated affinity group. ‘Literate’ in this context simply means effective and efficient interpretation of the design grammar. Domains can be extremely specialized so proper interpretation is essential. Learning this grammar is no different from a new language: people *bootstrap* or parrot more advanced members of the group (Gee, 2007b). Entering a new domain becomes problematic for initiates, as they
are unaware of—or at least unfamiliar with—the intricacies of the domain, the grammar, and other members of the group. Consider the word *foul* in relation to sports. An initiate to the affinity group for a particular basketball team’s semiotic domain would need to know that *foul* means to sufficiently break the rules enough to incur penalty, rather than to sully or pollute. Gee calls this “sociolinguistics” (Gee, 2007b, p. 28), and it is the understanding of these nuances that produce literacy in a domain.

Once the domain is identified, literacy is achieved within the design grammar, and membership to the affinity group is acquired, Gee suggests that all the requirements exist for authentic learning (Gee, 2007b, 2008). He defines this as any “learning that leads to the growing mastery of the semiotic domain’s design grammar and growing membership within its associated affinity group” (2008, p. 138). Huizinga and Caillois would identify this as someone who participates in a particular form of play and improves, as the playing reinforces itself and becomes iterative. Consider a game wherein all players are at level 1. Those who progress and get better attain level 2. There then exists a community of all players, and sub-communities, one for each level. While the affinity groups become split and segregated as more people play and make varied progress, it simply means that authentic learning is occurring throughout and at differing speeds.

Gee criticizes current schooling and learning processes, saying that the social context of the content is lacking (2011). Two students classically illustrate this point: one student grew up on a farm, and another in a dense urban environment. Both students receive the same standardized test that contains the question, *What is a lark?* It is entirely possible that the rural student’s response will be *a bird*, and the city-dwelling student will
respond a cigarette. Gee is suggesting that for authentic learning to occur, the context is essential: that content without context is impotent. Beyond learning, literacy itself is contextual. Taking this to its logical extreme, he identifies the pervasiveness of the Internet as the most profound driver of the learning-as-social-event concept in contemporary times: there is learning occurring just as much in Animal Crossing as in World of Warcraft because they exist in their own semiotic domains, have their own design grammar, their own affinity groups, and require literacy within the domain to progress in the games.

**Resource precursor trajectories.** Beyond this, Gee discusses his concept of the resource precursor trajectory (RPT). He nods to constructivist theorists by addressing this scaffolding concept: “An RPT for a given semiotic domain is the set of all semiotic domains that contain elements or are associated with affinity groups that facilitate mastering that given domain” (2008, p. 147). An example best explains this idea: for a student to attain mastery in the semiotic domain of high school calculus, there are many precursor domains that she must attain mastery (or near-mastery) in prior. These may include algebra, geometry, trigonometry, statistics, or even logic and philosophy. The way in which Gee (2008) differentiates between “advantaged” and “disadvantaged” learners is to examine how “well precursed” or “poorly precursed” the student is (p. 147). It may be, to Gee, that when a student seems to be failing or unable to keep up in a certain class or with a certain task, it’s simply because the literacy the teacher is requesting from the student is not built upon previously well-precursed semiotic domains. This may not be the student’s fault (though she is often blamed, regardless), hence
trajectory, a path the student has been set on that may or may not be her doing.

Understanding how precursor domains are presented to students is key to promoting mastery in the currently addressed domain.

In short, Gee maintains that if mastery of a semiotic domain is occurring, learning is also occurring. Since play and video games exist within semiotic domains, learning occurs as we play, be it video games or Cops n Robbers. It’s the negotiation of the semiotic domain that serves as the nexus between playing and learning. Following is a history of virtual worlds and massively-multiplayer online environments (MMOs) and an examination of games and learning.

**History of Virtual Worlds and MMOs**

While video and mobile games, as well as augmented environments, may create virtual worlds in the narrative sense for users, there also exist virtual worlds that are closer to multiverses in that they are persistent, numberless, and usually ever-expanding. Mobile gaming and augmented reality will be discussed in a later section after an exploration of virtual worlds, MMOGs, and their myriad variations.

The history of virtual worlds and MMOs is long, dating back to the mid-1970s with text-based games played on university networks, then multi-user dungeons (MUDs) played via the telnet protocol between servers in the 1980s (Freitas, 2006), on to the relatively primitive 3D virtual worlds of the 1990s, and then to the immersive environments of the 2000s and 2010s familiar today (Messinger et al., 2009). They promote enjoyment, innovation, and collaboration, but there are considerations to be made: realism, depth-of-field, lighting, means of communication, server availability and
load, user bandwidth, even the inclusion of haptic feedback (Lin et al., 2008). These may create problems for both the developers and users of virtual worlds, but the field shows no signs of slowing down in its growth, especially in the field of education (Kim, Lee, & Thomas, 2012). Virtual worlds are seemingly being created daily for nearly every subject imaginable.

As there are scores of virtual worlds designed for virtually any topic or need, Duncan, Miller, and Jiang (2012) developed a taxonomy to better organize and understand those virtual worlds that relate to education. The authors make a distinction between virtual worlds (VWs), multi-user virtual environments (MUVEs), and virtual learning environments (VLEs), pointing out the difference between VWs and MUVEs being that some VWs could be played offline (the authors reference *The Sims* [Maxis et al., 2014] as an example; or *Dark Souls* [From Software, 2011], as they are simultaneously solo and multiplayer games, allowing the player to prioritize either one to her liking). VLEs are specifically aimed at “enabling teaching and learning” and may include “educational documents, assessment uploading and tools as well as a communication facility between tutors and students” (Duncan et al., 2012, p. 950). The term *virtual world* is used generically to include MUVEs and VLEs.

**Learning in Virtual Worlds and MMOs**

MMOs fall into the category of virtual worlds, which Petrakou (2010) suggests can be used as effective learning environments for students, but that students need to be very familiar with, first. In addition to familiarity, synchronous interactivity and
communication should be scaffolded by asynchronous methods, but within the virtual world in particular, much like a social bulletin board found in traditional MUDs.

Moving in the direction of literature on serious virtual worlds for learning, there appears to be, according to Wrzesien and Alcañiz Raya (2010), the lack of a “rigorous methodological approach” (p. 179). The authors examined the E-Junior software, built to match the standards and learning objectives of Spanish elementary schools, and found in terms of learning effectiveness, that it was not significantly different from standard schooling. Students who used E-Junior reportedly enjoyed it more than traditional schooling, though according to the students it could have been improved by making it less boring or by increasing the interactivity regarding the “passive form of instruction before the active form of learning” (Wrzesien & Alcañiz Raya, 2010, pp. 184–185). Methods of improving playability while maintaining pedagogical considerations include having an interdisciplinary team involved in the development of educational games or virtual worlds (Sadler et al., 2013) or utilizing a more active development methodology (Paraskeva et al., 2010).

In contrast to typical brick-and-mortar school environments, “MMOG players seem to develop inquisitor, exploratory, social and collaborative behaviors [that] could inspire the design of educational activities, and introduce new models for creativity and learning, appropriate for the current social, technological, and work demands” (Voulgari et al., 2013, p. 246). The design of these virtual environments when learning is the goal cannot be understated. The authors continue: “the learning and acquisition of expertise in MMOGs do not constitute the goal of the environment but rather emerge spontaneously
as a means for attaining the goals” (p. 264). The development of learning outcomes with this in mind may serve game designers best.

Building upon current considerations is, for some, not enough. The development of *Schome* (a portmanteau of *school* and *home*) represents just such a movement. Twining (2009) suggests the complete restructuring of the British school system using virtual worlds—in this case, *Teen Second Life*, an instance of *Second Life* created especially for adolescents—into a brand new paradigm. While thoughts on changing how students are formally educated normally center on altering existing methods or directions, “the Schome Initiative starts from the assumption that reforming our existing systems will fail to deliver an optimal system; the degree of change needed is too great, as is the resilience of socially embedded complex systems” (p. 497). While the Schomes system of virtual world-supported education may not have caught on (the Schome Forum [http://www.schome.ac.uk/forum/index.php](http://www.schome.ac.uk/forum/index.php) has been largely deserted since 2011 when Schome Park in *Teen Second Life*, having been moved to the main grid, closed), it at least demonstrates that there is considerable interest in the type of virtual community Schome attempted to create.

**Immersion and flow.** Immersion is a key aspect of games in general, but especially in virtual worlds. As when Kushins (2014) played *Second Life* without the Oculus Rift and then with it, noting the intense difference, immersion is seemingly the goal behind the design of virtual worlds. Faiola, Newlon, Pfaff, and Smyslova (2013) call upon Csikszentmihalyi’s concept of *flow* to describe the nine dimensions of its nature, including timely feedback, a “loss of self-consciousness… [an] altered sense of time,
[and] the experience of becoming ‘autotelic’” (p. 1114). (They point out this flow also exists while learning, though it may be more colloquially recognized as being in the zone.) The authors regard play as an autotelic experience; harkening back to the works of Huizinga, Caillois, and Gee, noting that play is for itself, not to achieve any external goal. The suggestion, then, is that a successful virtual educational world achieve the greatest flow possible (Kirriemuir & McFarlane, 2004). In support, Hwang, Wu, and Chen (2012) linked flow and intrinsic motivation, “‘perceived ease of use’ and ‘perceived usefulness’” (p. 1254) of game-based learning.

Some virtual worlds lend themselves to ease of use and immersion (flow) better than others, and some users find them easier to use than others. H. Lu, Brockmann, and Stieglitz (2013) examined a cohort of German digital immigrants and their use of virtual worlds and found that some of the “game-based functionality” (p. 346) made it difficult for them to gain full utility in the virtual world. The notion of digital natives and digital immigrants, Marc Prensky’s (2001a, 2001b) differentiation between those for whom technology is and has been ubiquitous and those who came into the digital world but were not born into it, respectively, is still in the zeitgeist. It may be noted that this dichotomy alone may no longer be sufficient (Watson, 2013), and the notion of digital tribes should replace it. This is scaffolded by the age range of the digital immigrants (23-48) in Lu et al. (2013).

**Second Life and World of Warcraft.** Second Life and World of Warcraft, two wildly different genres of virtual world, may trace what the future holds for virtual worlds (Bainbridge, 2007). In 2007, when virtual worlds of that caliber were still fairly
nascent, these constructs were seen as holding great potential for, among other things, testing artificial intelligence (can players tell if another character is a PC or NPC?), the testing of human-computer interface models, or even sources of new media like machinima (Bainbridge, 2007). The study points out that, at least in 2007, there was a tremendous gap between virtual world and virtual reality, the gap mainly consisting of the lack of immersion. Since then, great strides have been made, the most popular of which recently being the Oculus Rift. As wearable devices become more popular and affordable, this trend is likely to increase.

Over a number of studies, Nick Yee (D. Williams et al., 2008; Yee, 2006a, 2006b) examined the motivations of MMORPG players via self-reported personality traits. Thousands of players responded to the survey and provided Yee with an impressive and unmatched sample to study. Breaking down responses into a small number of factors and analyzing those with collected demographics, Yee was able to paint a picture of the average player that was anything but the stereotypical, anti-social, uneducated young male (more on this notion in following sections). The different components of Yee’s study show people not only play games differently, but may even appropriate the game and their experiences to their liking, choosing to “customize their gameplay” (Herodotou, Winters, & Kambouri, 2012, para. 38).

Lau and Lee (2012) suggest one of the most effective means of improving users’ experiences and making the use of virtual worlds more fun is the introduction of “unusual environmental stimulation” (p. 13). That is, to develop ways and means that can manifest only in a virtual world, not to simply recreate what already occurs in the real world. A
basic example from the study was students *flying* during a creative exercise in *Second Life*, which turned out to be very enjoyable. Still, *Second Life* provides a great deal more than merely the opportunity to virtually fly.

*Second Life.* *Second Life* (Linden Lab, 2003) has established itself as one of the dominant virtual worlds available in part by its adoption by centers of business and higher education. Even though it may have “slowly slipped out of the cultural consciousness” (Kushins, 2014, para. 1), it boasts over 37,000,000 signups since its public launch in 2003, and still receives an average of 10,500 new signups every day (Voyager, 2014). Thanks to the acquisition of the Oculus Rift by Facebook, Linden Labs is developing a new virtual world specifically for use with wearable virtual reality gear (Dredge, 2014), potentially heralding a second chance for *Second Life*.

The world. As it is, *Second Life* is still the center for a dizzying array of useful locations and services. Among its more notable, myriad uses are holding virtual lectures in online classes, hosting concerts and health clinics, collaborative computer-aided design and architecture development, even the recreation of “the Sistine Chapel… and the Dresden Museum” (Baker, Wentz, & Woods, 2009, p. 60).

The use of *Second Life* is a boon for medical and health librarians and educators (Boulos, Hetherington, & Wheeler, 2007). The authors describe *HealthInfo Island*, created in concert with the National Institutes of Health, a location that included areas devoted to various aspects of medical research, including the Virtual Neurological Education Center (VNEC), developed in connection with the University of Plymouth.
With the opportunity for real-time interaction and video streaming, it opened an encouraging avenue for the dissemination of accurate and timely health information.

Virtual worlds are also being used to drive innovative practices in the real world. Kohler, Matzler, and Fuller (2009) examine the integration of virtual worlds with research and design in the realm of business. Corporations like Coca-Cola, Alcatel-Lucent, Toyota Scion, and Mazda have taken to using avatar-based virtual worlds as a means to examine and improve product development. Beyond just product development, companies may design and test devices, locations, architecture, even the background music being played at brick-and-mortar stores (Kohler et al., 2009, p. 397). Notable examples of this are the customizing of Toyota Scions, prototyping new Aloft hotels (Kohler et al., 2009), or even the clothing company American Apparel debuting new styles of clothing on Second Life before they appeared in stores (Edery, 2006). In a study performed by Luse, Mennecke, and Triplett (2013) on businesses and virtual worlds it was similarly found that while there may be benefits to the interactivity and collaboration inherent in virtual worlds, business professionals are simply more likely to send an email or text message than log in or even begin a video call. Though traditional business models may not lend themselves to the innovative and interactive nature of virtual worlds, other areas do.

*The classroom.* While virtual worlds are useful in doling out interactive and interesting material, using them to teach takes the interactivity to a new level. Jarmon, Traphagan, Mayrath, and Trivedi (2009) conducted an interdisciplinary graduate-level course in communications in Second Life. In 2007, when the study was performed, it was
already host to myriad topics: “cultural anthropology, Spanish, library science, professional development, history, training for emergency personnel, literature, human reproduction, ecology, genetics, educational informatics, English, algebra, toxicology, music, and Japanese culture” (Jarmon et al., 2009, p. 170), suggesting it was a valid arena for communication studies, as well. Utilizing a virtual world for experiential learning—though the class consisted of five heavily-vetted students—appears to be a worthwhile pursuit, but the authors note that “when the SL instructional activities have been well-planned and integrated into the core course content, using SL can be conducive for project-based experiential learning of interdisciplinary communication” (Jarmon et al., 2009, p. 171). Schiller, Goodrich, and Gupta (2013) reiterate this notion by utilizing SL in teaching an undergraduate course in marketing and reporting the same results: “SL can be enjoyable and effective for teaching and learning [as] students can be empowered by the firsthand experience through active learning to gain a stronger learning experience and enhanced learning outcomes” (p. 59).

Implementing a virtual world as a virtual classroom is no simple task. While Jarmon et al. (2009) and Schiller et al. (2013) demonstrate it may be useful for experiential learning, Kavia et al. (2011) look at it through the lens of problem-based learning in a small group setting with an eye to “develop guidelines and best-practice for delivering [problem-based learning] in immersive worlds” (p. 119). Of note are the themes that percolated to the surface during the study: “technological challenges, pedagogical design, usability and avatar identity, collaboration and interaction” (Kavia et al., 2011, p. 171), following the thread drawn by Jarmon et al. (2009) and Salmon (2009)
that efficient and effective learning in virtual worlds occurs in tandem with a substantial considerations. Pfeil, Ang, and Zaphiris (2009) address frequent issues and concerns about using virtual worlds to teach—like problems getting students to sign up, difficulty in assessing exploration, etc.—and provide relevant challenges and opportunities, while Warburton (2009) lists a number of these considerations, which he refers to as barriers: “technical” (bandwidth, hardware, etc.), “identity” (the potential difficulty in developing social ties), “culture” (communities may be difficult to create and maintain), “collaboration” (outside resources like forums may be required and maintained), “time” (building and teaching in virtual worlds takes significant time, of which teachers typically have little), “economic” (who pays for licensing, etc.), “standards” (maintaining a high level of quality can be problematic), and “scaffolding persistence and social discovery” (much of the community established by users is lost after logging off) (pp. 423-424).

Franklin (2008) examined how, taken from various technology- and education-related fields, users like participants in the National Science Foundation grant sponsored “Science and Technology Enrichment for Appalachian Middle Schoolers (STEAM) project, technology coordinators…, school administrators, a [virtual school] representative, faculty members from [a university] campus, and graduate students in instructional technology who plan to enter Higher Education as faculty in the future” (p. 34) considered, reacted to, and reflected upon Second Life. While users generally felt very positively about Second Life as a concept and a tool, those feelings were tempered by concerns of learning curve and time spent in-world, and that “the K-12 school environment was not quite ready for this technology due to legal issues and equipment
needs” (p. 38). Virtual worlds like *Second Life* hold great possibilities for the future of education (a point with which all the participants of the study agreed), but improvements to both bandwidth access and a sense of openness to their nature may be required for them to be utilized fully.

In terms of using *Second Life* for pedagogical means, much as recreating transparent overheads as Powerpoint slides, “there is a need to move beyond what technology can replace and consider the unique characteristics and potential for learning that technology can offer” (Girvan & Savage, 2010, p. 343). By flipping the pedagogical equation and instead looking at a virtual world developed to be a game but is now being studied and used as a pedagogical tool, it is possible to do just that.

*World of Warcraft.* Released in 2004, *World of Warcraft* (WOW or WoW) (Blizzard Entertainment, 2004) has grown into most popular MMO, both in economic terms (Makuch, 2014) and playtime (NoizyGamer, 2014). It has also been the subject of considerable attention, from the press referring to it as a cause of mass murders (Nagourney et al., 2014) to players reportedly dying from marathon gaming sessions (Rose, 2005) to elaborate themed weddings (Daily Mail Reporter, 2013). An examination of the game, why people play, and how it can be used as more than just a game, follows.

*The players.* Billieux et al. (2013) studied *World of Warcraft* players’ motivations and game behavior by performing a confirmatory factor analysis to test Yee’s exploratory study. The results show Yee’s *Motivation to Play in Online Games Questionnaire* (MPOGQ) to be valid and reliable, but suggest further study on whether motives actually predict players’ behaviors and how they transfer to *real life.*
Including the nature of passion with motivation, Fuster, Chamarro, Carbonell, and Vallerand (2014) examine the relationship between the two in the setting of *World of Warcraft*. Two types of passion—harmonious passion (HP) and obsessive passion (OP)—were found to both address motivation but in very different ways: “exploration, socialization, and achievement are motivations triggered by HP, whereas those of dissociation, achievement, and, to a lesser extent, socialization are experienced when engaging in MMORPGs out of OP” (p. 295). This points to two types of players who, while “equally passionate about the game… show different motivational patterns” and thus experience the game differently (p. 295).

Graham and Gosling (2013) utilized a modified release of Yee’s *Motivations for Play in Online Games* instrument in addition to a measure of the Big Five personality traits (“extraversion, agreeableness, conscientiousness, neuroticism, and openness” (p. 2)). Interviews with participants in a pilot preceding the study proper revealed the need to add extra dimensions to Yee’s instrument, those including qualities of leadership and individuality. The authors find that the field would benefit from more research, especially in how online personas relate to offline personas, and whether and to what extent they inform one another, and thus how the us in virtual environments like MMORPGs are different from the us in others like social networks.

Part of customizing gameplay and personal experience is choice. It is popular now for games to force players into making moral decisions by situating them within moral dilemmas. Khoo (2012) examined the nature of moral choice in *World of Warcraft* and found it did present players with genuine moral dilemmas. While MMORPGs can be
important in this sense because the morality often involves how to treat other (real) people, they still lag behind conventional single-player, narrative driven games. A game developer at Bethesda, the development firm responsible for producing games like the *Elder Scrolls* and *Fallout* series, Emil Pagliarulo, explains:

I think *Heavy Rain* has proven this better than any game in recent memory. In order for a developer to provide moral choices that matter, the player has to be convinced that those choices are going to have some kind of effect on the characters in the game, and the more believable those characters, the stronger the emotional impact.

At the end of *Heavy Rain*, if there's one thing you feel it's that Ethan loves his son and is completely invested in finding him, and this really challenges the player's willingness to go as far as it takes.

As it turns out, when I played *Heavy Rain*, I wasn't willing to do carry out one of the sequences, and I actually sat there yelling at my TV, saying, 'No! I won't do it! This isn't my fault! I will not be made the bad guy! You stole my son -- it's your fault! Not mine!' I was pissed off. Not at the developers, but at the Origami Killer. And you know what? The game didn't exactly have a happy ending. (Zoss, 2010, para. 7–9)

The fluid and social nature of MMORPGs make it difficult to achieve that level of moral engagement and empathy, though, as with interpersonal relationships, the opportunity exists to a certain extent.
The classroom. To bring *World of Warcraft* into the realm of formal learning, Rosario and Widmeyer (2009) look at the inclusion of design theories within commercial MMORPGs—*World of Warcraft* being one of them—and educational games that, according to the authors, are necessary for creating a “Constructivist Gaming Learning Environment” (p. 289) and found that not all of them—not even the educational games—include all of them. The inclusion of them in game-based VLEs would help in “creating a cyber-enabled constructivist environment that is engaging and encourages deep learning” (p. 299).

Curry (2010) considers how to integrate features of MMORPGs into classrooms, much like the *Classcraft* project, creating, for example, *guilds* within the classroom or turning assignments into *quests*. The authors suggest that “educators who can structure their classes based on the socially engaged principles present in these games can encourage students to practice social literacy skills required for today’s world, in addition to creating new interest and engagement in their courses” (p. 253). So not only does using the atmosphere and means present in MMORPGs possibly improve collaboration and engagement, but also may rekindle interest in topics students may have become bored with.

*World of Warcraft* has been considered for teaching specific areas of study. Barnett and Archambault (2010) consider the use of MMOs (*World of Warcraft* being one of them) as a means to teach economic theory, the education of which is, according to the authors, sorely and increasingly needed. Using the economic layer of *World of Warcraft* (the in-game auction) may teach, for example, the concept of supply and
demand when rare items sell for immense amounts of money. While this, in concept, is sound, the authors suggest teachers consider MMOs like *World of Warcraft* “as they might a television program or sports metaphor—that is, as supplementary tools used to engage students rather than substitutes for instruction” (p. 34).

Pirius and Creel (2010) discuss a course at Inver Hills Community College that was not only about *World of Warcraft* (titled *Warcraft: Culture, Gender, and Identity*), but was held within *World of Warcraft*, using the MMORPG as the VLE. The result was positive, with the course being a success and students displaying the transfer of skills from the online environment to offline, though the course appeared to suffer from the same problems as gamification, in that the novelty seemed to wear off as the semester went on.

Using games to teach and learn is written about extensively, but little research has focused on what happens to the classroom dynamics when games are introduced (Dickey, 2011). After all, the game culture of *World of Warcraft* is considerably different than that of the typical undergraduate class. The authors cite examples of the MMO culture potentially bringing in issues surrounding “[crass] humor, gender representation, and profanity, community, conflict and conflict resolution” (p. 208). While bringing the classroom into the digital world is potentially beneficial, it may be a double-edged sword in that community was fostered in the game and transferred to the class, but so was any conflict that arose within the game.
Games and Learning

For many students across all academic stages and levels, education is becoming increasingly digital (Deng & Tavares, 2013; Dew, 2010). Part and parcel of this sea change is the inclusion of games and simulations into the pedagogical toolbox. In 2008, Kebritchi and Hirumi (2008) examined the educational video games released between the years 2000 and 2007, identifying 24. By and large, they were learner-centric, constructivist in their nature, and made an attempt at authentic, realistic contexts for learning. The games that did not present those qualities—for example, games that focused on drilling practice or rote memorization—were found to be less effective. The authors also found that between the years identified, only half of the educational games designed reported using specific pedagogical foundations. More recently, considerably larger reviews have been performed, which gives an indication of how much the field has grown, with one meta-study reviewing 30 other reviews (Girard, Ecalle, & Magnan, 2013) that regards the future of games and learning with a certain level of enthusiasm, and another looking at well over 300 separate articles (M. Young et al., 2012) that takes a more reserved approach, though the future of games and learning is the key concern in both.

Annetta (2008) provided his expectations and desires for what the future of educational gaming may be. He suggested game designers take into consideration haptics (moving beyond sight and sound, and adding the sense of touch to gaming, though forced feedback has been associated with video games since 1976 [Wolf, 2007]), “textbook replacement” (placing the textual content within the game’s narrative, somewhat
reminiscent of *The Diamond Age: or, A Young Lady’s Illustrated Primer* [Stephenson, 1995]), “distance education” (the use of virtual worlds as classrooms, something for which *Second Life* is utilized), “home school/virtual school” (growing in popularity, for example the entirely virtual school districts the Electronic Classroom of Tomorrow or ECOT [http://www.ecotohio.org/]), and “game components” (using aspects of game design to create effective education, now referred to as *gamification*) (pp. 236-237).

Recent predictions and suggestions for the field are now beginning to come to light.

Few longitudinal studies have been published in the field of games and education, but one such four-year study performed on high school students was undertaken to determine what, if any, improvement playing video games had on problem solving skills (Adachi & Willoughby, 2013b). According to the study, higher problem solving skills were reported in adolescents who played role-playing or strategy games. These problem solving skills were linked to higher academic achievements, lending credence to the idea that playing video games can lead to better performance in school.

Pre-service teachers tended to be optimistic about using games to improve student learning, according to one study (Bakar et al., 2006). The focus of their considerations was mainly on how to use multiplayer games, suggesting collaboration was at the forefront of how they imagined they’d use games in class. Also demonstrated in the study were gender differences between what types of games the pre-service teachers considered using, the males being drawn to a first-person shooter and females to a puzzle game.

**Achievement.** In addition to the genre of game used, context appears to have an impact on student achievement. While the effect was small, Grove, Looy, Neys, and
Jansz (2012) found that students who played educational video games at home had a better experience—though both were positive—than those who played at school. The authors suggested this is likely due to being able to play more freely at home and with better equipment or hardware.

Whether at home or at school, children’s motivations for playing are most often socialization, the fun or challenge of the game, or to relieve stress (Ferguson & Olson, 2012). Interestingly, children identified as having ADHD symptomology were not different in terms of time spent playing or how violent their games of choice were, but they did gravitate more toward the cathartic side of motivations. Generally speaking, it would seem that “for the majority of children, the inclinations to engage in video game playing is probably healthy and developmentally appropriate” (p. 163).

Children with special needs benefit from playing video games, as well. According to Ke and Abras (2013), “if well designed and used, [video games] can promote engagement and learning for students with special learning needs” (p. 239). While games designed specifically for students with special needs may not necessarily need to be wholly separate entities, considerations like adding a particular difficulty level or setting that allows for accommodations, like the removal of time constraints or additional help with language difficulties, should be included.

**Frameworks for classroom games.** The appropriate framework is necessarily for effective use of video games in educational settings. Del Blanco, Marchiori, Torrente, Martinez-Oritz, and Fernandez-Manjon (2013) bring forth the idea that, while games may very well be used educationally, pairing them with a virtual learning environment via
well-established standards would be beneficial. The authors suggest using SCORM or AICC-style compliance, which, while industry standard, do require that games be made using compatible authoring platforms, thus automatically precluding the use of any commercially produced games. Along these lines, one group of researchers suggests basing classroom games on MMOs by creating classroom multiplayer presential (having presence) games or CMPGs (Echeverría et al., 2011). CMPGs require students to work collaboratively while the teacher keeps control by assuming a game master or administrator role. The game developed with this framework in mind, First Colony, demonstrates the possibility of using a game that is both visually appealing and entertaining to teach complex, difficult concepts (in this case, electrostatics and Coulomb’s Law). Moreso, students’ experiences in the game successfully transferred to written tests. For games being built specifically for the purposes of teaching, the CMPG framework may hold potential.

STEM. In 1999, in the face of “no clear evidence” (Roussos, Johnson, Moher, Vasilakis, & Barnes, 1999, p. 247) of virtual worlds being viable methods or atmospheres for children’s learning, came about the implemented the “Narrative, Immersive, Collaborative/Constructivist Environment” (p. 248), or NICE. NICE was used to teach science, technology, engineering, and mathematics (STEM) in the area of botany to elementary school students. Through the constructivist methodologies instilled in the development of NICE, students learned to garden and take care of plants via trial and error and directed feedback, eventually discovering what combination of environment and care will grow the best plants. NICE also directed students to create narratives about
their gardens, and to work with one another. While the technology and science left something to be desired, it helped solidify the idea that virtual learning environments—when constructed with the proper attention to learning goals and scientific accuracy—are viable options for authentic learning.

As demonstrated by NICE, virtual immersive worlds and environments can improve learning outcomes in STEM education (Barab et al., 2009). Using Taiga, a virtual environment utilized to teach students about water quality, as an example, Barab et al. (2009) find that virtual worlds can provide the foundation for the transformation of skills developed in virtual space to real life. They suggest this is in part due to the active role taken on by the learner in virtual environments, in contrast to being simply “passive receivers expected to memorize abstracted disciplinary content” (p. 316).

To wit, Sung and Hwang (2013) utilized a STEM oriented game intended to do more than just “provide more interesting learning environments [or] employ digital games as an approach for promoting students’ learning motivation” (p. 49). As mentioned previously, support beyond simply adding a game is best for learner achievement, therefore, the authors included Mindtools (methods of organizing knowledge by computer interface, like a database or concept map [Hwang, Chu, Lin, & Tsai, 2011]). The results of this method showed higher attention and reported more interest and challenge, suggesting one direction for STEM game-based learning in the future.

Another game development and design methodology is akin to agile software development, being an iterative process. Lester et al. (2014) created a game used to teach science to elementary school students using this method. Crystal Island: Uncharted
Discovery focused on narrative, complex problem solving, and student engagement in a visually pleasing virtual game environment to teach concepts like map usage and landform vocabulary. The authors suggest that in order for game-based learning to achieve widespread adoption, educational games “must be easily integrated into the classroom with accessible teacher training and minimal hands-on support” (p. 16).

Along those lines, Jaipal and Figg (2009) utilized a video game to teach biology at the middle school level. While performance increased for students that played, the authors lament a lack of “differentiated instructor for learners of different abilities and learner styles” (p. 130), supporting the need for considerable teacher guidance and preparation. In classrooms where the teacher was a “non-gamer” (p. 131), students were essentially forced to collaborate when problems arose, which actually led to the development of leadership skills and improved social interactions.

High school biology classes have gotten the game-based learning treatment. For example, Corredor, Gaydos, and Squire (2013) address a game used to teach viral spread and found that students who played the game developed dynamic mental models differently from those who did not play the game. Accordingly, the authors suggest that the effects of game-based learning should be assessed in different ways beyond simple verbal answers or paper tests to accommodate these varied models. Sadler, Romine, Stuart, and Merle-Johnson (2013) also examined using games to teach biology-related high school content. The authors used Mission Biotech (MBt), a constructivist game “designed by an interdisciplinary team including biomedical students, science educators, biology teachers, educational technologists, and a game development studio” (p. 484) to
explore an epidemic while based in a virtual biotechnology lab. Results supported previously established research regarding the benefit and use of games for learning: not only that students of varying levels of academic achievement benefited but specifically that students in lower levels may benefit most (in contrast to concerns put forth by some general education or lower-level teachers). Considering previous studies, part of this success may be at tribute to the multidisciplinary development process. Rosenbaum, Klopfer, and Perry (2006) address a similar augmented reality game, *Outbreak @ The Institute*, where students took on the roles of medical professionals to control a disease outbreak and, like Google’s *Ingress*, play was physically located in the real world, in this case throughout a university campus. The game resulted in high levels of enjoyment and immersion.

**Computer-assisted language learning.** Games have also been shown to be viable and effective computer-assisted language learning (CALL) routes. Golonka, Bowles, Frank, Richardson, and Freynik (2014) describe ways in which foreign language study can be assisted by various technologies, including virtual worlds or serious games, by allowing learners to, among other things, “navigate within simulated environments, including those modeled after target language locales and incorporating culturally relevant objects” and “role play through the ability to embody different characters within a scenario” (p. 74). While the authors seem unimpressed by the use of virtual worlds to achieve foreign language learning beyond the enjoyment of using the technology, they are more optimistic about the use of serious games, referencing military applications as
showing potential, though these games should be “part of a ‘structured language program,’ rather than as a stand-alone training solution” (p. 83).

Miller and Hegelheimer (2006) found that simulation games can be effective means of CALL instruction with some caveats: guidance from an instructor and coverage of vocabulary prior to playing the game provide the best results, with the inclusion of supplemental material. Ranalli (2008) replicated and expanded this previous work in a pilot study utilizing *The Sims* (Maxis et al., 2014). The author’s reason for selecting *The Sims*, beyond it simply being a replication study, was it being seen as an advantageous choice for CALL, particularly for vocabulary study as the game has a high “abundance of useful, everyday objects, actions and situations” (Ranalli, 2008, p. 443), but it also met Miller and Hegelheimer’s (2006) criteria for being appropriate CALL materials (based on the work of Chapelle [2001]). Though the sample was small, the results supported previous findings that “with theoretical guidance” commercial simulation games can “be adapted for use by ESL students” (Ranalli, 2008, p. 453).

Non-foreign language literacy can also be improved using video games. Steinkuehler, Black, and Clinton (2013) suggest literacy can be achieved through video games in a number of ways, such as writing fan fiction based on games, developing locale literacy by exploring virtual worlds, or understanding semiotics or the symbology and meaning behind design, action, and interaction in games. Beavis and O’Mara (2010) add the notion of *paratext*, a notion described by Consalvo (2009), used in addition to games, like “reviews, websites, forums, magazines, walk-throughs, cheats, Machinima,
and more” (p 74), moving literacy from beyond the traditional paper-based notion and into a multimodal paradigm.

**Use of commercial games.** The use of commercial games to teach in non-STEM areas is growing. Berger and McDougall (2013) provide an example by using *L.A. Noire* (Team Bondi, 2011)—a game set in Los Angeles post-World War II with the player as a police officer—in British high school and undergraduate English literature classes in order to examine pedagogically sound methods of *reading* games. The study goes toward reinforcing the idea that games used in the classroom require considerable teacher involvement and that the teacher must feel absolutely comfortable with the game, which presents difficulties. For example, while some video games present the illusion of free choice (storylines may branch depending on player decisions but almost invariable collapse on one inevitable ending (Cassidy, 2011)), the narrative structure is still extremely varied (for a description and analysis on how the Hero’s Journey may be made interactive via games, see Delmas, Champagnat, and Augeraud (2007)). When reading a traditional novel, the story does not branch depending on how the reader feels. For a teacher to experience and master each branch of a game like *L.A. Noire* or, even moreso, the *Mass Effect* line of games (BioWare, 2010), would be a monumental task. Studying games like *Skyrim* (Bethesda Game Studios, 2011) in the *Elder Scrolls* series through the lens of embedded history or mythology may be a more accomplishable task.

**Serious games for teaching.** Serious games are being used for teaching history. In a study by Hess and Gunter (2013) demonstrated that students who play the relevant game were highly motivated to partake in the lesson, but the length of the “serious game-
based course” (p. 383) ended up being significantly longer. The authors were unable to narrow it down to why, whether it be because students spent more time delving deeper into the content, if the curriculum of the game-based course and the non-game-based course divulged significantly, or if the game-playing students were just more satisfied. The authors highlight that, clearly, more research is needed in the area to determine best practices when using serious games to teach.

Using serious games to teach goes beyond traditional school subjects. Rodriguez, Teesson, and Newton (2014) examine the usefulness of serious educational games to teach children about (or, rather, ward children away from) alcohol and drugs. The authors reviewed the serious games meant to accomplish this, of which there were little, though the results were moderately positive in that they increased students’ content knowledge (though only one instance of decreased drug use frequency was reported).

**Gamification.** Taking a serious concept and adding the qualities of a game to it, rather than simply using a game to teach a topic, is becoming more popular. Gamification, as it has come to be called, uses game-like options overlaid on traditional means of conveyance. The gamification urge is widespread, shown in the University of Alabama Libraries’ creation of *Project Velius*, a *World of Warcraft* inspired gamification of library use and resource instruction (Battles, Glenn, & Shedd, 2011). On the other side of the spectrum, one notable example is *Fitocracy*, the online gamified fitness tracker (http://www.fitocracy.com), in which people level up and receive (and proudly display) achievement badges by performing increasingly difficult fitness routines.
Southerton (2013) examines fitness gamification. She suggests that gamification, as in the type presented by the *Zombies, Run!* (Six to Start & Alderman, 2012) may point to the need for a reconsideration of immersion or flow (Faiola et al., 2013), as it switches between the user running and paying considerable attention to the narrative being acted out by the characters, and the user running but becoming “mechanic or repetitive, requiring little attention” (Southerton, 2013, p. 2), all without needing to view a screen. In traditional MMOs, this is not truly an option. When playing games or using applications like *Zombies, Run!*, after having been launched, there is no requirement for users to look at their phones, while looking away for considerable periods of time while playing *World of Warcraft*, for example, may be detrimental to the player. While research has shown that gamification can either improve learning outcomes or simply make the player/user more willing, interested, and engaged in learning, there are indications that a certain level of attrition may occur as time goes on (M. Cheng, She, & Annetta, 2014).

Combining nearly all the subjects broached above—gamification, games in the classroom, embodiment, among others—is the recently developed *Classcraft* (http://www.classcraft.com), created to gamify the classroom, as opposed to actual content or fields of study. Much like how *HabitRPG* (http://www.habitrpg.com) gamifies the process of maintaining a to-do list, *Classcraft* gamifies the process of being in a classroom and situates itself in a liminal—if physical—space between game-based learning and a virtual world.
Mobile Gaming and Learning

Mobile gaming, learning, and usage has exploded in the past decade, not only with the associated technology improving exponentially, but with acceptance doing the same (Traxler, 2013). Ten years ago, university students on the cutting edge of mobile learning were given Pocket PCs with nothing more than Wi-Fi connectivity (Corlett, Sharples, Bull, & Chan, 2005) to trial in class, whereas today there are devices like Google Glass and lightning-fast 4th generation mobile networks (4G) to not only access the world’s knowledge in an instant, but to even visualize that information projected onto reality in front of us. Follows is an examination of recent usage of mobile devices in the United States, a number of ways in which mobile media learning is expressed in academic—and, to a certain extent, popular—literature, and some instances of mobile learning that can be seen as shaping the field going forward.

Mobile usage. General use of mobile devices in the United States in 2013 seems to support the notion that mobile learning shows no sign of slowing down. The Pew Research Institution performed a large-scale study of cell phone, smartphone, and computer device usage. In it, they discovered that a full 91% of Americans have a cell phone, while 56% of them have a smartphone (Brenner, 2013). Smartphone users became a simple majority of the population in May of 2013. At the same time, 63% of American adults went online (accessed the Internet) using their phones, as compared to 74% of teens. Even more striking, 34% most often use a phone to access the Internet, eschewing traditional desktop or laptop computers for mobile devices. Pew (Duggan, 2013) calls these users "cell-mostly internet users" (para. 11) and they make up a fifth of the total
cellular phone owning population (with teenage girls being more likely at 34% compared to 24% of teen boys, even though they're equally likely to have smartphones). Tablets are also included in the realm of mobile devices, of which 35% of Americans aged 16 or over had by September of 2013.

Particular usage of cell phones and smartphones in 2013, considering the numbers reported above, seems lower than would be imagined. While 81% used the SMS function and 52% used email, only 50% downloaded applications or apps, 49% used some sort of location-aware application like mapping or to find restaurant reviews, 48% listened to music, 21% used any kind of video conferencing function, and a mere 8% checked in using a social network (Duggan, 2013). Video conferencing alone has increased nearly 300% since 2010.

As mobile devices become more prevalent, the privacy and safety of minors when using mobile devices also becomes more concerning. Nearly as many teens that have downloaded apps (58%) have also "avoided certain apps due to privacy concerns" (Madden, Lenhart, Cortesi, & Gasser, 2013). Over a quarter of teens (26%) have removed an application after discovering it collected more personal data than they expected. Impressively, nearly half of teens (46%; 59% of girls and 37% of boys) have taken the step to turn off location sharing due to privacy concerns. These data show that teens may be more privacy-aware than is thought.

While the raw numbers show that mobile usage is prevalent in the United States, it does not necessarily reflect that learning is occurring. Relevant literature emphatically shows that it is, and in ways that are both surprising and encouraging.
**Mobile learning.** In 2002, Lehner and Nosekabel (2002) reviewed the state of mobile learning and found that it should not replace more traditional methods of education but support it (that is, the devices and methods by which students learn with them should scaffold good learning practices, rather than taking the place of what came before), in part due to the somewhat primitive nature of the technology at the time (for example, browsing the web on a mobile device in 2002 was tedious, at best). Three years later, projects were underway in 2005 (though not published about until 2007) using personal digital assistants (PDAs) in a university setting to improve understanding of the potential of mobile learning, scaffolding it on the anytime-anywhere idea (Motiwalla, 2007). This serves a reminder that the image conjured today of "mobile device" is very different from what was in use just a decade ago, two years prior to the release of the first iPhone in 2007.

PDAs have also been integrated in the university as a method of improving teacher education. Franklin, Sexton, Lu, and Ma (2007) placed PDAs in the hands of pre-service teachers taking classes in educational technology and early elementary science at a Midwestern university. While the majority of students viewed the integration of the PDA into their classroom and learning workflow, there was a level of dissent. For example, “the more enthusiastic students arrived at each period with unsolicited stories about using their [PDA] for various tasks in the personal and school life while those less enthusiastic arrived with talk of being too busy [and cited] technical difficulties or belief statements about lack of need for technology in younger grades as reasons for their lack of enthusiasm” (Franklin et al., 2007, p. 48). The mobility, the ubiquitous access to their
class schedules and course materials, and the ability to use software like Microsoft Word or Excel anytime and anywhere made the use of PDAs, generally speaking, a boon for the participants of the study.

With support growing as time goes on, Thomas, O'Bannon, and Bolton (K. M. Thomas, O’Bannon, & Bolton, 2013) decided to examine teachers' perspectives of mobile devices in classrooms. Attendees to the Imagining the Future of Learning conference in Louisville, Kentucky (n = 78), were surveyed about whether they support smartphone usage. The numbers, considering the name of the conference, are striking: 70.5% of participants supported classroom use, but only 59% believed it increased student engagement, 24% thought they increased student motivation, and a mere 5% thought they provided anywhere-anytime learning. Ironically, 72% of the respondents used their cell phones while at work.

**Affordances of mobility.** That using mobile devices and technology to educational ends is couched in sound pedagogical notions cannot be overstated. Cochrane and Bateman (2010) summarize “the key drivers” of mobile learning and its importance as “the enhancement of teaching and learning, facilitating student-centered social constructivist pedagogies. The goal is the establishment of social constructivism (in its various emergent forms) as the strategic pedagogy” (p. 2) in this venture. They highlight the exploration of innovative technologies and learning practices, the fostering of authentic learning, and bolstering the use of connected emergent technologies as some of the key factors. The use of mobile technologies also “afford’ real-time information
whenever and wherever learners need it” and “a rapid access interface” for performing work (Lai, Yang, Chen, Ho, & Chan, 2007, p. 328).

This extends into the realm of augmented reality. Dunleavy and Dede (2014) identify a number of affordances particular to augmented reality, most notably “the ability to present to a group of learners multiple incomplete, yet complementary perspectives on a problem situated within a physical space” (p. 739) “the ability to leverage physical space as an additional layer of content for students to observe, manipulate and analyze” (p. 739), “access to outside resources (i.e., Internet) and additional software on the devices to solve the given problem more effectively” (p. 739), the potential for students to “leverage the technologies provided by the handhelds in unanticipated, yet superior ways relative to how the designers had planned” (p. 739), and simply the fact that “[students] and teachers report high engagement as a result of using the handhelds, adopting roles, negotiating meaning within active, inquiry-based compelling narratives, solving authentic problems, and physically exercising” (p. 739). Cheng and Tsai (2012) relate that a 2011 study “suggested that [augmented reality] should be adopted in the next 2-3 years to provide new opportunities for teaching, learning, research, or creative inquiry” (p. 449), which has already been passed by the time of the present study’s publication.

The affordances provided by mobile technologies and experiences that fall within the realm of augmented reality categorically make the study of these games different enough from other games that are simply incidentally mobile. A game like Tetris (Atari Games, 1988) could easily be played on a mobile device but the nature and design of the
game is not meant to take advantage of the myriad benefits of location awareness or contextualized gaming, nor is it intended to. For this reason and others, mobile AR games are unique. Beyond the benefits afforded by the use of mobile devices, there are additional factors leading to successful learning, however.

**Mobile learning success factors.** Five years into the lifespan of the Apple iPhone, Squire and Dikkers (2012) interviewed and observed the usage habits of minors. Not only did students find that "learning was quick and easy" (p. 459) but they eventually began referring to the iPhones as a "lifeline" (p. 453). They downloaded apps that made the smartphone into more of a "Swiss army knife" (p. 453), even though they did play games and spend a third of their time on social networking sites.

According to Vogel, Kennedy, and Kwok (2009), that mobile learning be successful is not an option: it must succeed or it is discarded, as modern students very quickly determine what works and what doesn't, casting aside the latter without a second though. The authors expresses that "good enough" is no longer enough, as "students are critically aware of the strengths and weaknesses of various technologies, discarding those without a direct personal benefit" (Vogel et al., 2009, p. 470).

In order to bolster mobile learning usage, Cochrane (2010) identified the following factors for success: "importance of the pedagogical integration of the technology into the course assessment; lecturer modelling of the pedagogical use of the tools; the need for regular formative feedback from lecturers to students; the appropriate choice of mobile devices and software to support the pedagogical model underlying the
course” (p. 136). The implementation of these suggestions led to a relatively widely approved Web 2.0 integration into his home university.

**Location and time in mobile learning.** In line with Cochrane, Alnuaim, Caleb-Solly, and Perry (2012) suggested that "the challenge is to try to match the technology to educational activities" (p. 1), though this smacks of turning an overhead projection sheet into a PowerPoint slide, which is decidedly poor usage of technology. In contrast, Squire and Dikkers (2012) lament that "Educational technologists developing curricula for mobile media devices have typically created applications designed to work within these inherited educational systems rather than transform them" (p. 460).

One of the most useful—and, pedagogically speaking, most exciting—aspects of mobile learning is its ability to present “here and now” content in ways heretofore unavailable or even unimagined. Squire (2009) agrees but suggests that while “anytime, anywhere” (p. 70) seems to be the most common way of expecting mobile learning to occur, it’s actually the location-sensitive aspect of mobile learning that is most important. Ozdamil and Cavus (2011) agree in that it’s not necessarily the any time, any place learning that’s most important, as much as it is the right time and the right place. The benefit of mobile learning is that any time can be the right time, any place the right place.

Mobile learning should allow for constant and engaging involvement with learning. The mobile device should be, essentially, transparent. That is, whatever is being used to deliver or access the mobile learning should not be a hindrance to the learning, itself. Martin and Ertzberg (2013) support this idea in their focus on “authentic learning and context-based applications” (p. 77), in stating that a “mobile-based learning
environment, by virtue of its portability, will provide scaffolding when and where students need it—whether in the classroom or investigating in the field. Mobile technology can sustain the learning environment regardless of where the student or the investigations are situated” (p. 78). This harkens back to Squire and Dikkers’ (2012) finding reported earlier that students refer to their mobile devices as “lifelines” (p. 453).

**Alternate mobile learning methods.** A number of interesting and innovative case studies on current uses and the potential of mobile devices in learning exist. Some, like the case of bodystorming, concern themselves more with how to integrate mobile devices into pre-established forms. Bodystorming is a form of brainstorming that involves the whole body and it is suggested that this is one method of exploring the utility and effectiveness of mobile learning environments and methods, as "location and place can become a meaningful part of learning experiences" (Smith, 2013, p. 72). This is just one example of how teachers and researchers are attempting to bring current practices into the newer world of mobile learning.

There are other interesting ways mobile devices are being used that aren't typical mobile learning methods. In Taiwan, for example, a mobile museum guide was created using a WiiRemote (Wang, Huang, Lin, & Wu, 2012), a system the visiting public seemed to enjoy. Also in Taiwan, an "augmented reality library instruction system (ARLIS)" (Chen & Tsai, 2012) was developed to instruct elementary students on library usage as Taiwan has mostly elected to cut this topic from the curriculum. A secondary point discovered during ARLIS testing was that students' ability and skill to play video games had no impact on their efficiency at using the augmented reality system,
supporting the notion that AR systems could easily and effectively be put into wider implementation. Chen (2013) also reported on the use of augmented reality in library book recommendations in Taiwan, using maps and problem-based learning. Some uses of mobile learning are novel, but no less effective.

The use of radio frequency identification (RFID) tags has begun picking up steam in mobile learning. Alnuaim et al. (2012) discusses how these tags were applied to plants as a means of environmental science mobile location-based learning. Quick Response (QR) codes have also been used in mobile learning. Some researchers have even said location-based mobile learning (augmented reality, in particular) is “frustrating and distracting” (Bressler & Bodzin, 2013, p. 505), and that using QR codes could be the solution. This seems unlikely, as QR codes seem to be fading from the public eye (Pozin, 2012) and even Google suggests QR codes are more a red herring than anything, plotting NFC as the alternative (Castillo, 2011). Focusing on the peripheral abilities of a mobile device can obfuscate a quality of said devices that has increased considerably in recent years: computational power.

**Mobile STEM.** Science-related apps have come a long way and now rival desktop-based software in their abilities. LabBuddy, for example, offers students quick and easy reference to electrical current ratings, color scales, and more (van der Kolk, Hartog, Beldman, & Gruppen, 2013). The Wolfram|Alpha "knowledge engine" is supported on mobile devices (http://products.wolframalpha.com/mobile/) and allows for mobile access to its computational power that used to only be available to desktop users as Mathematica until 2009 (The Wolfram|Alpha Launch Team, 2009). Even Google has
produced apps like Google Sky Map—a sort of mobile, augmented reality planetarium—which boasts over 10,000,000 downloads (http://www.google.com/mobile/skymap/). There is no shortage of variety or power in science-based apps for mobile learning, though the human element can become a hindrance.

Franklin and Peng (2008) examine the potential of mobile devices in teaching mathematics to elementary students in rural Appalachia. In a school where “eighth grade students met 42.5% of the required 75% passing score on the Ohio Achievement Test in mathematics for the 2006-07 academic year” (Franklin & Peng, 2008, p. 72), both the students and teachers involved in the study were excited to integrate the use of the Apple iPod Touch into the teaching of particular mathematic concepts and the creation of videos on those topics. Students, faculty, and staff reacted positively to the technology itself and the results produced through the creation of animated math videos matching state math standards.

**Mobile assisted language learning.** Another area in which mobile learning has truly shined is language learning. Like computer-assisted language learning (CALL), it seeks to improve and supplement the learning of foreign or second languages by way of digital devices. Golonka (2014) performed a wide-ranging study of the mobile learning literature and found that while smartphones and iPods were almost universally approved by users, mobile assisted language learning (MALL) typically took more time than traditional learning, possibly due to typing on smaller screens. The use of SMS (text messaging) in MALL also showed to be very effective and approved by users (Cavus & Ibrahim, 2009). De Jong (2010) found that mobile language learning benefited from
location-awareness much like mobile learning in general, and is found to be more useful than context-specific language learning. Traditional, physical means of language drilling (for example, flash cards) have been shown to be less effective than the use of digital replacements (Basoglu & Akdemir, 2010), also supporting the anywhere/anytime theory of mobile learning. Beyond simply converting traditional leaning methods into digital methods, Chang and Hsu (2011) found that mobile devices offered unique benefits like “instant translation annotation mode” (p. 155) that heavily improve language learning. Language learning applications like Duolingo (www.duolingo.com), the most popular application in its category for both Android and iOS, provide users with not only paced, ubiquitous learning opportunities, but a certain level of gamification, as well.

Game-based learning with mobile devices has grown over the past decade thanks to authors like James Paul Gee and Jane McGonigal, who have brought academic research into the realm of popular science literature. Studying the difference between mobile and traditional versions of the same educational content now occurs. Furió, González-Gancedo, Juan, Seguí, and Rando (2013) plotted the use of an iPhone game against a traditionally played game to determine learning outcomes. While the study found no significant differences between groups, the children in the study reported they did want to keep playing the mobile game, and nine out of ten enjoyed the iPhone version more than the traditional. Evolving beyond the traditional mobile game is the genre of augmented reality.
Augmented Reality

Sometimes referred to as “hybrid reality…, augmented virtuality” (Wu, Lee, Chang, & Liang, 2013, p 42), “alternate reality” (Whitton, Jones, Wilson, & Whitton, 2012, p. 243) or even simply virtual reality, augmented reality is the overlaying of computerized data onto the real world via devices like smartphones or wearable technology (such as Google Glass). This may range from using a smartphone as a window to the world, in the case of Yelp’s Monocle view, or using Google Glass to interact with virtual items with bare hands (Bai, 2014), a variation of which was studied so far back as a decade ago (Kaufmann & Schmalstieg, 2003).

Dunleavy and Dede (Dunleavy & Dede, 2014), in Handbook of Research for Educational Communications and Technology, offer a superior examination of current and relevant literature on augmented reality, its use as a pedagogical tool, and the impacts it may have on both learners and facilitators. The authors describe two kinds of AR used by educators: ‘location-aware,’ like Google’s Ingress, and ‘vision-based,’ like the previously mentioned Yelp Monocle. Augmented reality resides firmly within, they say, constructivist theories of learning (that is, “people construct new knowledge and understandings based on what they already know and believe, which is shaped by their developmental level, their prior experiences, and their sociocultural background and context” [p. 736]) and situated- or place-based learning (that “knowledge is embedded in the settings in which it is used; learning involves mastering authentic tasks in meaningful, realistic situations” (p. 736). The authors also suggest that AR matches well with design-based research in that “this formative research uses an approach of progressive
refinement where AR designs that have been informed by the learning theory frameworks as well as video game design principles” (p. 377) to determine what works and what does not.

Kesim and Ozarslan (2012) provide a simple but informative overview of augmented reality, its nature, and how it can be used in education. The immersion in augmented realities provides a happy medium between two imperfect situations: “[educators] prefer to use two-dimensional media in education which is very convenient, familiar, flexible, portable and inexpensive. But it is static and does not offer dynamic content. Alternatively computer generated three-dimensional virtual environment can be used but these scenes requires high performance computer graphics which is more expensive than others” (p. 297; grammatical errors printed in original). Augmented reality allows for relatively inexpensive and accessible devices like smartphones to reap all the benefits of a fully 3D world (reality) without the need for massive computing power. The authors identify a number of methods by which augmented reality is delivered: headmounts (though examples are from 2011 and were then far from consumer or school ready, the Oculus Rift being the most analogous), handheld devices (such as tablets or smartphones), and wearable tactile devices that allow users to manipulate virtual objects in the style of Minority Report (known in the literature as “pinch gloves” [p. 300], but should not be considered as confined to only pinching). While still relatively new, at least one Chinese university has been implementing this technology for years (Pan et al., 2006).
**Augmented reality in schools.** Traditionally, only the handheld devices were feasible to use in education. A decade ago, British researchers Facer, Joiner, Stanton, Reid, Hull, and Kirk (2004) were using personal digital assistants (PDAs) to teach middle school students about life on the Savannah. They took on the role of lions, prowling the grasslands, their PDAs acting as their senses of smell and sight. They were told, via the mobile device, how far away they were from water or their den. Much like *The Oregon Trail* (MECC, 1974), itself an educational game, if students spent too much time in the sun or without food, they “died” and were forced to return to the den. By taking students out into the field, the lesson could benefit from interesting, engaging situated learning.

Six years later, Brom, Sisler, and Slavik (2010) undertook something quite similar to the Savannah Project with *Europe 2045*. By developing an “augmented learning environment (ALE)” (p. 23), the researchers both studied the use of AR in digital game-based learning and the use of a new theoretical model. The AR game was intended to improve secondary students’ performance in social science courses in the Czech Republic. Part of the construction of the game was attention being paid to cross-platform usability, something that can often be overlooked with the divulgence of mobile platforms (consider the number of iPhone apps that are unavailable on Android and vice versa).

In Australia, at least two hybrid reality games are pushing boundaries between the physical world of the everyday and the digital world, paving the way for mobile learning to follow suit. *The Day of the Figurines* and *I Like Frank* both use mobile technology in concert with other technologies to "[interrogate] the relationship between traditional
playful spaces and the spaces of our daily ("ordinary") life" (de Souza e Silva & Sutko, 2008, p. 448). *I Like Frank*, designed by British artistic group Blast Theory, matched remote (on-site) "street players (SPs)" using two-dimensional maps on their mobile devices with "online players (OPs)" (p. 450) to help them navigate the city of Adelaide. OPs could see where SPs were and communicated with them using SMS and voice messages. The goal: find Frank. Collaboration was necessary and resulted in SPs experiencing Adelaide in a new way. *Day of the Figurines*, created by Nottingham University's Mixed Reality Lab and performed in places like Barcelona and Berlin, attempts to turn the city into a game board that lasts for three and a half weeks. The game allows players to move to different parts of the city, interact with one another, all while mixing game and reality. It certainly shows the potential for becoming a learning experience (more so than it likely already is for the players).

Thornton, Ernst, and Clark (2012) provide an overview of augmented reality in relation to engineering and its potential to improve students’ spatial awareness and ability to manipulate 3D objects. They see augmented reality as the next step in bringing computer-aided design (CAD) off the screen and into the world (albeit virtually), not only in STEM fields but “across all disciplines” (p. 18).

**Case studies.** The fact that learning is taking place in a particular location is key, a concept Sobel (2005) calls ‘place-based education.’ This idea of ‘situated learning’ (Lave & Wenger, 1991) is grounding for most AR projects. A number of anecdotal case studies have been recorded on the practical uses of AR in educational settings and for learning, as well as the benefits of having students design AR experiences. Dikkers,
Martin, and Coulter (2011) describe experiences steeped in constructivist learning theories by educators, for educators, as “educators are in the best position to see what works for learning” (2011a, p. 22). Dikkers explains the benefit of using these technologies: “Using the mobile devices, the experience of the field trip could be a launching point for classroom projects, discussions and lessons” (2011b, p. 176). Beyond the technology, he also points out a highly beneficial result: “Collaboration appears to be a natural byproduct of mobile media learning” (2011b, p. 182).

Included in these case studies are demonstrations of mobile and/or augmented reality projects that look at complex ecological systems through exploration and ethnography (Wagler & Mathews, 2011), attempt to create a more interesting and narrative-driven nature hike (J. Martin, 2011), a call to make the utilization of AR in schools easier by developing very small games as an introduction to it (Coulter, 2011), and how to utilize augmented reality to design an immersive, interactive museum tour (Dikkers, 2011b).

Olson and Wagler (2011) used augmented reality projects to generate the “cultural tour,” an experience through which “teachers, students, parents, and community partners collaborate to design large, integrated classroom projects encompassing an entire year’s worth of hands-on activities focused on a single place or theme” (p. 289). Through this, they aim to encourage “learning in a more flexible and interactive context” (p. 289) that are “carefully scaffolded and structured to create interactive encounters” (p. 307) and thus strengthen the connection between person, place, and culture.
The connection between augmented reality and video games as educational materials is becoming more frequently expressed and efficiently addressed. Klopfer and Squire (2007) go so far as to coin the phrase “augmented reality educational gaming” (p. 203) in reference to *Environmental Detectives*, “a multi-player, handheld augmented reality simulation game designed to support learning in late high school and early college environmental science” (p. 205). They suggest that the creation of these games by the students is part-and-parcel of the future of educational AR and gaming.

The future of the creation of hybrid environments (the ‘augmenting’ of reality) can be seen in Paul Driver’s *Digital Debris* (http://digitaldebris.info) and Bryan Carter’s augmented reality projects (http://ibryancarter.com/research/). Both use augmented reality to explore history, language, storytelling, and urban life around the world in order to embed both the digital media and the learner in the situation and location. Libraries are also getting into the AR game, as evidenced by Kelly Czarnecki’s *Bringing the Total Gaming Experience to Your Library* (2012), in which she provides practical ways to gamify libraries with augmented reality.

**Limitations.** Bringing AR across disciplines is potentially a double edged sword (Wu et al., 2013), not because they suggest it is inappropriate in an educational setting, but because of the terminology. Depending on the field, the phrase *augmented reality* could be easily replaced by *hybrid reality, augmented virtuality, virtual reality*, or even examined on a continuum between “augmented reality and augmented virtuality” (Wu et al., 2013, p. 42). They support the idea that the terminology should be left broad and open in order to encompass the wide range of projects and environments that AR addresses.
They also list “features and affordances of AR systems in five aspects based on research that exploits AR for educational purposes” (p. 43). They are: “(1) learning content in 3D perspectives, (2) ubiquitous, collaborative and situated learning, (3) learners’ sense of presence, immediacy, and immersion, (4) visualizing the invisible, and (5) bridging formal and informal learning” (p. 43). By employing these features effectively and in concert with appropriate learning approaches and instructional methods, augmented reality can fulfill the potential so many see it has.

Dunleavy and Dede (2014) argue that one of the integral aspects of augmented reality, the location itself, can serve as a limitation on its efficacy. They suggest, in relation to “place-dependent” AR projects, “the more aligned an AR experience is to a specific environment, the less portable it is to other locations, which significantly decreases the experience’s scalability” (p. 740). Conversely, when these AR projects are location agnostic and can be implemented anywhere, what the authors call “place-independent,” these experiences, “which, once designed, [are] highly portable (i.e., can be played anywhere), [lose] a significant amount of authentic interaction with the environment” (p. 740).

They go on to describe other limitations that emerge from the nature of the augmented reality experience. First, that that participants can be “overwhelmed with the complexity” (Dunleavy & Dede, 2014, p. 739) of the project itself, the rigorous inquiry, or team decision-making. Second, the authors suggest choosing “exploratory, inquiry based activities” (p. 739) that are more demanding for the teacher and students in terms of time and management and may not represent skill or knowledge acquisition well on
tests. Additionally, facilitation by two or more teachers is suggested, which may be difficult to accomplish in schools. Finally, technological problems may arise, like flawed GPS locations or simply devices failing to work. They suggest more attention be paid to the design and implementation of AR experiences with these limitations in mind, however much a challenge this may seem.

Beyond the impact gaming, virtual and augmented reality, and mobile devices have had on learning and education in general, there are pros and cons that have been aggressively or simply tangentially uncovered in relevant literature. What follows is a look at some of the most prevalent, from gaming addiction to recuperative gaming, violence and addiction to sexuality and gender issues.

**Effects and Critiques**

The vast majority of children and adolescents play video games in the United States, with numbers reaching upwards of 91% and, in 2011, was growing even faster than the population (NPD Group, 2011). Considerable literature has been written on the effects video games have on players, both adults and children, but most has been aimed at the negative effects: “the potential harm related to violence, addiction, and depression” (Granic et al., 2014, p. 66) and declination in behavior and academics, with the exception of educational games (Hastings et al., 2009), though conflicting data suggests gaming frequency and poor academic performance have “little association” (A. Drummond & Sauer, 2014, p. 4). Follows is an examination of both negative and positive research in the fields of violence and aggression, gender and sexuality, socialization and problematic gameplay, and biology and health, as related to the play of video games.


Violence and aggression. As with gaming studies in general, conflicting conclusions about video games and their effects extends into the realm of violent video games. A recently published review of the literature on the topic of the psychological impact video games have on youth highlights not only the general conflicting nature of research in the field, but also the need for, generally speaking, a “more rigid methodology” (Mclean & Griffiths, 2013, p. 127). Elson and Ferguson (2014) also performed a review covering 25 years and found that the literature generally makes claims that over-reach at best, are disingenuous at worst, and that making “unambiguous claims” (p. 33) is dangerous. They also suggest a re-working of the acceptable methodology used in studying the relationship between aggression and violent video games. Ferguson (2011) also suggests a reason for the disparity in the literature may simply be “antigame scholars reviewing their own work and declaring it beyond further debate” (p. 820).

Inconsistencies. To illustrate the inconsistency in the field, two separate studies may result in conclusions that are totally opposite, as in the case of Chalres, Baker, Hartman, Easton, and Kreuzberger (2013) and Williams (2013). In a study comparing non-violent and violent games and players’ level of aggression having played them, Charles et al. (2013) found that the use of motion controls (like the Nintendo Wii’s nunchucks or the Playstation 3 Move controllers) resulted in less aggression compared to those who played with traditional analog controllers, and in fact were “indistinguishable” (p. 2522) from players who were given the non-violent control game. The authors posture that this is explained by the exertion involved in using motion controls, whereas the
anxious or aggressive energy of those using traditional controllers is without a physical outlet. In direct contrast to this, Williams (2013) found that, while the effect size was small, “the experiment did show that a naturally mapped [motion] controller can increase hostility beyond that of a traditional controller” and “because the violent behavior used to control the game (punching in this case) more closely resembles the violent behavior portrayed on screen, the player feels less like they are controlling a game and more like they are actually taking part in the violent behavior” (p. 41). Both of these studies employed fighting games (the former being Soul Calibur and the latter being Punchout) and came to entirely different conclusions. Again, this is but one example of the disparity in the literature in video game studies field, but in violence and aggression, particularly. It is entirely possible that the notion of the ‘magic circle’ (that is, a temporary space in which the rules differ from those in reality) is behind the fleeting heightened aggression after playing violent games and that any lingering or persistent feelings may be due to other factors, discussed below.

It has been found that the playing of violent video games may correlate with increased aggression during a short period after playing (Barlett, Branch, Rodeheffer, & Harris, 2009; J. A. Drummond, 2014) and drops off sharply as play goes on for longer (Krcmar & Lachlan, 2009). In contrast, Espinosa and Clemente (2013) found that all types of video games correlated with increased aggression, not just violent games, and Hasan, Bègue, and Bushman (2012) and Hasan, Bègue, Scharkow, and Bushman (2013) reported levels of aggression and hostile expectations that increased over a span of three days in French college students when playing violent games. There is no evidence to
support the notion that it increases violent tendencies generally and permanently in those players. Were this the case, “the rate of day-to-day violence and physical aggression would have dramatically increased in North America due to the recent rise in prevalence rates of violent video game play” (Adachi & Willoughby, 2011, p. 61), and, while the association of increased aggression in those who play violent video games is also established, it is not causational and other effects may be in play. For example, (Zhen, Xie, Zhang, Wang, & Li, 2011) found the most influential mediator between the playing of violent video games and physical aggression in younger children to be pre-established beliefs about aggression. That these reactions occur in players of these violent games is not the point of contention, but rather why.

**Potential causes of aggression.** The main problem with most violence and aggression studies regarding video games is, according to Adachi and Willoughby (2011, 2013a), the difficulty in determining if what is being measured is aggression or competitiveness. This, in concert with “difficulty and pace of action” (Adachi & Willoughby, 2011, p. 61), stands to reason as some of the top AAA games published yearly have both aggression and competitiveness at their cores (consider the *Call of Duty* [Infinity Ward, Treyarch, & Sledgehammer Games, 2014] line and any number of franchised sports series like *FIFA* [EA Sports, 2014] or the American football *Madden NFL* [High Schore Entertainment, 2013] series). Ferguson, Garza, Jerabeck, Ramos, and Galindo (2013) attempt to use a more rigorous methodology to study the influences of violent video games on youth in light of an overwhelmingly correlational canon and
conclude there is “no evidence that video game violence is predictive of either positive or negative outcomes in youth” (p. 121).

Aggressiveness has also been linked to the realism of games, both violent and non-violent. As computational power grows, game developers can produce more and more photorealistic video games. Beyond graphical realism, it could affect aggressiveness via the player’s point of view and depiction of realistic blood. Krcmar and Farrar (2009) plotted players of a violent video game against a controlled no-game group and identified two conditions that increase aggressiveness: having visible blood resultant from in-game violence, and the use of a third-person perspective rather than first-person, a result potentially identified as related to a sense of retaliation rather than identification with the character. Interestingly, the authors suggest that, at least in their study, “blood seems to act as a reward” (Krcmar & Farrar, 2009, p. 134), which adheres to the study of aggression and violence in traditional media, as well.

**Perception.** Bartlett and Rodeheffer (2009) examined the impact of realism in terms of fantasy on aggression, citing the notion that “realism yields significant differences in arousal and immersion” (p. 213). That is, the difference between battling enemies that are human (realistic) or alien (unrealistic). As with the researchers’ previous study, their findings suggest playing violent games does increase aggressiveness for a time, but realism has no impact on this.

This is in concert with the research of Hartmann and Vorderer (2010) that found that the appearance of the enemy in a game (human vs. nonhuman) has no impact on players’ negative feelings like guilt, suggesting the killing of humanoid characters in
games has no moral implications for players. This notion is put to the test in one of the only truly experimental studies on violent video games and aggression using the “hot sauce paradigm” originally developed by Lieberman et. al. (1999) in which (in this modified version) participants would play a violent game and then choose the potency and amount of hot sauce another participant “would eat every drop” (Barlett et al., 2009, p. 228) of, after having been told that second participant disliked spicy food. Their study found the period after playing violent games during which players’ aggressive behavior increased—as measured by the amount of hot sauce they forced the other, non-existent participant to eat—was short (between five and ten minutes) but present. What, then, drove the participants to act aggressively and amorally?

The perceived levels of justification in the killing of characters that the player believed should or should not die did, though, have a slight impact on players’ sense of morality (Hartmann & Vorderer, 2010), but the authors decided it was too small an effect to elicit feelings of actual guilt, even though interviews with players revealed anecdotal feelings of remorse when innocent characters were killed. More interestingly, it was also the familiarity of the players with the specific violent video game that showed changes in negative feelings and guilt: the more familiar the player with the game, the less guilty they felt when partaking in virtual violence. The idea of enjoyable “virtual violence” (Hartmann & Vorderer, 2010, p. 94) and why it is enjoyable becomes something of note. As it is the job of the game developer to elicit enjoyment from the player, it is worth exploring.
A prime example of game violence and how game developers use it to elicit feelings from players is the *No Russian* chapter of Activision’s *Call of Duty: Modern Warfare 2* (Infinity Ward, 2009). In this scene, the player takes control of a soldier named Joseph Allen who has infiltrated the antagonist’s group and is tasked with massacring scores of bystanders at a fictional airport in order to stir-up international relations between East and West. Though there is an option to skip that scene, this unadulterated slaughter of innocent people has made it one of the most controversial in gaming, but also one of the most important, as Mohammad Alavi, the developer of the scene, explains: “In the sea of endless bullets you fire off at countless enemies without a moment’s hesitation or afterthought, the fact that I got the player to hesitate even for a split second and actually consider his actions before he pulled that trigger – that makes me feel very accomplished” (as cited in Burns, 2012, para. 13).

**Who plays and why.** What type of person plays violent video games, then? The traditional feeling is that people drawn to violent video games are violent, themselves, and these games devolve into a feedback loop. Nije Bijvank, Konijn, and Bushman (2012) examined the educational abilities of Dutch school boys (as determined by standardized tests) and “found that boys with lower educational abilities favored stand-alone games and violent games more than other boys did” and believed the games to be more realistic, possibly because, the authors suggest, they are unable to “attain success via conventional means because they often come from families with low socioeconomic backgrounds” (p. 159). Boys with higher educational abilities tended toward more social games. The authors make the claim that this is especially dangerous for boys on the lower
end of the ability scale because “the mass media often depict a world in which unhealthy behaviors such as aggression, substance abuse, and unprotected sex are depicted as appealing and risk free” (Nije Bijvank et al., 2012, pp. 153–154), and the level of interactivity video games provides may prove problematic.

Some research supports the idea of the playing of violent video games and actual, physical hostility outside the game. A self-reporting study of Canadian children found a connection between the playing of mature and violent games and instances of bullying and cyberbullying (Dittrick, Beran, Mishna, Hetherington, & Shariff, 2013). It was “unclear whether bullying and/or cyberbulling are a consequence of mature and violent video games (socialization hypothesis) or that those individuals who bully and/or cyberbully select more mature and violent video games due to a pre-existing trait, such as hostility (selection hypothesis)” (Dittrick et al., 2013, pp. 311-312). Regardless, violence and the play of violent video games has been connected for some time, especially in popular media.

When two students massacred their classmates in Columbine High School in 1998, the media was quick to blame it on violent video games (in particular, the Doom series [ID Software, 2012]) (Nizza, 2007), but that was just the beginning of the trend. After the mass shooting at the Washington Navy Yard in 2013, the perpetrator of which “played violent video games including Call of Duty for up to 16 hours at a time” (Allen, 2013, paragraph 1). Yet another example is the Isla Vista, CA shootings in 2014, perpetrated by someone obsessed with World of Warcraft (Nagourney et al., 2014). And while there has been some popular pushback against this mindset (Gaudiosi, 2011), the
fear that violent video games will turn children into mass murderers is still prevalent and is exemplified in a *Guardian* op-ed from 2013 about, specifically, the *Grand Theft Auto* franchise:

From its inception, this game raised eyebrows and glorified committing acts in-game (IG) that would see multiple life sentences if committed in real life (IRL). So why then, has Rock Star continued to produce—and profit outrageously!—from a game so riddled with abhorrent sociopathic and frankly psychotic behavior? Why are there no sanctions on this company and this game? Why is GTA still so easily available on the market, and still destroying our children’s moral compasses? More disturbingly, why are parents buying this game *for their children*? (Tasby, 2013, para. 4)

This personifies much of the popular thought on not only violent video games, but video games in general, but also points to a notion raised by (Ivory & Kalyanaraman, 2009) in that singling out specific games for criticism can actually make it more difficult to generalize the same feeling.

Chory and Goodboy (2011) examine the relationship between personality and violent video game usage, finding that personality traits like openness and disagreeability predict the likelihood of playing violent video games, whereas higher levels of neurosis did not (against the authors’ prediction), suggesting it may be a certain personality type that is drawn to these games, rather than the games turning players into, to harken back to Tasby, sociopaths and psychotics. Taken with the studies performed by Charles et al.
(2013) and Williams (2013), the conclusion points toward a very complex and still misunderstood relationship between violent games and behavior in players.

The body of literature at hand often focuses on how boys react to playing violent games and the resultant aggression, but physical violence—be it virtual or real-life—is simply one type of violence. Yao, Mahood, and Linz (2010) examined the likelihood of male players to engage in sexual harassment after playing a “sexually explicit” (p. 77) video game. The tendency for males “exposed to sexually objective depictions of women in the media” (p. 81) to become inappropriate and aggressive makes salient the notion that issues of gender and sexuality are just as notable as simple, physical aggression and violence.

Gender and sexuality. Some games by their very nature deal with gender and sexuality at some level. This may range from the gender of players and how that affects what and why they play, to concern brought forth by the “abhorrent sociopathic and frankly psychotic behavior” (Tasby, 2013, para. 4) like the killing of prostitutes in the Grand Theft Auto (Rockstar North, 2014) series of games, to the ways in which gendered characters and sexuality of all types are presented. As gaming becomes more social, the need to understand how gender and sexuality play into them and impact players becomes ever more salient.

Gender and gender differences. In exploring the gaming preferences of children aged 10-15, especially how it relates to gender, Homer, Hayward, Frye, and Plass (2012) found no relationship between play time and “negative psychological adjustment” (p. 1783), only that time spent playing and gaming preference diverged between genders.
The study situates itself among others discussed here that go against what is considered “stereotypical” in terms of gaming and gender roles: girls who preferred to play FPS games “feel better about themselves” (p. 1788) and boys were less likely to play MMOs as their “internalized difficulties” (p. 1784) increased. In addition, there was a gendered and opposite relationship with anxiety, as “boys who reported a high level of video game playing reported the lowest levels of anxiety, while girls who responded with high levels of video game playing reported the highest levels of anxiety” (p. 1783). While the differences in gameplay by gender are interesting, the authors note that it may point more toward normative societal expectations and changing social roles as children age, suggesting that “game preferences may stem from psychological and social needs that are met in the virtual environment” (p. 1789), rather than gaming being an unhealthy or escapist outlet. Research performed by Greenberg, Sherry, Lachlan, Lucas, and Holstrom (2010) supports the disparity between genders in terms of game preference and time played, noting that gaming in general had a greater impact on males’ lives than on females’. Interaction between the genders in-game can be a different story.

Fortim and Grando (2013) examined gendered identification in multiplayer games in which there is typically a default main character whose gender is not necessarily the same gender as the player (as opposed to MMOs that normally allow the player to choose a gendered avatar). Female players reported marked prejudice against upon the announcement of their actual gender. Almost half the women who self-identified to other players as female reported experiencing gender-based retaliation at some point and more than half admitted to refusing to use a microphone, lest their voices give away their
gender. Females reported to a lesser extent, instances of general aggressive behavior, courtship advances, and a quarter of female players even reported threats of rape. One respondent remarked, “…every time I make a mistake or my character dies, it goes through my mind that might be reinforcing the stereotypes about women gamers. In fact, as a woman, I feel more ashamed to fail and more pressure to prove that I [am as good] as men” (Fortim & Grando, 2013, p. 9). In addition to interaction between genders, interaction within genders is also worth noting.

Anderson (Anderson, 2008) found that 5th graders playing a game to learn about science displayed a distinct difference between genders. First, not surprisingly, the use of a game in this context was well accepted and advantageous to students. Second, gameplay differed between the genders, also unsurprisingly. Between different pairings of genders (boy-boy, boy-girl, and girl-girl), the author found that girl-girl pairs tended toward higher levels of focus and more effective communication, while boy-boy pairs’ conversations centered on how to win in-game points, even though no difference in test scores could be seen. The differences between genders are not only evident in how they play and what they talk about during, but also how they view the games they play.

Body image and associated dissatisfaction begins as young as five years old for girls and remains persistent as girls age (Grogan, 2006). Martins, Williams, Harrison, and Ratan (2009) apply this concern with female body imagery to video games and the female characters found therein. The findings—that the more photo-realistic a female game character is, the thinner she is—point to the notion that, in concert with Grogan’s argument, as in other forms of popular media, girls are constantly presented with female
imagery of a particular ideal, that ideal being thinner is better. To illustrate this, the authors calculate the real-world measures of the average video game character: “5’4” tall, with a 29” bust, 22” waist, and 31” hips” (Martins et al., 2009, p. 831), measurements that are practically unrealistic. They also mention—with a certain level of heteronormativity—that this is problematic not only for girls’ self-images, but also for boys, as the females they see in video games set expectations that real women will almost never fulfill. This opens up the conversation to issues of sexualization and hypersexualization in video games.

**Sexualization.** Playing video games with over- or hyper-sexualized female characters can have real-world, negative effects on players of both genders (Behm-Morawitz & Mastro, 2009). Female players, for example, after being exposed to hypersexualized female characters may suffer from a reduction in “confidence in their ability to succeed in the real world” and negative “feelings of self-efficacy” (Behm-Morawitz & Mastro, 2009, p. 819). Along these lines, there was no connection to self-esteem in females. This is in opposition to perceptions about females’ intelligence and physical capabilities after playing a sexualized character, which turned out to be negative for both genders. That is, both male and female gamers thought less of females’ intelligence and physical abilities after having experienced an overly sexualized character in the game.

This sort of objectification can cross gender lines. Just as “female video characters are consistently shown as beautiful, busty, scantily clad sex objects,” a heavy majority of “male video game characters are hyper-masculine” and characterized as
violent (Dill, Brown, & Collins, 2008, p. 1402). When teenagers were asked to “describe
typical male and female video game characters [they] described female characters as
being sexually promiscuous, wearing revealing clothing and as thin with large breasts”
while male characters were described as “physically powerful, dominant, violent, mean
and cocky” (Dill et al., 2008, p. 1402). The same study showed that games that promote
these views may alter players’ tolerance of sexual harassment, with male players
tolerating most the harassment of a younger female by an older male, while female
players tolerated harassment less. While violence and harassment are explicit problems
that may occur in relation to gaming, some concerns are more internalized (addiction)
and some are not problems at all (prosocial gameplay). The following examines these
areas.

Socialization and problematic gameplay. Among the many concerns raised
about video game play are the notions of addiction and problematic play. Conversely,
there is considerable research that supports the notion that gaming with others—be it
virtually or physically proximal—has pro-social benefits, presuming the player does not
fall into the problematic play or addiction trap. It can be difficult to reconcile research
across these fields due to the lack of a clear and consistent terminology, especially when
it comes to internet, video games, and mobile usage (Carbonell, Guardiola, Beranuy, &
Bellés, 2009), though recent events may change that.

In 2013, the study of gaming addiction was added to Section III of the Diagnostic
and Statistical Manual of Mental Disorders (DSM-5 or DSM-V) (American Psychiatric
Association, 2013), labeling it a “condition warranting more clinical research and
experience before it might be considered for inclusion in the main book as a formal disorder” (NCRG Staff, 2013, para. 1). Though gaming addiction and problematic gaming behavior is well documented, there is a lack of consistent and standardized diagnostics, identified comorbidities, and applicable treatments (Petry & O’Brien, 2013), though a recent study identified the Internet Addiction Test (K. Young, 1998) as a viable scale by which to study addiction related to MMORPGs (Byrne, 2013). The inclusion of the disorder in Section III is intended to give direction and means of improvement to relevant research. Prior to the conditional inclusion of Internet Gaming Disorder in the manual, gaming addiction was studied using the same scales and criteria as gambling addiction as described in the DSM-IV (Gentile, 2009; Lemmens, Valkenburg, & Peter, 2009), but the new version makes a distinction between games of internet gambling and nongambling (American Psychiatric Association, 2013). Some proposed criteria include gaming becoming the “dominant activity in daily life,” withdrawal, tolerance (the need to continually increase play time), inability to refuse playing, discarding other hobbies or interests, denial, hiding playing time, escapism, and damage to relationships, jobs, or other life aspects.

Much like alcoholism, a well-defined condition in the DSM-V, true problematic gaming behavior and addiction does not simply appear overnight: it takes time and lifestyle changes, though specific motivations can point to those at risk, including “reward and completion, mood regulation, and the social aspects of online gaming” (Haagsma, Pieterse, Peters, & King, 2013, p. 449). Unlike alcoholism, identifying gaming addiction can prove difficult as it may be masked by legitimate computer use (K.
Young, 2009). Additionally, problematic gaming may be the result of increasing and extreme lengths and high frequency of gaming sessions. MMOs, specifically, may be the most likely to elicit problematic gameplay, most likely due to groupthink and the encouragement of teammates to continue playing, and moderation is encouraged to stem these concerns.

The correlation between problematic gameplay and time spent playing games is well established, though one would do well to remember, much like ice cream sales and murder rates, correlation does not prove causation (Perdicoulis, 2013). Hellström, Nilsson, Leppert, and Åslund (2012) found just such a correlation, in that more than five hours of playtime per day is related to negative consequences like withdrawing from friends, ignoring personal hygiene, fighting with family members, or ignoring responsibilities. Motivation for playing appears to be the most salient factor. Gaming for “fun or social motives had a reduced risk” while those who played to “escape, for gaining status, or because of demands” had higher risks (Hellström et al., 2012, p. 1385). In the study, the majority of participants claimed to have experienced the negative effects of gaming, the most frequently reported being a lack of sleep due to staying up late to play, which, while seemingly tame, the authors note may be detrimental to the physical and mental health and development of adolescent.

This correlation between time spent playing and aggression is also demonstrated in one of the most well-known texts regarding video games and problematic gameplay and behavior: *Grand Theft Childhood: The Surprising Truth About Violent Video Games and What Parents Can Do* (Kutner & Olson, 2008). In this text, the authors examined the
playing habits and resultant behaviors of over 1,200 children of middle-school age and point out a rather well balanced view. Games can be beneficial or detrimental, the authors suggest, and a good deal of public opinion on violent video games and their impact on children stems from misinformation or politics. Being a text published for popular consumption, however, it lacks some scientific rigor present in other works.

In another study, it was immersion that coincided with time spent playing as “strong predictors for problematic playing behavior” (Kneer & Glock, 2013, p. 1419). The authors suggest that trouble begins when motives become internalized. Kirby, Jones, and Copello (2014) support this notion, connecting an internalized motive of immersion with negative psychological wellbeing, but mediating for immersion and other problematic behavior, found “no observed direct effect of play time on psychological wellbeing” (p. 47).

Problematic gameplay entails a gendered aspect. Tolchinsky and Jefferson (2011) reported a relationship between gender, time management, attention-deficit/hyperactivity disorder (ADHD) symptoms, and problematic play. For men, “time management skills mediate the relationship between ADHD symptomology and problematic play” while, for women, “ADHD symptomology mediates the relation between time management skills” (p. 494) and problematic game playing, offering a path for further research addressing gender differences in problematic gaming. They also inform potential treatment options in relation to addressing the issues put forth in the DSM-V.

Problematic gameplay also extends to aspects of socialization. Collins and Freeman (2013) examine the growing importance of socializing while gaming. By all
rights, this should be a boon for bringing naturally sociable people into the gaming fold, but this presumes everyone is normal. The authors compared typical with problematic gamers, labeled such possibly because of real life socialization issues that extend into the gaming realm. While the study found no meaningful difference between participants—be they normal, problematic, or non-gamers—in terms of personality (identified via empathy, extraversion, and prosocial tendencies), there was a difference in terms of relative importance placed on social capital. That is, both normal and problematic players placed an emphasis on in-game social capital, but only problematic players decreased emphasis on offline social capital. Ensuring gamers maintain the relative importance of offline social capital may mitigate problematic behavior.

**Gaming with friends.** While much research paints a fairly dim picture in terms of playing video games and the dangers and potential problems that may accompany it, Kowert and Oldmeadow (2013) report that, while those who play online games are certainly going to have a different kind of social profile from others, the dire portrait painted by some literature of the anti-social, misanthropic gamer simply does not hold up, and lends credence to concerns raised by Ferguson (2011) regarding anti-gaming claims. In fact, some research shows that playing online games improves players’ sociability and may even “promote prosocial behavior” (Greitemeyer & Osswald, 2010, p. 215).

Snodgrass, Lacy, Dengah, and Fagan (2011) found that playing MMOs with real-life friends actually decreased the risk of problematic play, though the exact reason why remains unclear. In fact, the qualitative portion of the study supports the idea that not only does it “protect” (p. 1219) players from problematic use, but improves offline
relationships with the co-players, and, most importantly, accomplishments made in-game appear to transfer into the real world: “[MMO] play becomes an extension rather than a replacement of the actual self” (p. 1219). When friends or partners play together, they not only support one another but also can act as voices of moderation, ensuring the other party does not begin experiencing any negative real-life impact and especially reducing the danger of problematic immersion. In a related study, Snodgrass, Lacy, Dengah, Fagan, and Most (2011) suggest there is the equivalent of immersive or dissociative sweet spot, at which point gameplay “contributes to their happiness and satisfaction” (p. 53).

**Offline multiplayer.** It appears that in a world of MMOs with millions of players worldwide, game developers are beginning to re-discover the notion of playing multiplayer games while physically together (Foddy, 2014). Games like *TowerFall* (Thorson, 2014), a 2D retro-style downloadable game that has brought in over half a million dollars in sales, provides no online multiplayer whatsoever, and has been both lauded and criticized for this (Tach, 2014). Getting together with a group of people (Trepte, Reinecke, & Juechems (2012) refer to these groups as *clans*) can be highly beneficial to gamers. Those who play in clans tend to have greater off-line friendships with other clan members, and those who participate in clan leadership typically have higher social capital within the clan. Higher levels of social proximity (physically being near other clan members when playing games) tend to provide the most benefits to membership.
While offline play provides benefit, online play may provide the same. Domahidi, Festl, and Quandt (2014) find that, in opposition to concerns raised by other research about gamers being anti-social, social gamers are not much different from non-social gamers or non-gamers. The opposite seems to be true: social gamers were more likely to transfer online friendships to offline ones. The authors note that their findings suggest for those “who seek sociability” (p. 113); social gaming may be an effective route. The transformation of online friends to offline friends may be so effective that the authors suggest game developers actually design games with this in mind.

Transference of friendship, skills, or traits developed while playing games can be positive. Lu, Shen, and Williams (2014) studied a Chinese MMO, *Chevalier’s Romance III* (CR3), and the link between in-game behavior and off-line leadership abilities. The authors found a bifurcated link between behavior and leadership: “individuals’ relationship-oriented behaviors are relevant to players’ leadership status in voluntary organizations, while their task-oriented behaviors are marginally linked to offline leadership status in voluntary organizations, but not in companies” (p. 59), supporting the notion of skill transference from games to real life, but there is still more that games may change about players beyond simply what players choose to do.

The growing importance of online gaming has led some researchers to think outside the behavioral box. Problematic or prosocial gameplay research is no longer limited to observations of in-game behavior or self-reported activities. With MRIs, researchers are now able to examine physical changes to the brain related to “online game addiction (OGA)” (Weng et al., 2013, p. 1308). In Weng’s study, those subjects who
were identified with OGA showed “multiple structural changes in the gray matter and white matter” (p. 1311), and, interestingly, the insular cortex, an area related to addiction to drugs like narcotics and nicotine. One (albeit inflammatory) story was recently released suggesting that video games were not only addictive like heroin—a narcotic—but posed an equal health risk (Parfitt, 2014). Sensationalistic news stories aside, not only may genuine neuroscientific research like this pave the way for the inclusion of internet gaming addiction fully into the DSM-V (and the identification and treatment of the condition), but it also joins an ever-growing body of literature related to video games and the human body.

**Biology and health.** The effects of playing video games can extend to physical changes in the players’ bodies that exhibit beyond social interaction or changes in thought patterns or brain chemistry. Some of these include rehabilitation of injured body parts, increased visual acuity and response alacrity, and even measured growth of the brain. These and others are discussed below.

**Physical therapy, recuperation, biological changes.** An action game and an arcade game were used to train older adults’ “useful field of view (UFOV)” as opposed to traditional means of intervention (Belchior et al., 2013, p. 1318). In opposition to a younger sample in previous studies, the use of a targeting game like an FPS vs an arcade game like *Tetris* (Atari Games, 1988) displayed no discernable difference, and the use of video games was as effective as traditional means of intervention. This is not to suggest that playing a video game is an incredibly more efficient means to rehabilitation, but simply that it is an alternative that is at least as effective.
Beyond a simple on-screen game, Golomb et al. (2011) brings virtual reality and rehabilitation together. Like other studies, the authors point out the lack of long-term examinations of this idea, but report the story of a 15-year-old who both rehabilitated arm and hand strength, as well as bone health, and maintained it more than a year later. If nothing else, the experiment shows there is proof of concept when it comes to using virtual reality as rehabilitative means.

There is of a growing movement to link video game playing with physical, potentially beneficial neurological changes (Hummer et al., 2010; S Kühn et al., 2013; Simone Kühn et al., 2014; Li, Ngo, Nguyen, & Levi, 2011; Weng et al., 2013). In one study of cortical thickness in adolescents, there was “a positive correlation between [it and] self-reported hours of video gaming per week” (Simone Kühn et al., 2014, p. 4). Interestingly, it was the total number of hours played and not the frequency that was associated. The areas of the brain specifically implicated in this study are the “left dorsolateral prefrontal cortex (DLPFC) and left frontal eye fields (FEFs),” which deal with “executive control and strategic planning” in the former, and “visuo-motor integration” in the latter (p. 1). It may be that gaming keeps people sharp as long as it’s done regularly.

Increasing evidence is mounting that older adults that regularly play video games are generally happier than non-gaming older adults. In one study performed in the United States, regular gaming older adults “reported less depression and lower negative affect as well as higher well-being than their non-gaming counterparts” (Allaire et al., 2013, p. 1305). While most research on the effects of gaming examines adverse effects and
focuses on adolescents, as the population ages and gaming becomes more ubiquitous, studying the effects of gaming on the aged may become a prevalent area. Related to this is the area of health care professionals, who are also benefiting from gaming.

Tucker (2008) looks at the use of video games in the health care industry in terms of training health care professionals. He suggests that gaming can help both medical professionals by performing simulations and can also help patients by, just as one example, relieving stress. By allowing professionals to partake in realistic situations in which the correct medical steps must be made but without fear of harming a patient due to anxiety, poor technique, etc., and even place themselves in different life-threatening situations like “an earthquake, bombing, or saran gas attack” (Tucker, 2008, p. 61). In addition to reactionary care, video games are being used to address preventative care.

**Dietary and fitness considerations.** A positive correlation between time spent using media screens and increased BMI was found in 13-15 year olds, though there was “no evidence that BMI was associated with duration of TV viewing or with attention to or duration of using video games or computers” (Bickham et al., 2013, p. 939). While studies like this are often touted in popular media as proof that video games and television are bad for children’s health, this study actually suggests that it has more to do with advertisements for “energy-dense, nutritionally questionable foods” and point toward “unconscious eating” (p. 936) as potential causes, so, while the two may be related, that relationship is far from causational.

A similar study of over 11,000 high school students in the United States, finding higher media screen usage associated with a likelihood to drink “sugar-sweetened
beverages” (Demissie, Lowry, Eaton, Park, & Kann, 2013, p. 756), but also attribute this more to the effects of advertising and “mindless” snacking, noting the “more than $1 billion [being] spent on marketing food products to adolescents” (p. 758) in 2006.

As previously noted, adequate sleep for children and adolescents is key to health and growth. The playing of video games was negatively correlated with age-appropriate hours of sleep, and thus related to poorer health and academics (Stroebele, McNally, Plog, Siegfried, & Hill, 2013). The relationship is complex and includes television time, whether children ate breakfast or lunch, level of obesity, and level of physical activity, suggesting it is a combination of all these—a lifestyle, as it were—that predict one another. One solution to this may be exergaming, or the combination of physical activity and game playing.

**Exergaming.** LeBlanc et al. (2013) examine the literature in the field of “active video games (AVG)” (p. 1) and young people’s health. While the study found support for the idea that exergaming increases the activity of gamers (light to moderate) and may be beneficial, as moving some is healthier than moving none, there is more research needed in the area and exergaming is not sufficient to achieve the ”guidelines of 60 minutes of moderate- to vigorous-intensity physical activity on a daily basis” (LeBlanc et al., 2013, p. 18) suggested by the World Health Organization.

Similarly, Daley (2009) laments “encouraging results” in the recent exergaming fad, finding that exergaming is not a true substitute for traditional exercise or sports. They call for more “high-quality randomized, controlled trials” (Daley, 2009) to validate a cautious optimism. Like Leblanc et al. (2013), Parisod et al. (2014) published a meta-
review (a large scale review of reviews) and found that, essentially, nothing has changed since Daley suggested the need to find “ways in which we can work with [the gaming culture] rather than against it” (Daley, 2009).

On the other hand, Graf, Pratt, Hester, and Short (2009) found that in children aged 10-13 playing video games that required movement, it was the equivalent of moderate-intensity walking. While these are still not replacements for high-intensity fitness activities or sports, Graf et al. (2009) suggest they should still be considered “safe, fun, and valuable means of promoting energy expenditure” (p. 534).

One study in particular (Mellecker, Witherspoon, & Watterson, 2013) turns this area of study somewhat on its head by looking at the means by which a game is played driving the content, rather than the other way around. Using “footgaming” (p. 352), students played a game about nutrition by controlling a mouse cursor with their feet. Children’s knowledge of nutrition improved between pre- and post-tests, a fact which the authors suggest have implications on “active video games” (p. 356). As the field is still in its infancy, this sort of work adds to the cautious optimism found in the literature.

Summary

As demonstrated by the preceding review of the literature on and surrounding these myriad fields, conflict abounds. Be it whether violent video games cause aggression, or games make players anti-social, or whether augmented reality is ready for prime-time, or if massively popular games or virtual worlds are truly an appropriate conduit for learning. Two ideas remain a clear thread throughout, however: one, more research with increasing vigor is needed; and two, digitally based education, video
games, and mobile devices are only going become more popular as time goes on. With this in mind, this study hopes to use the concerns, critiques, and suggestions demonstrated by the work that has come before and open pathways to future advances. Follows is a brief look at learner characteristics and motivation to preface the construction of the current research and the theoretical framework involved.

**Learner Motivations and Characteristics**

Learner characteristics can range from demographic to learning preference, physical capability to mental capacities, to simple learning style. These also change in salience depending on the learner’s age (Knowles, 1970). Employing Gardner’s (2011) multiple intelligences, the vast majority of primary and secondary students fall into the visual or visual-kinesthetic groups, which is not reflected in standardize test construction (Jensen, 2005). Vandewaetere, Desmet, and Clarebout (2011) suggests more stringent considerations be taken for learner characteristics when designing digital learning, and as Scheiter and Gerjets point out, “learner characteristics have been found to influence whether learners will benefit from the opportunity to exceed control over their learning with hypermedia environments” (2007, p. 296) For learning to occur, the learner should be motivated to want it to occur and to make the effort (Dean, Ross Hubble, Pitler, & Stone, 2012).

Malone and Lepper (1987) identify a number of what they define as individual and interpersonal motivations. The intrinsic motivations are: challenge (consisting of goals, uncertain outcomes, performance feedback, and self-esteem), curiosity (consisting of sensory curiosity and cognitive curiosity), control (consisting of contingency, choice,
and power), and fantasy (consisting of emotional and cognitive aspects and endogeneity) (pp. 248-249). The interpersonal motivations they identify include cooperation, competition, and recognition.

Medina (2005) provides an overview of motivation in digital game learning. Identifying a number of threads historically, she concludes that an examination and concern with learner motivation is key to proper utilization of digital games being used for learning. She concludes,

Commercial and educational games share common elements that help them to promote users motivation, such as, multiple goals, feedback, challenge and rewards. Yet they differ in other aspects that promote or undermine intrinsic motivation. Some of the main differences I identified by playing games myself and becoming familiar with the relevant literature are different purposes (commercial aimed entertainment, while educational emphasis learning), different Level [sic] of challenge and help to overcome the obstacles, different use of new technology, type of rewards, and use of social interaction systems. (p. 9, emphasis in original)

Shunk (1983) remarks that “offering performance-contingent rewards promotes children’s task accomplishments, perceptions of efficacy, and skill development. In contrast, offering children rewards for simply participating at a cognitive-learning task does not promote the outcomes over what results from merely providing training” (p. 517). In short, reminiscent of Csikszentmihayi’s (1996) notion of flow, motivation comes from the challenge.
From learner characteristics and motivations to the existence of learning, the present study now turns to the theory of discovery learning and an examination of how it can be utilized in learning in tandem with technology.

**Theoretical Framework**

The present study is predicated on the notion that learning can occur through play and is exemplified by the scholarship of James Paul Gee, who combines notions of play with constructivist learning theories. In particular, discovery learning will be examined to scaffold the experimental and experiential learning that may occur through simply playing games like *Ingress*. Follows is a brief history, description, and exploration of discovery learning theory and how it is situated in technology, games, and *Ingress*.

**History of discovery learning.** Discovery learning is a constructivist approach to learning that was advocated by Jerome Bruner and his 1961 text *The Act of Discovery*. It stems from previous constructivist theories like those of Dewey, Piaget, and Vygotsky, in that it is a theory that contends learners produce their learning based on previous knowledge, using that knowledge to make sense of and scaffold new information in meaningful and authentic ways, though these authors differ slightly in how this is best accomplished.

**Dewey, Piaget, and Vygotsky.** In Dewey’s *Democracy and Education* (1966) he identifies learning as the emergence of new ideas and knowledge through learners’ interaction with others. It is based on community, previous knowledge, and engaged participation in authentic situations. Piaget (1973) suggested that discovery breeds understanding and, lacking understanding, creative processes and productivity become
impotent. Without these, he suggests, learners can simply repeat information and nothing more. Vygotsky (1978) reiterates the community and social aspects of cognitive development. His ‘zone of proximal development’ promotes this notion, suggesting that learners can move beyond what they could accomplish alone with the help of social scaffolding. The main source of learning, whether internal or external, is a stark difference between Piaget’s and Vygotsky’s works.

**Bruner.** In his text *The Act of Discovery* (1961), Jerome Bruner emphasizes the self-reliance of learners in the creation of their own learning through discovery. That is, learners are better able to recall ideas if they are developed through their own discovery-based experiences. He hypothesizes, “Practice in discovering for oneself teaches one to acquire information in a way that makes that information more readily viable in problem solving” (Bruner, 1961, p. 24). Bruner’s definition of discovery is not an absolutist one: “I do not restrict discovery to the act of finding out something that before was unknown to mankind, but rather include all forms of obtaining knowledge for oneself by the use of one’s own mind” and that true learning will “come from permitting the student to put things together for himself, to be his own discoverer” (p. 21).

In Bruner’s discovery learning, the student or learner is an active participant in her own knowledge formation. He remarks, “The student is not a bench-bound listener, but is taking part in the formulation and at times may play the principle role in it. [The student] will be aware of alternatives and may even have an ‘as if’ attitude toward these and, as [she] receives information [she] may evaluate it as it comes” (p. 22).
Also key to Bruner’s notion of discovery learning is the motivations behind learning. He suggests that learning should come from intrinsic motivations, and that a student that begins responding to extrinsic motivations to learn ends up in “a pattern in which the child is seeking cues as to how to conform to what is expected of him,” producing thinkers “lower in analytic ability” than intrinsically motivated students (p. 24). Bruner suggests that a key component of discovery learning is in stark contrast to what this extrinsically motivated thinker is going for (a correct or approved method of accomplishing something) in that “success and failure,” he says, should be seen “not as a reward and punishment, but as information” (p. 26).

In regards to transference of skills, Bruner’s position is clear: “It is only through the exercise of problem solving and the effort of discovery that one learns the working heuristic of discovery, and the more one has practice, the more likely one is to generalize what one has learned into a style of problem solving or inquiry that serves for any kind of task one may encounter—or almost any kind of task” (pp. 27-28). Through discovery then, Bruner suggests, learners are becoming best prepared to deal with much more than what is just being learned at the time.

**Modern discovery learning.** Ormrod defines discovery learning as “a process through which students interact with their physical or social environment—for example, by exploring or manipulating objects, performing experiments, or wrestling with questions and controversies—and derive information for themselves” (1998, p. 594). As a constructivist theory of learning, discovery learning provides students with the chance to “construct a more complete understanding of the world when they have opportunities to
explore and manipulate their environment” and the experiences that the students have “are critical for cognitive development” (p. 594). Likewise, students are better able to predict events when observing real-world principles. It also “encompasses an instruction model and strategies that focus on active, hands-on learning opportunities for students” (J. Castronova, 2002, p. 2) Being immersed and included within these events as agents of change and understanding provide students with authentic, meaningful learning experiences. Ensuring that learners have the requisite knowledge to scaffold and make sense of what discovery learning may uncover is paramount, which is not unlike Gee’s condition of being well-precursed.

Key aspects of discovery learning, then, are motivation and curiosity that are hoped to lead to deeper and more meaningful learning. This differs from traditional education in a number of different ways: a preference for active learning, a focus on process over content, the acceptance and even encouragement of failure, heavy feedback, and the development of deep, authentic understanding (J. Castronova, 2002). The focus is on creativity, construction, and curiosity, and the fostering of these qualities in learners.

While discovery learning may provide authentic, creative learning experiences, it suffers from some potential drawbacks, especially when implemented in traditional classrooms. With the contemporary state of education in the United States and the prevalence of standardization over individualized instruction, teachers may find it difficult to gather the time, resources, and possibilities to implement discovery learning as it is “a process that unfolds over time. It is possible that teachers feel pressed for time and that such a concern may add to the tension they feel regarding using a teaching
method such as discovery learning versus a more traditional approach to covering the content” (Sullivan & Moriarty, 2009, p. 114). One suggestion provided by Sullivan and Moriarty to help institute a discovery learning method in the classroom is to provide more guidance to students throughout the process. This is supported by what Mayer calls “guided discovery learning” (2004, p. 14), a form of discovery learning which involves more guidance from educators, which he found to be “more effective than pure discovery in helping students learn and transfer” (p. 14). Bruner himself suggested this in The Process of Education: “The teacher’s task as communicator, model, and identification figure can be supported by a wise use of a variety of devices that expand experiences, clarify it, and give it personal significance” (1963, p. 91). Different implementations of discovery learning have since been identified.

Schank and Cleary (1995) describe five distinct types of discovery learning: case-based learning, incidental learning, learning by exploring/conversing, learning by reflection, and simulation-based learning. Case-based learning involves describing examples and experiences that are descriptive of the topic to be learned, which is accomplished by the students’ reflection upon these cases and the information contained therein. Incidental learning is as the name implies: learning that occurs naturally through authentic engagement with content, though not through direct exposure to the topic to be learned. By exploring and conversing, teachers and students may take on the positions of Socrates and Euthyphro, respectively, in an attempt to tease out learning and knowledge through dialog. Reflective learning flips the exploring/conversing method, imploring the learner to ask questions that then lead to discovery and learning, and, it is hoped, the
ability to ask better questions. In simulation-based learning, students are given a sandbox in which to experiment and develop without risk of real-world consequences, freeing them to think more abstractly. Some topics are better suited to some methods than others, suggesting teachers obtain a clear mastery of these pedagogical models in order to best facilitate this type of learning.

**Discovery learning and technology.** Discovery learning is very well supported by modern technologies (J. Castronova, 2002). One way technology supports discovery learning is through the use of ‘cognitive tools’ (Joolingen, 1999). These can be defined as “instruments that are designed for supporting cognitive processes and thereby extending the limits of the human cognitive capacities” (p. 389). This can be done through data visualization via animations or simply through the use of devices or software. While powerful, the “challenge here is to make the tools unobtrusive, i.e. keeping the discovery character of the learning environment while at the same time trying to support and direct the learning process going on” (p. 390).

Modern computers and especially mobile, handheld devices are perfectly suited for this (J. Castronova, 2002). The affordances of mobile technologies, especially, seem well suited to discovery learning as they can be used as cognitive tools to provide access to a vast array of information and knowledge instantaneously and anywhere. This ubiquitous access to information promotes students’ abilities to experiment and explore in order to accomplish the task they have been given. Technology also supports community building, a key component in the social aspect of discovery learning. “That is, it is more important to help students learn how to find or create knowledge as they need it
and to negotiate its meaning within the community of practice rather than to teach them
only what the teacher believes they need to know now” (Borthick & Jones, 2000, pp.
183–184). Unfortunately, educators tend to use technologies that match their own typical
teaching styles and pedagogies, even though generally they enjoy experimentation (Zhao,
Pugh, Sheldon, & Byers, 2002).

**Discovery learning, multiple intelligences, games, and Ingress.** Assisting in the
facilitation of learning is understanding how each learner learns. Part of Bruner’s notion
of discovery learning is predicated on “modes of cognitive representation” (Ormrod,
1995, p. 230). These include enactive (“representing one’s understanding through motor
responses”), iconic (using images to represent understanding”), and symbolic (“using
symbol systems such as language, musical notation, and mathematical notation to
represent understanding”) (p. 230). This is reflected in the multiple intelligences theory of
Howard Gardner (2011), which he identified as linguistic, logical-mathematical, spatial,
musical, body-kinesthetic, interpersonal, intrapersonal, and naturalistic. Kong, Masaki,
Ackerman, Borengasser, and Leong (2010) tie the theory of multiple intelligences to
Gee’s (2007a) learning principles. Using an earlier list of Gee’s principles (16 in total,
before Gee expanded them to 32), they found that “several elements of Gee’s Learning
Principles are aligned with Gardner’s Multiple Intelligences” (Kong et al., 2010, p. 165).
Among these, the ‘interaction principle’ matches with the ‘interpersonal’ intelligence, the
‘challenge and consolidation principle’ matches with Gardner’s ‘logical-mathematical’
principle, but three of Gee’s principles—risk-taking, customization, and agency—match
with all of Gardner’s intelligences. The authors suggest, “further study into learning
theory and gaming would extend a body of knowledge related to gaming that has a basis in education, learning, and instruction” (p. 166).

The experience of playing Ingress is based almost entirely on exploration and experimentation, and can be firmly rooted within the principles described above. The ‘interaction principle,’ defined as “The player talks and the game talks back offering feedback and the possibility of new challenges” (Kong et al., 2010, p. 162), can be demonstrated through the inclusion of an in-game narrator and guide that literally talks back to the player, both encouraging the player and describing gameplay possibilities. The ‘challenge and consolidation’ principle, “Games use a system that allows players to master skills before they are guided to the next level, enabling them to become experts” (Kong et al., 2010, p. 162), is evident in the game’s inclusion of leveling requirements such as badges that require certain skills in order to progress (a certain number of links established or a minimum number of unique portals discovered). The ‘risk taking’ principle, “Video games allow for players to explore with a calculated risk of failure,” (Kong et al., 2010, p. 162), is demonstrated in that players are never prevented from attempting something at level 1 which would theoretically only be possible at level 8 (the destruction of high-level, fortified portals, for example). The ‘agency’ principle, “Players feel a control over what they are doing,” (Kong et al., 2010, p. 162), is demonstrated by the game’s core functionality and mechanic, as every action and decision is theirs to make. That is, the game never ‘requires’ the player to do anything or dissuades the player from attempting something.
The ‘customization’ principle, “Games have different difficulty levels that players can adjust to their playing capabilities,” (Kong et al., 2010, p. 162), is the only principle identified by Kong et al. that does not isometrically match to an experience in *Ingress* as it does not implement difficulty levels. However, players are welcome to play in such a way that they can, in effect, determine the difficulty level based on their own in-game strength and inventory.

**Conclusion.** It is this intersection, described by Kong et al. (2010) and scaffolded by the discovery learning championed by Bruner (1961) and other constructivist theorists, that the following research design is predicated. By examining the nexus of video games, mobile technologies, and the learning opportunities afforded by them, the following study seeks to illuminate how commercial augmented reality mobile gaming is currently located in the learning sphere, who plays these games and why, and how they may further be used to support authentic learning in the future.
Chapter 3: Methods

Individual and group benefits and implications of the use of video games, mobile devices, and augmented reality are argued in relevant literature. A considerable amount has been written on the benefits and costs of video game usage (a broad search for video games as a subject in the Academic Search Complete database returns 12,250 results), as well as those of mobile devices (likewise, a broad search for mobile device as a subject in the Academic Search Complete database returns 5,159 results). Augmented reality, whether due to newness or some other factor, is less represented in the literature: a broad search for augmented reality as a subject in the Academic Search Complete database returns 387 results. Identifying means that combine all of them is a gap in the collective body of research. Previously identified studies have unveiled that students who engage with these disparate methods and services (playing games for learning, using mobile devices in schools, etc.) are more engaged and express higher satisfaction in formal and informal educational settings (Basoglu & Akdemir, 2010; T. D. Cochrane, 2010; Girvan & Savage, 2010; Grove et al., 2012; Hess & Gunter, 2013; Ke & Abras, 2013; Sadler et al., 2013; Sayenko et al., 2011; Sherry, Lucas, Greenberg, & Holmstrom, 2013; Wrzesien & Alcañiz Raya, 2010). This study’s research questions are in light of these findings. ‘Problematic,’ in the following context, refers to addictive-like behavior. The questions addressed are:

1. What are the characteristics of those who play augmented reality massively multiplayer mobile games?
a. Are there significant differences in the demographic characteristics (age, education level, income, family size, and social tendencies) and motivations of *Ingress* players?

b. Are there indicators of positive gameplay identifiable in *Ingress* players’ characteristics, motivations, or behaviors?

c. Are there indicators of problematic gameplay identifiable in *Ingress* players’ characteristics, motivations, or behaviors?

2. Using Gee’s learning criteria, what characteristics of people playing augmented reality games like *Ingress* suggest it may be used for educational means?

These statements are addressed using a single survey instrument and, as commercial augmented reality mobile gaming is still in its apparent infancy, one game of the sort—Google’s *Ingress*—is considered. The instrument used consists of a combination of questions regarding demographics (age, gender, salary, education, etc.), playing habits and method (time spent per week, method of transportation, etc.), motivations, and reasons for playing (respondents’ self-reported feelings about statements ostensibly describing them).

For the pilot study, participants were contacted via online social networks and were primarily from the American southwest, specifically Arizona, though some respondents were located in other parts of the United States and Australia. As the study is mainly exploratory, the sample is retained as a single group to discover where schisms naturally appear. More about this pilot study can be found in Appendix N.
A relatively large number of responses were expected from the full survey as the survey was distributed online by popular and highly visible *Ingress* players, as well as the researcher. The initial exploratory survey was necessary to identify early and account for any differences between the original survey developed by Yee (2006b) and the altered version used in the pilot.

Chapter 3 includes details of the research design, a more detailed description of the population and sample, an account of how the survey was developed and its validity, the details, methodology, and how the survey responses were gathered.

**Research Design**

As research of this type has not been performed on games of this type and scale, the researcher elected to base the survey instrument on one that had been previously and successfully used to study the motivations of players of various MMOGs. A web-based survey was created to mimic in content Yee’s (2006b) survey instrument. The survey instrument is located in Appendix B and its associated IRB acceptance form in Appendix F. Data was collected using Qualtrics (http://www.qualtrics.com), an online survey creation and hosting service. Demographic questions contained response options relevant to the questions (multiple choice for gender, or a drop-down list for country, for example). Motivation-based questions were presented as 8-point Likert scales with options ranging from 1 to 8 and explanatory text such as *This does not describe me at all* or *I completely agree*, respectively. The use of 8-point scales lacking a neutral option was intended to encourage thoughtful response (Krosnick et al., 2012). The choice to use an 8-point scale rather than 13-point was made to mitigate respondents abandoning the
survey due to being overwhelmed or scared by the size of the response option sets
(Krosnick & Presser, 2010). To further reduce fatigue, a progress bar was added to show
participants how much of the survey they had finished, and demographic items were
interspersed with Likert groupings to maintain variety. Additional items about ethnicity,
social ideology, political affiliation, and addiction-identification were also added. Some
open-ended questions were also presented in order to allow for more nuanced,
individualized responses.

Population and Sample

The population for the current study is the entirety of Ingress players worldwide.
As the game is available to anyone with an Android smartphone or tablet or an Apple iOS
device, there are only two apparent and potential assumptions that can be made about
members of this population: first is a relative affluence, as these devices can be expensive
and then taking into account the additional cost of data packages and potentially
transportation; second is that they spend more time in urban or suburban areas, as portal
concentrations are highest in those locations, suggesting more opportunities for gameplay
and more players with which to interact. The results are not intended to generalize to the
worldwide population, but to all potential and real users of Ingress.

Development of the Survey

As studying the motivations of commercial augmented reality mobile game
players is an essentially untouched field, an antecedent instrument in a related area may
provide the best beginning point. With this in mind, Stanford graduate and UbiSoft
research scientist Nick Yee was contacted by the researcher to request the use of an
instrument he had previously used to study the demographics and motivations of MMORPG players. The author chose Yee’s (2006b) instrument as, not only is it ostensibly the largest and oldest study of its kind, it provided a well-tested and validated instrument that could both lend that validity to the present study and provide a ‘control’ demographic against which the present study’s results could be compared. Results of Yee’s study have been published in journals like Presence, Journal of Computer-Mediated Communication, and CyberPsychology & Behavior, and he has recently published a book, The Proteus Paradox: How Online Games and Virtual Worlds Change Us—And How They Don’t (2014), using the data collected in what he calls the Daedalus Project. As the original instrument was MMORPG-specific, some terminology was altered to fit into the Ingress universe (Table 1). Further research into MMORPGs, like the study performed by Billieux et. al. (2013) was not considered for alteration in place of Yee’s due to the almost exclusively World of Warcraft-centered terminology (references to quests, guilds, dungeons, and raids, for example), even though factor loading was very similar to this pilot study. Yee’s original questions (both the 40-item version the present study was predicated upon and the 39-item version available online), coding system, and scoring instructions in their entirety are located in Appendix D. More information on how the current study was coded can be found in Appendix E.
### Table 1

_Survey Items from Yee (2006b) and Altered Ingress-Specific Items_

<table>
<thead>
<tr>
<th>Original</th>
<th>Ingress</th>
</tr>
</thead>
<tbody>
<tr>
<td>I can’t stand those people who only care about leveling.</td>
<td>I can’t stand those people who only are about seeing their name everywhere.</td>
</tr>
<tr>
<td>I try to optimize my XP gain as much as possible.</td>
<td>I try to optimize my AP gain as much as possible.</td>
</tr>
<tr>
<td>I research everything about a class before starting the character.</td>
<td>I researched everything about a faction before starting the game.</td>
</tr>
<tr>
<td>Class-balancing or realm-balancing issues do not interest me.</td>
<td>Faction-balancing issues do not interest me.</td>
</tr>
<tr>
<td>I like to try out new roles and personalities with my characters.</td>
<td>I like to try out new roles and personalities with my agent.</td>
</tr>
<tr>
<td>I make up stories and histories for my character.</td>
<td>I make up stories and histories for my agent.</td>
</tr>
<tr>
<td>I scam other people out of their money or equipment.</td>
<td>I try to prevent the other faction from gaining high-level equipment.(^a)</td>
</tr>
<tr>
<td>I am uninterested in player-killing.</td>
<td>I am uninterested in targeting specific players.</td>
</tr>
</tbody>
</table>

*Note.* \(^a\) There is no _Ingress_-specific antecedent for _scamming_, as there is no in-game economy. The statement was reworded to represent depriving other players from gathering desired equipment.

In addition to the items from Yee’s survey, items developed by Lemmens et al. (2009) were also altered and added to the survey instrument to collect information on potentially problematic gaming behavior of _Ingress_ players. The _Game Addiction Scale_ was constructed in two forms: the full 21-response instrument and a condensed 7-response instrument. This instrument was chosen over the _Internet Addiction Test_ (K. Young, 1998), used to study addiction in MMORPGs (Byrne, 2013), due to the length of the survey. The lead investigator in the study was contacted and gave permission...
(personal communications can be found in Appendix C) to have items altered for style and added to this survey instrument (Table 2).

Table 2

*Survey Items from Lemmens et al. (2009) and Altered Items*

<table>
<thead>
<tr>
<th>Original</th>
<th>Altered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did you spend increasing amounts of time on games?</td>
<td>I spend increasingly more time playing.</td>
</tr>
<tr>
<td>Did you play games to forget about real life?</td>
<td>I play to forget about real life.</td>
</tr>
<tr>
<td>Have others unsuccessfully tried to reduce your game use?</td>
<td>Others have unsuccessfully tried to reduce my gaming time.</td>
</tr>
<tr>
<td>Have you felt bad when you were unable to play?</td>
<td>I feel badly when I’m unable to play.</td>
</tr>
<tr>
<td>Did you have fights with others (e.g., family, friends) over your time spent on games?</td>
<td>I have fought with others (e.g., family, friends) over the time I spend gaming.</td>
</tr>
<tr>
<td>Have you neglected other important activities (e.g., school, works, sports) to play games?</td>
<td>I have neglected other important activities (e.g., school, work, sports) to play.</td>
</tr>
</tbody>
</table>

**Content Validity**

The validity of a survey instrument—whether it measures what it is designed to—can be identified a number of ways. Litwin (1995) lists *face, content, criterion*, and *construct*. For the present instrument, relevant methods used to determine validity were face (survey participants responded favorably in comments left after participating) and concurrent criterion (comparing the instrument to its original source).

Much of the instrument is based on a survey presented in 2006, by Nick Yee, the questions from which were based on statements generated from previous “open-ended
questions…, information drawn from online forum discussions and Bartle’s (1996) player types” (Yee, 2006b, p. 318), also exhibiting face, content, and criterion validity. Yee’s original instrument consisted of statements intended to determine player motivation and style, along with demographic items like age, gender, and so on. Included also is a 7-item Game Addiction Scale (Lemmens et al., 2009).

**Data Collection**

Immediately upon receiving an IRB approval, the researcher began data collection. Data was collected via a survey built on the Qualtrics website, distributed primarily through posts shared to an online social network. The researcher directed posts (the content of which is contained in Appendix C) to individuals and Ingress communities on Google+, posted the link on Twitter, Facebook, and Reddit. Posts contained a basic description of the survey and an anonymous link to the survey instrument located on the Qualtrics website (http://www.qualtrics.com). Users were asked to share the survey link widely with hopes of reaching the full population of Ingress players. It is important to note that prior to accessing the survey instrument was a consent form that only let participants move forward if they agreed to its terms (Appendix B for the consent form and survey instrument). Responses started being gathered on October 3, 2014, and analysis began on November 27, 2014 when the response rate had sufficiently slowed down. In the next chapter, an analysis of the survey’s results is presented.
Chapter 4: Results

This study examined the demographics, opinions, tendencies, and motivations of players of Google’s Ingress worldwide. The results in this chapter consist of analyses driven by the research statements identified in chapter one, restated here:

1. What are the characteristics of those who play augmented reality massively multiplayer mobile games?
   a. Are there significant differences in the demographic characteristics (age, education level, income, family size, and social tendencies) and motivations of Ingress players?
   b. Are there indicators of positive gameplay identifiable in Ingress players’ characteristics, motivations, or behaviors?
   c. Are there indicators of problematic gameplay identifiable in Ingress players’ characteristics, motivations, or behaviors?

2. Using Gee’s learning criteria, what characteristics of people playing augmented reality games like Ingress suggest it may be used for educational means?

Instrument Statistics

A survey constructed using the Qualtrics web-based software was distributed via social networks like Google+, Facebook, Reddit, and Twitter. The reach was global and responses varied greatly. The survey was launched on October 3, 2014, and results were collected for this study through November 27, 2014. It was started a total of 3,487 times with 2,292 responses ultimately being kept for initial analysis (those immediately discarded did not complete the survey), displaying a 65% completion rate. Due to the
nature of social media, it is impossible to know how many potential respondents had
access to the survey but chose not to participate. All significance tests in the current study
were performed at the two-tailed, 0.05 threshold.

Following are results for research question 1a, “Are there significant differences
in the demographic characteristics (age, education level, income, family size, and social
tendencies) and motivations of Ingress players.” General demographics will be reported
followed by Ingress-specific demographics.

**General Demographics**

A large number of demographic items were collected during this study to better
understand who plays augmented reality games, specifically Ingress, and to identify
whether the ‘average’ player is similar to the ‘average’ player of MMOs, as determined
through Yee’s (2006b) identification.

**Gender and age.** Of the 2,292 valid responses, 74.3% (N = 1705) identified as
male, 24.6% (N = 565) as female, 0.7% (N = 17) as ‘other,’ and 0.3% (N = 8) preferred
not to answer this question, compared to 85.4% (N = 5547) identifying as male in Yee’s
(2006b) study. In the current study, the average overall age was 35.29 (N = 2292, SD =
9.35), with the most frequently reported ages being 31 (N = 117) and 32 (N = 117). The
range was 70, from 13 to 83 years old. MMO players are reported as being 26.57 (N =
5509, SD = 9.19), ranging 11 to 68 years old. The lower and upper quartiles in the
present study were 29 and 41, respectively, versus 19 and 32 in MMOs.

Yee’s (2006b) study found a significant difference in player age by gender, while
the current study presented no significant difference between ages between females (M =
35.61, SD = 9.45, N = 565) and males (M = 35.25, SD = 9.32, N = 1702), \( t(2265) = -0.777, p = .437 \). This non-significance is retained even when including the ‘other’ and ‘prefer not to answer’ response options (\( f(3,2288) = 2.411, p = 0.06 \)).

**Employment and income.** *Ingress* players are mostly employed full-time (73.6%, N = 1690), while 9.9% (N = 227) are full-time students. This is in contrast to MMO players, half of which (50%, N = 2846) “worked full-time, while another 22.2% were full-time students” (Yee, 2006b, p. 316) (Table 3). For *Ingress* players, households making $100,000 or more topped the list (22.4%, N = 514) (Figure 1).

<table>
<thead>
<tr>
<th>Occupational Status</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employed, full-time</td>
<td>1681</td>
<td>73.9</td>
</tr>
<tr>
<td>Employed, part-time</td>
<td>146</td>
<td>6.4</td>
</tr>
<tr>
<td>Student, full-time</td>
<td>223</td>
<td>9.8</td>
</tr>
<tr>
<td>Student, part-time</td>
<td>34</td>
<td>1.5</td>
</tr>
<tr>
<td>Homemaker</td>
<td>51</td>
<td>2.2</td>
</tr>
<tr>
<td>Unable to work</td>
<td>31</td>
<td>1.4</td>
</tr>
<tr>
<td>Unemployed</td>
<td>72</td>
<td>3.2</td>
</tr>
<tr>
<td>Prefer not to answer</td>
<td>38</td>
<td>1.7</td>
</tr>
<tr>
<td>Total</td>
<td>2276</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Ethnicity and location. Of Ingress players, 83.6% (N = 1919) identify as White/Caucasian, 5.4% (N = 125) identify as Asian, 4.1% (N = 94) as Hispanic, 2.2% (N = 50) as Native American, 0.7% (N = 16) as African American, and 0.7% (N = 15) as Pacific Islander. Of the 3% (N = 64) who identified as Other, the five most popular identifications were Middle Eastern, European, and American (all N=3), and Indian and Arabic (both N=2).

In terms of location where Ingress is played most, 56.9% (N = 1306) reported their country of residence as the United States of America. The most frequently reported countries following in descending popularity were Australia (6.7%, N = 153), the United Kingdom of Great Britain and Northern Ireland (5.4%, N = 124), Canada (5.1%, N =
117), Germany (4.8%, N = 110), Netherlands (2.1%, N = 48), and New Zealand (1.8%, N = 41). The full list of countries is available in Appendix G.

For those 1306 respondents who reported living in the United States, they were also asked to report which state they reside in. In descending order of popularity was California (8.8%, N = 203), Minnesota (4.0%, N = 93), Arizona (3.8%, N = 87; though this may be artificially high given the author's residence and connection to the local population), Washington state (3.7%, N = 86), Ohio (2.5%, N = 58), Pennsylvania (2.4%, N = 56), New York (2.4%, N = 56), Texas (2.4%, N = 55, and Colorado (2.4%, N = 55). All other states reported less than 2% of the sample. The full list can be seen in Appendix H.

**Education level.** The Bachelor's degree was the most frequently reported completed level of education (33.4%, N = 767), with high school diploma or equivalent (21.7%, N = 496) and Master's degree (12.6%, N = 289) following (Table 4).

**Relationship and family size.** Nearly half (44.8%, N = 1028) of respondents identified as being married, while 29.9% (N = 686) identified as single, never married. Domestic partnerships made up 14.2% (N = 327) and divorcees made up 5.6% (N = 129) (Table 5).
Table 4

*Highest Degree or Level of Schooling Completed*

<table>
<thead>
<tr>
<th>Highest Level of Education</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor's degree</td>
<td>764</td>
<td>33.6</td>
</tr>
<tr>
<td>High school diploma or equivalent</td>
<td>489</td>
<td>21.5</td>
</tr>
<tr>
<td>Master's degree</td>
<td>288</td>
<td>12.7</td>
</tr>
<tr>
<td>Vocational/Technical degree</td>
<td>255</td>
<td>11.2</td>
</tr>
<tr>
<td>Associate's degree</td>
<td>249</td>
<td>10.9</td>
</tr>
<tr>
<td>Professional degree</td>
<td>63</td>
<td>2.8</td>
</tr>
<tr>
<td>Doctoral degree</td>
<td>57</td>
<td>2.5</td>
</tr>
<tr>
<td>Currently attending primary or secondary school</td>
<td>44</td>
<td>1.9</td>
</tr>
<tr>
<td>Valid Total</td>
<td>2209</td>
<td>97.1</td>
</tr>
<tr>
<td>Prefer not to answer</td>
<td>67</td>
<td>2.9</td>
</tr>
<tr>
<td>Total</td>
<td>2276</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 5

*Relationship Status*

<table>
<thead>
<tr>
<th>Relationship Status</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Married</td>
<td>1023</td>
<td>44.9</td>
</tr>
<tr>
<td>Single, never married</td>
<td>676</td>
<td>29.7</td>
</tr>
<tr>
<td>Domestic partnership</td>
<td>325</td>
<td>14.3</td>
</tr>
<tr>
<td>Divorced</td>
<td>128</td>
<td>5.6</td>
</tr>
<tr>
<td>Prefer not to say</td>
<td>58</td>
<td>2.5</td>
</tr>
<tr>
<td>Separated</td>
<td>27</td>
<td>1.2</td>
</tr>
<tr>
<td>Civil union</td>
<td>26</td>
<td>1.1</td>
</tr>
<tr>
<td>Widowed</td>
<td>13</td>
<td>.6</td>
</tr>
<tr>
<td>Total</td>
<td>2276</td>
<td>100.0</td>
</tr>
</tbody>
</table>

When asked about children, 55.6% (N = 1277) of *Ingress* players reported not having children, while 43.1% (N = 988) do, and 1.3% (N = 30) preferred not to answer.
Of those that have children, two children (42.8%, N = 423) was the most frequent number, followed by one child (32.3%, N = 320), three (13.7%, N = 136), four (7.2%, N = 72), and five children (1.8%, N = 18).

**Social tendencies.** There are many aspects of social tendencies that were gathered during this study, some related to *Ingress* and some not. *Ingress*-related results will be presented later, while generalized social tendencies are presented here.

The most frequently reported religious preference was atheist (24.2%, N = 555), with none (16.9%, N = 389), Christian (other) (12%, N = 275) agnostic (11.6%, N = 226), and spiritual, not religious (8.2%, N = 189) making up the top 73% (Table 6).
Table 6

*Religious Preference*

<table>
<thead>
<tr>
<th>Religious Preference</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atheist</td>
<td>551</td>
<td>24.2</td>
</tr>
<tr>
<td>None</td>
<td>385</td>
<td>16.9</td>
</tr>
<tr>
<td>Christian (other)</td>
<td>274</td>
<td>12.0</td>
</tr>
<tr>
<td>Agnostic</td>
<td>263</td>
<td>11.6</td>
</tr>
<tr>
<td>Spiritual, not religious</td>
<td>187</td>
<td>8.2</td>
</tr>
<tr>
<td>Catholic</td>
<td>178</td>
<td>7.8</td>
</tr>
<tr>
<td>Protestant</td>
<td>176</td>
<td>7.7</td>
</tr>
<tr>
<td>Other (please specify)*</td>
<td>82</td>
<td>3.6</td>
</tr>
<tr>
<td>Prefer not to answer</td>
<td>80</td>
<td>3.5</td>
</tr>
<tr>
<td>Buddhist</td>
<td>44</td>
<td>1.9</td>
</tr>
<tr>
<td>Jewish</td>
<td>31</td>
<td>1.4</td>
</tr>
<tr>
<td>Muslim</td>
<td>11</td>
<td>.5</td>
</tr>
<tr>
<td>Hindu</td>
<td>8</td>
<td>.4</td>
</tr>
<tr>
<td>Native American</td>
<td>6</td>
<td>.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2276</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

*Note: *a No specifications were provided.

For respondents who reported as being in the United States, they were asked with which political party they most identify. This question as confined to respondents from the United States to avoid confusion regarding political party names internationally. Democrat (21%, N = 272) and Independent, leaning Democrat (20.8%, N = 269) were the most frequently reported, followed by Libertarian (11.7%, N = 151), Independent (10.2%, N = 132), and Republican (9.6%, N = 124) (Table 7). A chi-square test of goodness-of-fit was performed to determine if the political parties and their variations were equally preferred amongst United States *Ingress* players. The preference was not equally distributed, $X^2(8) = 348.109$, p < .001. This is not dissimilar to a February 2015
Gallup poll that reports Democrats at 29% and Independents (including ‘leaners’) at 43%, however, the Gallup poll reported 25% Republicans, compared to the 9.6% in the present study (Gallup, 2015).

Table 7

**Political Affiliation**

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Democrat</td>
<td>272</td>
<td>21.0</td>
</tr>
<tr>
<td>Independent, leaning Democrat</td>
<td>269</td>
<td>20.8</td>
</tr>
<tr>
<td>Independent</td>
<td>132</td>
<td>10.2</td>
</tr>
<tr>
<td>Independent, leaning Republican</td>
<td>107</td>
<td>8.3</td>
</tr>
<tr>
<td>Republican</td>
<td>124</td>
<td>9.6</td>
</tr>
<tr>
<td>Green</td>
<td>32</td>
<td>2.5</td>
</tr>
<tr>
<td>Other</td>
<td>100</td>
<td>7.7</td>
</tr>
<tr>
<td>Prefer not to answer</td>
<td>107</td>
<td>8.3</td>
</tr>
<tr>
<td>Libertarian</td>
<td>151</td>
<td>11.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1294</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

All participants (N = 2295) were asked to rate their stand on moral issues by selecting a number ranging from 1 (extremely liberal) to 8 (extremely conservative). Respondents leaned toward the liberal side (M = 3.34, SD = 1.662) (Figure 2).
Figure 2. Stance on social issues.

A comparison of both US and non-US respondents’ answers to the previous question demonstrates similar social stances (Figure 3). Non-US respondents were shown to be slightly more liberal than US respondents. Respondents from the US reported an average score of 3.48 (SD = 1.791) while non-US respondents reported an average score of 3.16 (SD = 1.452). A chi-square test for the goodness-of-fit was performed to determine if participants’ stands on moral issues were equal across groups. Preferences were not equally distributed, $X^2(7) = 926.315$, $p < .001$. In comparison, a 2013 Pew
Research study showed Americans to be 22% liberal, 36% moderate, and 38% conservative (Pew Research Center, 2013).

Figure 3. Stance on social issues, US versus non-US.
**Ingress-specific Demographics**

Participants were asked a number of questions that pertain specifically to *Ingress*, such as agent statistics (faction and level), how they began playing, and basic playing tendencies. These are reported here.

**Agent statistics.** Players could choose between two factions when beginning to play *Ingress*. Respondents of this study chose the Enlightened faction (54%, N = 1261) over the Resistance faction (45.1%, N = 1034) significantly more often, \( t(2294) = 139.643, p = 0.00 \). The other key statistic about players’ ‘agents’ is their level. The most frequently reported level was 10 (30.6%, N = 703). This level was followed by 8 (14.5%, N = 333), 11 (12%, N = 275), 9 (10.8%, N = 248), and 14 (7.8%, N = 179) (Figure 4).

![Figure 4](image.png)

*Figure 4.* Level by faction.
Instigation and methods of play. Respondents were asked to report how they first were introduced to and began playing Ingress. The most frequently reported answer was "invited by a friend" (33.5%, N = 769). Following that, 26.4% (N = 607) received an invitation from Google, and 24.6% (N = 565) joined the game after an invitation was no longer needed. Of the 'Other' responses that made up 12% (N = 275) of the responses, some interesting responses included, “Because it become [sic] a hot topic in IOS support,” “gizmodo mentioned it,” “my brother in law told me about the game and told me to go blue so I went green,” “Purchased invite on ebay (march 2013),” “saw on BBC news,” “Was looking for a game to play while walking (weight loss),” “XKCD comic,” and simply, “curiosity.”

Faction switching. Players are given the opportunity to switch factions. When asked about their stance and history on this topic, respondents mostly (88.8%, N = 2039) said they had not switched factions and did not plan to. A small number of respondents (6%, N = 137) said they have not but would consider it and an even smaller minority (0.3%, N = 8) said they had not but planned on it. For those who had switched, 1.1% (N = 26) switched for faction balancing or competition, 1.1% (N = 25) disagreed with their faction, 1% (N = 23) chose their faction by mistake, 0.1% (N = 3) switched but want to switch back, and 1.5% (N = 34) gave a response of ’other.’

Playing time. Respondents were asked to estimate how many hours per week they played Ingress. Players averaged 11.66 hours per week (N = 2295, SD = 10.36). The lower quartile was 5 hours, while the upper quartile was 15 hours. There was a wide range of responses, from no hours per week (1.5%, N = 34) to extremes above 40 hours
per week (2.2%, $N = 51$), compared to “about 8-9%” of MMO players (Yee, 2006b, p. 316) who play more than 40 hours per week (Figure 5). It is possible that zero hours is a valid response, as respondents were not required to be actively playing at the time of the survey, only that they had been players at some time. Likewise, it is possible that extremes over 60 hours is possible if the respondent lives and works within range of a portal. It may also be that some players, to their own minds, never stop playing even when not actively using the application.

*Figure 5.* Number of hours played per week.
Participants were then asked whether or not they had 'marathoned,' defined in the instrument as playing more than 10 hours continuously or devoting an entire day/weekend to playing. Most had (56.6%, N = 1299), similar to the 60.9% of MMO players who also have ‘marathoned.’ A weak but significant positive correlation exists between having ‘marathoned’ and number of hours played weekly ($r = .243, p = .000$). Both *Ingress* players and MMO players exhibit a weak, negative, non-significant correlation between age and hours played weekly ($r = -.02$ and $r = -.04$, respectively).

Participants were then asked if they had experienced burn-out, defined as the cessation of play for prolonged periods of time. Most had not (66.8%, N = 1534). For those that had (33.2%, N = 761), they were asked to briefly describe why this occurred. Frequently, players stopped because of boredom, interpersonal problems with other players, the existence of cheaters, lack of interest in the local community, or that they hit the previous level cap and had no goal to work toward. There is a weak but significant negative correlation between number of hours played and the reporting of experiencing ‘burn-out’ ($r = -.121, p = 0.000$). There is also a weak but significant positive correlation between reports of both ‘burn-out’ and ‘marathoning’ ($r = .129, p = .000$).

Respondents were also asked they had traveled to play, defined in the instrument as going more than 100 miles or out-of-state, to which 58.5% (N = 1343) said they had not. A medium-sized positive and significant correlation was found between those willing to travel and those who report having ‘marathoned’ ($r = .473, p = .000$).

Regarding what method of transport players most frequently use to play, 45.3% (N = 1040) reported using a private vehicle, 40.9% (N = 938) play while walking, 9.1%
(N = 209) play using a bicycle, 3.5% (N = 80) use public transportation, and 1.2% (N = 28) responded ‘other.’

**Socialized play.** *Ingress*, being a social game by nature, requires teamwork or, at the very least, distributed effort to accomplish most goals. Respondents were asked how likely they were to play in various ways, such as alone, with friends, family members, and so on by stating rating their methods using a Likert scale of 1-5. Generally, participants most frequently played alone (N = 2295, M = 3.71, SD = .658). Males (N = 1705) were most likely to play alone (M = 3.76, SD = .629) and least likely to play with a romantic partner (M = 1.77, SD = 1.095). Females (N = 565) were also most likely to play alone (M = 3.76, SD = .718) but were rather least likely to play with co-workers (M = 1.42, SD = .818). While both males and females were equally as likely to play *Ingress* with a friend (t(2268) = -1.413, p = .110), females are statistically more likely to play with a romantic partner (t(853.847) = -13.115, p = .000). It is important to note that this only captures what method players are most likely to use when playing, not necessarily which one they feel is best or even prefer.

Regarding play style with hours spend playing weekly, the strongest correlation exists between time spent playing and playing with a friend (r = .186, p = .000), while playing alone correlates to less time spent playing (r = -.061, p = .003). Generally speaking, those who play alone do not engaged in other sorts of social play styles, while those who do play socially are more likely to play with others regardless of relationship (Table 8).
Players were also asked if they had cheated (coded as ‘Yes’ = 0 and ‘No’ = 1 to the question ‘Have you cheated?’). The majority (83.8%, N=1908) had not. Of those that had, 82.4% (N=299) had not gotten caught. Faction played no part in the decision to cheat ($t(2274) = -.102, p = .919$), though women (N=561, $M=.81, SD=.01$) were significantly less likely to cheat than men (N=1691, $M=.81, SD=.012$) ($t(1349.302) = -6.95, p = .000$).
In line with gathering information about those playing with romantic partners, respondents were asked a few questions about how friendship and romance has been impacted by Ingress. While 82.1% (N = 1884) said they had not experienced romantic problems because of Ingress, 12% (N = 276) had because of their (the participant's) play, 2% (N = 47) because of their partner's play, and 3.8% (N = 88) because of both partner's
play. Even less people have reported friendship problems due to Ingress (89.9%, N = 2064 reporting 'no' to 'Have any of your friendships been negatively impacted because of playing?). A small number of people (5.8%, N = 133) reported developing a romantic relationship with someone met while playing Ingress.

Motivations

Beyond demographics, participants were asked to respond to a number of statements designed to determine what motivations are most salient in their decisions to and how to play. On a scale of 1-8 from strongly disagree to strongly agree, participants were asked to describe how much certain statements described them. Among the most strongly agreed statements were “I do not beg for items in the game” (M=7.08, SD=1.351), “I like wandering and exploring” (M=6.71, SD=1.315), “Doing massive amounts of damage is very satisfying” (M=6.54, SD=1.701), “The game mechanics are not too complicated for the average player” (M=6.09, SD=1.515), and “I find myself having meaningful conversations with others” (M=5.93, SD=1.540). Among the least agreed statements were, “I make up stories and a history for my agent/character” (M=1.79, SD=1.420), “I like to try out new roles and personalities with my agent/character” (M=2.42, SD=1.706), “It’s not just a game” (M=2.74, M=1.811), “I like to taunt or annoy other players” (M=2.77, SD=1.948), and “I play to forget about real life” (M=2.94, SD=1.973). A full list of motivation scale items and means can be found in Appendix I.

Principle component analysis. A principle component analysis was performed to uncover which items loaded similarly and to produce different ‘dimensions,’ or groupings
of items with persistent themes, in order “to concisely describe (and perhaps understand) the relationship among observed variables” (Tabachnick & Fidell, 2013, p. 615).

**Components.** Extraction and rotation types are two main decisions to be made when performing PCA or factor analysis (Tabachnick & Fidell, 2013). Initially a factor analysis with maximum likelihood, a Promax rotation, and loadings smaller than .3 hidden was performed. This was in order to be in line with the analysis run by Yee (2006a) in the original study of MMO player motivations. This was discarded for Principle Component Analysis (PCA), in part as dimension reduction (the method of uncovering which items should be retained for further analysis) and in part to determine how the complete variance determine components and it more evenly spread items throughout components. A Verimax orthogonal rotation method was chosen over Promax as it intended “to maximize the variance of factor loadings by making high loadings higher and low ones lower for each factor” (Tabachnick & Fidell, 2013, p. 625), make interpretation simpler, and to produce generally uncorrelated factors, though it is understood that in the social sciences there will likely be a certain level of correlation (Costello & Osborne, 2005). A cut-off loading point of .32 was applied, as suggested by Tabachnick and Fidell (2013). The rotated component matrix is shown in Appendix J.

Running the PCA resulted in ten components with eigenvalues over 1 and explaining 53% of the total variance (the same result was achieved using Maximum Likelihood extraction and a Promax rotation). Reliability analyses were run on each of the components to determine what, if any items should be removed to improve each component’s reliability. Three were identified as candidates for removal. An identical
PCA was then run with these two items removed resulting in ten components with eigenvalues over 1 and explaining 54.38% of total variance, an increase from the previous PCA. This resulted in a slightly different loading of items with increased reliability throughout each component that was retained. Three items were removed completely as they either did not load above .32 or lowered component reliability in any component they loaded to. These were “I beg for items in the game,” “I researched everything about the factions before starting the game,” and “The way I am in the game is the way I am in real life” (Table 9).

**Retained components.** There is a considerable gap between seven of the components (Relationships, Competition, Escapism, Immersion, Achievement, Leadership, and Mechanics) that had alpha levels over .523 and the three that had less than .284 (Entertainment, Pragmatics, and Individuality) (Table 9). While the latter three components could be discarded, the exploratory nature of the present study retains them for analysis. The names of components were chosen by the researcher to best encapsulate the theme running through the items that loaded together.

Yee’s (2006b) factor loadings were somewhat different from the components here. Yee’s 8 factors were: Relationship, Manipulation, Immersion, Escapism, Achievement, Lead, Learn, and Solo/Group. Some items that loaded in Yee’s components did not load in the present study, and vice versa. Three items loaded in neither. A table comparing the list of components derived in the present study to the list found when studying MMOs and their respective loading counts can be found in Appendix K.
**Table 9**

*Loading of recoded items on components*

<table>
<thead>
<tr>
<th>Component</th>
<th>Item</th>
<th>Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relationships</td>
<td>I have made some good friends in the game.</td>
<td>.830</td>
</tr>
<tr>
<td></td>
<td>Friends in the game have offered me support when I had a real-life problem or crisis.</td>
<td>.715</td>
</tr>
<tr>
<td></td>
<td>I talk to my friends in the game about personal issues.</td>
<td>.712</td>
</tr>
<tr>
<td></td>
<td>I chat a lot with group members.</td>
<td>.699</td>
</tr>
<tr>
<td></td>
<td>I like to say funny things in chat.</td>
<td>.575</td>
</tr>
<tr>
<td></td>
<td>I find myself having meaningful conversations with others.</td>
<td>.564</td>
</tr>
<tr>
<td></td>
<td>I understand real-life group dynamics much more after playing the game.</td>
<td>.523</td>
</tr>
<tr>
<td></td>
<td>I have learned things about myself from playing this game.</td>
<td>.447</td>
</tr>
<tr>
<td>Competition</td>
<td>I like to dominate other players.</td>
<td>.737</td>
</tr>
<tr>
<td></td>
<td>I like to taunt or annoy other players.</td>
<td>.689</td>
</tr>
<tr>
<td></td>
<td>I like to manipulate other people so they do what I want them to.</td>
<td>.624</td>
</tr>
<tr>
<td></td>
<td>I like to feel powerful in the game.</td>
<td>.579</td>
</tr>
<tr>
<td></td>
<td>I try to prevent the other faction from gaining high-level items or maintaining a high-level farm.</td>
<td>.529</td>
</tr>
<tr>
<td>Escapism</td>
<td>I play to forget about real life.</td>
<td>.809</td>
</tr>
<tr>
<td></td>
<td>I like the escapism aspect of the game.</td>
<td>.751</td>
</tr>
<tr>
<td></td>
<td>Playing the game lets me vent and relieve stress from the day.</td>
<td>.646</td>
</tr>
<tr>
<td>Immersion</td>
<td>I make up stories and a history for my agent/character.</td>
<td>.750</td>
</tr>
<tr>
<td></td>
<td>I like to try out new roles and personalities with my agent/character.</td>
<td>.710</td>
</tr>
<tr>
<td></td>
<td>I like the feeling of being part of a story.</td>
<td>.503</td>
</tr>
<tr>
<td>Achievement</td>
<td>I try to optimize my AP gain or earn better badges as much as possible.</td>
<td>.788</td>
</tr>
<tr>
<td></td>
<td>I constantly try to set and reach goals.</td>
<td>.647</td>
</tr>
<tr>
<td></td>
<td>It's very important for me to get the best gear available.</td>
<td>.480</td>
</tr>
</tbody>
</table>

(table continues)
Table 9 continued

<table>
<thead>
<tr>
<th>Component</th>
<th>Item</th>
<th>Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leadership</td>
<td>I am an effective group leader.</td>
<td>.773</td>
</tr>
<tr>
<td></td>
<td>I would rather lead than follow.</td>
<td>.765</td>
</tr>
<tr>
<td>Entertainment</td>
<td>The game mechanics are not too complicated for the average player.</td>
<td>.586</td>
</tr>
<tr>
<td></td>
<td>Doing massive amounts of damage is very satisfying.</td>
<td>.483</td>
</tr>
<tr>
<td></td>
<td>People who role-play extensively don’t bother me.</td>
<td>.469</td>
</tr>
<tr>
<td></td>
<td>I like wandering and exploring.</td>
<td>.448</td>
</tr>
<tr>
<td>Mechanics</td>
<td>I would make maps if they weren't available.</td>
<td>.623</td>
</tr>
<tr>
<td></td>
<td>I'm fascinated by the game mechanics, and love charts and tables.</td>
<td>.468</td>
</tr>
<tr>
<td>Pragmatics</td>
<td>Faction-balancing issues do not interest me.</td>
<td>.740</td>
</tr>
<tr>
<td></td>
<td>It's just a game.</td>
<td>.404</td>
</tr>
<tr>
<td>Individuality</td>
<td>I can't stand those people who only care about seeing their name everywhere.</td>
<td>.837</td>
</tr>
<tr>
<td></td>
<td>It's important for me to achieve things with as little help from other people as possible.</td>
<td>.341</td>
</tr>
</tbody>
</table>

Note: Items “I beg for items in the game,” “I researched everything about the factions before starting the game,” and “The way I am in the game is the way I am in real life” were removed due to low loading or decreased alpha levels.

**Component analysis.** Items were broken down into ten distinct components and their respective means calculated (Figure 6). As the Likert scales of each item contained a range of 7 (values between 1 and 8), a true ‘neutral’ mean would be 4.5. Any mean higher than this represents an average positive response, while any mean lower than this reveals a negative response on the ‘is like me’ scale. Notably, *Ingress* players most likely, in decreasing order, identify with the motivations of playing for entertainment, feelings of being pragmatic, looking for achievement, feelings of leadership, and the fostering of
relationships. They are less likely to play, in decreasing order, for a sense of immersion, the feeling of competition, the need for escape, and to achieve a sense of individuality.

![Figure 6. Full sample means of component scores.](image)

The genders do not match in terms of motivations. Men are significantly more likely to play for feelings of competition, immersion, achievement, leadership, and the mechanics of the game, while females are significantly more likely to play for escapism (Table 10). Likewise, there are significant differences between players from the United States and non-US players (Table 11). Players from the United States are significantly more likely to play in order to form relationships, feel escape, a sense of achievement, feelings of leadership, for entertainment’s sake, for the mechanics, and because they are
pragmatic. Those from outside the United States are significantly more likely to play for feelings of immersion and individuality. All players worldwide are as likely to play for the sake of competition.
Table 10

*T*-tests of component means between genders of Ingress players

<table>
<thead>
<tr>
<th>Factor</th>
<th>Male (N = 1691)</th>
<th>Female (N = 561)</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>Relationships</td>
<td>4.86</td>
<td>1.33</td>
<td>4.94</td>
<td>1.43</td>
<td>-1.138</td>
</tr>
<tr>
<td>Competition</td>
<td>3.97</td>
<td>1.34</td>
<td>3.37</td>
<td>1.23</td>
<td>9.840</td>
</tr>
<tr>
<td>Escapism</td>
<td>4.03</td>
<td>1.58</td>
<td>4.38</td>
<td>1.64</td>
<td>-4.428</td>
</tr>
<tr>
<td>Immersion</td>
<td>2.99</td>
<td>1.35</td>
<td>2.74</td>
<td>1.18</td>
<td>4.121</td>
</tr>
<tr>
<td>Achievement</td>
<td>5.25</td>
<td>1.36</td>
<td>5.01</td>
<td>1.41</td>
<td>3.669</td>
</tr>
<tr>
<td>Leadership</td>
<td>5.07</td>
<td>1.57</td>
<td>4.74</td>
<td>1.59</td>
<td>4.459</td>
</tr>
<tr>
<td>Entertainment</td>
<td>6.04</td>
<td>0.92</td>
<td>6.11</td>
<td>0.97</td>
<td>-1.525</td>
</tr>
<tr>
<td>Mechanics</td>
<td>5.09</td>
<td>1.62</td>
<td>4.50</td>
<td>1.83</td>
<td>6.759</td>
</tr>
<tr>
<td>Pragmatism</td>
<td>5.28</td>
<td>1.45</td>
<td>5.35</td>
<td>1.44</td>
<td>-0.992</td>
</tr>
<tr>
<td>Individuality</td>
<td>4.27</td>
<td>1.60</td>
<td>4.21</td>
<td>1.55</td>
<td>0.747</td>
</tr>
</tbody>
</table>

Table 11

*T*-tests of component means between non-US and US Ingress players

<table>
<thead>
<tr>
<th>Factor</th>
<th>Non-US (N = 982)</th>
<th>US (N = 1294)</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>Relationships</td>
<td>4.86</td>
<td>1.31</td>
<td>4.89</td>
<td>1.39</td>
<td>-0.457</td>
</tr>
<tr>
<td>Competition</td>
<td>3.78</td>
<td>1.31</td>
<td>3.38</td>
<td>1.36</td>
<td>-0.899</td>
</tr>
<tr>
<td>Escapism</td>
<td>4.01</td>
<td>1.51</td>
<td>4.20</td>
<td>1.66</td>
<td>-2.817</td>
</tr>
<tr>
<td>Immersion</td>
<td>3.00</td>
<td>1.35</td>
<td>2.88</td>
<td>1.29</td>
<td>1.995</td>
</tr>
<tr>
<td>Achievement</td>
<td>5.02</td>
<td>1.36</td>
<td>5.32</td>
<td>1.37</td>
<td>-5.023</td>
</tr>
<tr>
<td>Leadership</td>
<td>4.83</td>
<td>1.57</td>
<td>5.13</td>
<td>1.58</td>
<td>-4.549</td>
</tr>
<tr>
<td>Entertainment</td>
<td>5.96</td>
<td>0.93</td>
<td>6.13</td>
<td>0.92</td>
<td>-4.331</td>
</tr>
<tr>
<td>Mechanics</td>
<td>4.82</td>
<td>1.65</td>
<td>5.04</td>
<td>1.73</td>
<td>-3.149</td>
</tr>
<tr>
<td>Pragmatism</td>
<td>5.18</td>
<td>1.44</td>
<td>5.38</td>
<td>1.44</td>
<td>-3.241</td>
</tr>
<tr>
<td>Individuality</td>
<td>4.36</td>
<td>1.56</td>
<td>4.18</td>
<td>1.61</td>
<td>2.679</td>
</tr>
</tbody>
</table>
A third natural dichotomous identifier is present in *Ingress*: faction. Comparing the component means of players based on faction, only two are significantly different: in both cases, the players on the Resistance side are more motivated by relationships ($t(2274) = -2.341, p = 0.019$) and pragmatism ($t(2274) = -5.058, p = 0.000$).

**Positive Gameplay Indicators and Learning**

Beyond demographics and motivation, participants were asked about their feelings of self-improvement. These questions included five questions about their interpersonal skills and ten questions about how *Ingress* may reward or encourage the player in line with selected statements from Gee’s principles (see Appendix A). It is through the following analysis that research question 1b is addressed.

**Interpersonal skills.** Players were asked to rank how much or little their interpersonal skills had improved while playing *Ingress* using a subset of questions also included in Yee’s (2006b) survey. On a scale with 1 to 8 with 1 labeled ‘None,’ 3 labeled ‘A bit,’ 6 labeled ‘A lot,’” and 8 labeled ‘Entirely,’ respondents noted that on average their leadership skills had improved most ($M = 3.13, SD = 2.201$), while their ability to mediate or resolve in-group tension improved least ($M = 2.86, SD = 1.985$) (Table 12). These items produce a reliable scale ($a = .963$) that does not decrease in reliability with the removal of any item.
Table 12

*Improvement of Interpersonal Skills*

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>My leadership skills.</td>
<td>3.12</td>
<td>2.188</td>
</tr>
<tr>
<td>My ability to take on leadership roles.</td>
<td>3.11</td>
<td>2.188</td>
</tr>
<tr>
<td>My ability to inspire and motivate others.</td>
<td>3.09</td>
<td>2.100</td>
</tr>
<tr>
<td>My ability to mediate or resolve in-group tension.</td>
<td>2.85</td>
<td>1.975</td>
</tr>
<tr>
<td>My ability to persuade other people.</td>
<td>2.70</td>
<td>1.918</td>
</tr>
</tbody>
</table>

**Learning items.** In addition to the demographics, the motivation components, the interpersonal scale, and the addiction scale, players were also asked about how *Ingress* in-and-of itself may encourage and demonstrate “good learning” (Gee, 2007a, p. 22) in an attempt to answer research question 2, “Using Gee’s learning criteria, what characteristics of people playing augmented reality games like *Ingress* suggest it may be used for educational means?” To determine this, ten statements were chosen and, like Yee’s motivational scale, slightly altered to fit with the instrument’s style and nature. These statements are as follows, ordered as found in the current survey instrument, with the original number and name of the antecedent in Gee’s learning principles (Appendix A) in parentheses, with an included description of how each pertains to *Ingress*:

1. The ability to understand the interrelation between words, images, and symbols as a system is a core aspect to being successful in *Ingress*. (3. Semiotic principle.)
   a. Throughout *Ingress* gameplay, various concepts are represented by words, images, and symbols, and the ability to understand how these fit together
is key to successful gameplay. Understanding that the image of a key symbolizes the ability to link two portals together, for example.

2. By putting in lots of effort and practice, I create a sense of commitment in the compelling virtual world of Ingress. (7. Committed Learning Principle.)
   a. In Ingress, ‘effort’ and ‘practice’ are normally one and the same. Playing can provide users with a sense of ownership (having ‘captured’ a portal) that encourages commitment.

3. I often feel as though accomplishing things with my resources can be challenging but is never impossible. (14. “Regime of Competence” Principle.)
   a. Players may find that their current collection of resources makes it feel impossible to accomplish a goal (taking down a heavily-fortified enemy portal, for example), but with time, persistence, and some farming, it is entirely possible and even probable.

4. Frequently, what I have learned by playing has been due to experiment and discovery rather than being told what to do. (28. Discovery Principle.)
   a. Players may ‘fumble’ around at first, testing what items do, experimenting with resonator placement, linking haphazardly, etc. Through this they gain knowledge of how the game itself works.

5. My ability to play has been bolstered by attempting to accomplish something, failing, then retrying with a different strategy. (15. Probing Principle.)
   a. Ingress is a game of constant turnover, as the property of one faction today is the property of another tomorrow. It may be that one player’s inability
to take a portal back today is due to poor strategy and a different approach
tomorrow will remedy this.

6. *Ingress* allows me to progress by relying on my own strengths and style, while allowing me to still try alternatives. (16. Multiple Routes Principle.)
   a. Like most games, there are opportunities for different playstyles in *Ingress*. One player might focus mainly on capturing neutral portals or bolstering friendly ones, though this by no means suggests they’re not allowed or even encouraged to use the weapons at their disposal to do damage to the other faction’s portals.

7. In *Ingress*, in terms of other players, experience is rewarded over knowledge. (22. Intuitive Knowledge Principle.)
   a. It may be that being ‘book smart’ in *Ingress* (knowing, for example, how much energy is produced by a level 7 portal with two incoming links) is less important than having participated in group events and large-scale operations.

8. I feel the rewards I receive from playing increase, as I get better. (11. Achievement Principle.)
   a. Progressing through *Ingress* presumes both the acquisition of better and more powerful items in-game and the introduction to and presumed association with other players.

9. By playing *Ingress*, I feel I am part of a group bonded primarily through shared endeavors, goals, and practices. (35. Affinity Group Principle.)
a. *Ingress* is predicated on the notion of ‘factions,’ that by their very nature share endeavors, goals, and practices.

10. *Ingress* is constructed in such a way that, as I play, I learn not only about it but about myself and my potential. (9. Self-Knowledge Principle.)

a. As players progress through *Ingress*, not only do their capabilities in the game improve, but it is possible that their leadership and interpersonal skills may improve, as well.

From the ten items listed, only one, “The ability to understand the interrelation between worlds, images, and symbols as a system is a core aspect to being successful in *Ingress*,” was found to have an average on the negative side of the 1-8 Completed Disagree/Completely Agree Likert scale, with an average of 4.35 (SD = 1.802). One other item, “*Ingress* is constructed in such a way that, as I play, I learn not only about it but about myself and my potential,” teetered at the neutral point (M = 4.49, SD = 1.877). The highest average on the scale was in response to “Frequently, what I have learned by playing as been due to experiment and discovery rather than being told what to do,” at 5.79 (SD = 1.605). When tested for reliability, the scale as a whole was reliable (α = .834, no increase when items removed). The full scale can be found in Appendix L.

When examining learning scores by player level, most levels were roughly the same (ranging in mean scores from 47 to 55), with the notable exceptions of levels 1 and 2, which averaged 33 and 34, respectively (r=.070, p=.04) (Figure 7). Unsurprisingly, players at levels 1 and 2 also reported considerably lower weekly playtime (r=.298, p=.000). A higher significant correlation between players’ learning total score and hours
played per week was also present \((r=.312, p=.000)\), with males’ correlating higher \((r=.340, p=.000)\) than females \((r=.182, p=.011)\) (Figure 8).

*Figure 7. Learning scores by level.*
The difference between players at levels 1 and 2 and those level 3 and above is also present in their motivations for play. Players levels 1 and 2 scored lower on every motivation scale except Pragmatism ($M = 6.44$, $SD = 1.29$) and Individuality ($M = 4.31$, $SD = 1.53$), in which players levels 3 and above scored 5.29 ($SD = 1.45$) and 4.26 ($SD = 1.53$), respectively.

An examination of the correlations between the standardized motivation scale means and the standardized learning item scores shows some moderate to high significant correlations. The learning item “By putting in lots of effort and practice, I create a sense of commitment in the compelling virtual world of Ingress” correlates moderately and
significantly with the motivation scales of Relationships \((r=.303)\), Escapism \((r=.358)\) and Immersion \((r=.335)\). The learning item “By playing *Ingress*, I feel I am part of a group bonded primarily through shared endeavors, goals, and practices” correlates strongly and significantly with the Relationships component \((r=.548)\). The learning item “*Ingress* is constructed in such a way that, as I play, I learn not only about it but about myself and my potential” correlates strongly and significantly to the Relationships \((r=.508)\) and Immersion \((r=.419)\) components, and moderately and significantly to the Escapism \((r=.380)\) and Mechanics \((r=.296)\) components. All other correlations were weak or non-significant.

**Informal Player Learning**

Participants were asked a number of optional open-ended questions to allow for more nuanced and individualized responses to how and why they play, and what it means to them. These responses described informal educational experiences that were steeped in discovery-based learning and the production of learning communities. Keywords partial matches like ‘learn*’ and ‘educat*’ were identified throughout the responses and four themes emerged: statements of general learning, statements of specific learning (learning about particular topics or fields outside the game content), the emergence of communities of practice, and the development of informal mentors/mentees. Following are responses to these questions and the participants’ unique case numbers assigned after the randomization of response order to mitigate potential identification through the perceived time of submission. A full list of questions can be found in Appendix B. Quotes are included verbatim with original spelling, grammar, and punctuation.
General learning. Throughout the responses gathered, self-reports of the pleasure of learning abounded. This is salient as engaged, enjoyable experiences make for improved learning (Malone & Lepper, 1987). Case 608 describes a self-reflection of learning becoming enjoyment: “It is satisfying to have a thorough understanding of how the game works. In the beginning made mistakes and want to be able to be more deliberate with my planning and execution of the game. Learning and becoming good at that has made the game more enjoyable for me.” Case 991 reflects on the drive to learn that is apparently intrinsic in Ingress players: “Ingress people have a constant desire to optimize things and use the best tools available - which means they are always willing to learn. I'm involved in the planning for one of the arsana anomalies now, and the agent in charge decided we were going to use an app that is not commonly used for Ingress, but that has significant organizational advantages over Google Hangouts. People didn't whine; we just learned how to use it.” Case 1995 describes the Ingress experience as being lifestyle-changing: “My lifestyle has been forever changed. I constantly learn more by playing the game. It is a social dynamic that has changed the way I perceive everything.” Case 2023 goes so far as to suggest that the learning experience present in Ingress is the most important aspect: “A learning experience, and chance to see how other people behave an act as a group. I see the new social ties it creates as kind of a bonus in addition to what I may learn. Without it being a learning experience, or an insight into things deeper than the game itself, I wouldn't see too much value in it-other than the potential social bonds and exercise.” Beyond more general learning, some
participants remarked on specific forms of learning and informal education that they had experienced.

**Specific learning.** In addition to discussing how *Ingress* is a learning experience in general, some participants remarked on specific areas in particular, like art, culture, geography, and history. Case 1133 describes, in addition to improved health and weight loss, the experience of discovery: “I have learned a great deal about my city and seen artistic, cultural, and historical sights I never would have noticed otherwise; I have visited interesting places I nevr would have visited; I have sought out, for the purpose of submitting new portals, historical information about my city and region that has enriched my experience of my surroundings.” Case 626 remarks on an experience of learning more about surroundings and art, specifically through the lens of augmented reality: “Augmented reality games make exploring and learning about the art and public places fascinating. I have discovered more art in the ara I work than I would have on my own. I read the history of the different portals and have found campus locations and campus art that I would not have found otherwise. I use Ingress to explore my world more than as a social networking instrument.” Case 2083 reflects on an urban environment that has become more visible: “I have learnt more about my city in the past few months than in the past 20 years.” Case 517 had a similar experience: “Ingress changed my perception of the outside world. I learned a lot about history and geography of my city. I learned to look for interesting unusual things in my surroundings.” Case 1893 has turned the informal history lessons present in *Ingress* into a teachable moment with family: “I have learned so much about my town. I have something to play with my son, and teach him
history too.” Similarly, Case 118 uses Ingress to teach about social responsibility: “When I first started I looked at Ingress as something to do when I was away from the house to occupy me and my children. Since we have done Anomalies. Helped locally. We get to see some of the best citiys have to offer and some of the worst. I can use thisas teachable moments for my kids. My kids dont ignore those that are less fortunate when we are out.”

Exploration provided players with more than just new knowledge of history and urban planning. Case 842 describes experiences that are unique to playing: “I've met some nice people, online and irl, i traveled to different places, learned about culture, history... While decoding, i learned a lot about ciphers and encoding technologies, knowledge that otherwise i wouldn't be able to get anywhere.” Case 1635 even “learned a lot about potentials of social networking and more basics of programming.” Along those lines, case 982 identifies the learning experience of playing Ingress as a catalyst for continued education: “I have gained a considerable amount of knowledge about many areas of technology including mobile, network, and programming. I have developed such a great interest in the programming aspect of the game and many of the tools that can be used with it that lam seriously considering returning to college (as an older adult) to pursue a career in a related field.” Learning about technology, not just programming, was present, as described by Case 82: “Didn't know the game. The referring friend was a long distance via facebook friend so no in person learning tech support. Learned by trial and error. Learned how to manipulate the various google and G+ pages and chats. Now I feel much more confident in ho I play the game and use the technologies that support it.”
Learning communities. A recurring theme in open-ended question responses was initial solo play and a subsequent move to more social play with an accompanying improvement of both gameplay skill and an atmosphere of shared learning. Borthick and Jones (2000) describe this as “collaborative discovery learning” in which “participants, immersed in a community of practice, solve problems together” (p. 181). Case 2199, for example, reported to have “Played alone and bumblingly, at first. Once I started regularly communicating with teammates, I learned a lot and had much stronger motivation to advance in the game.” Along these lines, case 2224 said, “I didn't know what I was doing. And I didn't really know where to look. It was a lot of trial and error before I figured things out and found my local ingress community.” Case 412 had a similar experience: “I started out playing entirely solo, but didn't really ‘figure out’ the game, or become particularly successful at it until I started participating in the social aspects.” Case 523 also describes the benefit of the communal learning: “At first I had no idea what I was doing. Meeting other players (crafty veterans) and learning with my friends who played helped out a lot.” Case 41 provides a description of the potential frustration experienced by newer players and how the sense of community improves it: “When I first started, seeing the high level opposition portals and trying to gain AP was daunting, but now that I have reached a level where I can use the entire arsenal of items at my disposal, not to mention having become a part of the local enlightened faction community, it has become a lot more about strategy and teamwork and communication, which makes it that much more enjoyable for me.” The responses given here may go some ways to explain why, as
in figure 7, participants’ scores on the learning scale were significantly lower at levels 1 and 2 than at levels 3 and beyond.

**Mentoring.** The bringing-in of new players into local communities appears to be a source of great pride for some. Case 120 discusses how players begin and move toward mastery: “The learning curve was steep back in the beginnings of Ingress. Nowadays it is still somewhat difficult to start playing without a helpful guide or player to teach the ins and outs, so I often try to be that guide for others.” Case 517 describes a number of benefits of playing *Ingress*, not least of all learning to be more social: “Ingress has given me an entire local social group, and a boyfriend, and this has changed my life hugely. It has also changed how I am able to interact with strangers without warning, and has allowed me to relax and be less anxious about meeting new people. It has also allowed me to exercise my leadership side by taking on a moderator role for the local community for my faction, and I am learning very well how to encourage local players, create opportunities for friendships to grow, and help resolve dispute.” Case 1635 remarks on the pleasure gained from learning and helping others to learn: “I still learn a lot on my own. I enjoy helping new players so they might have easier time ultimately having a better time.” Case 1474 felt similarly: “At first I had no idea what I was doing. Now I find I can effectively teach others what I've learned, and play better myself.” Case 1995 discusses improvements in leadership skills the result: “I have discovered my potential for leadership because of Ingress. I not only take charge in the communities now instead of just take part but I inspire others. Its very rewarding.”
Problematic Gameplay

Problematic gameplay was examined in the current instrument in different ways: first, the inclusion of the 7-item addiction scale; second, a subset of the motivation scale; third, self-reported responses about hours played and potential issues with interpersonal relationships. The results of these follow and are an attempt to address research question 1c.

Addiction scale. Participants were asked to complete a slightly modified version of the Game Addiction Scale developed by Lemmens, Valkenburg, & Peter (2009) that examines seven key areas they identified as indicators of problematic gameplay: salience (the game becomes the priority in the player’s life), tolerance (ever-increasing time spent playing), mood modification (potentially euphoric or tranquil feelings garnered by gameplay), withdrawal (inability to cope with removal from the game), relapse (falling back into problematic gameplay after stopping for some time), conflict (negative experiences with others due to gaming), and problems (disregarding of responsibilities or lack of self-control). For each of these areas, the authors designed three questions each, which formed the 21-item scale with an average reliability between two samples of $\alpha = .93$. For the 7-item scale, the average reliability was $\alpha = .835$. The 7-item scale was used and modified slightly to match the nature of the current instrument’s language (Table 2). The scale within this study showed a reliability of $\alpha = .77$, with no improvement when deleting items.

Multiple regression. A multiple regression test was run to determine which factors best predict a higher addiction score. Normality and homoscedasticity were
examined using the Kolmogorov-Smirnov test and Q-Q tests, and a check for influential cases was performed to identify extreme outliers. As suggested by Field (2013), this was accomplished by identifying extreme standardized residuals in excess of $|3.29|$, Cook’s distances greater than 1, leverage values that “exert undue influence over the model” (p. 307), and Mahalanobis distances greater than 25.

*Tests for violation of assumptions.* Determining normality is often done using the Kolmogorov-Smirnov test (Field, 2013). The standardized addiction scale responses were shown to deviate from a normal distribution ($D(2278) = 0.41, p = .000$). This can be problematic as “in large samples even small and unimportant deviations from normality might be deemed significant by this test” (Field, 2013, p. 187). Field (2013) suggests mitigating this by examining histograms (Figure 9) and Q-Q plots (Figure 10).

In finding standardized residuals in excess of $|3.29|$, only two cases were identified as having values of 3.67 and 3.48. These two were eliminated from the model. An examination of Cook’s distance values showed no values over 1, the number suggested by Field (2013) as a potential cut-off. In identifying cases for which the identified leverage is excessively high, Stevens (2009) suggests $3p/n$ where $p$ is the estimated parameters and $n$ is the number of participants. Using this formula, the cutoff is .010. This happens to coincide with the proposed cutoff of 25 for the Mahalanobis distance, suggesting a total of 15 cases should be excluded (Table 13). Tests for multicollinearity—tolerance lower than 1 but not below 0.1 and VIF greater than 1 but lower than 10 (Field, 2013)—showed no violation of assumptions regarding
multicollinearity in the model. A Durbin-Watson score of 1.987 shows no autocorrelation (Field, 2013). Tests for homoscedasticity and normality were also run (Figures 11 & 12).

*Figure 9.* Histogram of standardized addiction scale total.
Figure 10. Normal Q-Q plot of standardized addiction scale total.

Table 13

Regression Model Outlier Identification – Addiction Scale

<table>
<thead>
<tr>
<th></th>
<th>Cook's Distance</th>
<th>Centered Leverage Value</th>
<th>Mahalanobis Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.00572</td>
<td>0.01212</td>
<td>27.79648</td>
</tr>
<tr>
<td>2</td>
<td>0.00045</td>
<td>0.02007</td>
<td>46.03308</td>
</tr>
<tr>
<td>3</td>
<td>0.00045</td>
<td>0.04057</td>
<td>93.07854</td>
</tr>
<tr>
<td>4</td>
<td>0.00003</td>
<td>0.01344</td>
<td>30.82643</td>
</tr>
<tr>
<td>5</td>
<td>0.00005</td>
<td>0.01167</td>
<td>26.76460</td>
</tr>
<tr>
<td>6</td>
<td>0.00110</td>
<td>0.04095</td>
<td>93.93089</td>
</tr>
<tr>
<td>7</td>
<td>0.00056</td>
<td>0.01191</td>
<td>27.32327</td>
</tr>
<tr>
<td>8</td>
<td>0.00138</td>
<td>0.01209</td>
<td>27.74484</td>
</tr>
<tr>
<td>9</td>
<td>0.00329</td>
<td>0.01661</td>
<td>38.10065</td>
</tr>
<tr>
<td>10</td>
<td>0.00285</td>
<td>0.01276</td>
<td>29.28155</td>
</tr>
<tr>
<td>11</td>
<td>0.01496</td>
<td>0.03388</td>
<td>77.71115</td>
</tr>
<tr>
<td>12</td>
<td>0.01975</td>
<td>0.03443</td>
<td>78.99008</td>
</tr>
<tr>
<td>13</td>
<td>0.02332</td>
<td>0.03906</td>
<td>89.61355</td>
</tr>
<tr>
<td>14</td>
<td>0.03309</td>
<td>0.04561</td>
<td>104.61829</td>
</tr>
<tr>
<td>15</td>
<td>0.02789</td>
<td>0.03316</td>
<td>76.07079</td>
</tr>
</tbody>
</table>
Figure 11. Scatter plot of regression standardized residual values against regression standardized predicted values.

Figure 12. Normal P-P plot.
Regression analysis. The current analysis was performed to determine what aspects of the players’ behavior and motivations predict problematic gameplay. After removing the outliers described above, 2276 cases were considered when building the model. A hierarchical method was employed based on findings in the literature review that suggest escapism and higher time spent playing as major culprits in problematic gameplay, with other salient factors included as the researcher identified them. The number of hours played and the Escapism motivation factor were added as the first ‘block’ in the model (Table 14). The second ‘block’ included whether players had ‘marathoned’ and the Achievement motivation factor. The third ‘block’ included whether *Ingress* was the most rewarding/satisfying experience in the past week and the Competition motivation factor. The final ‘block’ contained the Relationships motivation factor.

The F-ratio values in the ANOVA show the model to be significant at each point in its construction, and when all are included together, $R^2$, the “measure of how much of the variability in the outcome is accounted for by the predictors” (Field, 2013), has a value of .501, meaning that all four models together account for 50% of the variation in the Addiction Scale variable (Table 15). The first model alone has an $R^2$ value of .413, meaning the hours played and score on the Escapism motivational scale account for 41.3% of the variation in the Addiction Scale value. The adjusted $R^2$ of the entire model is .501, a difference of only 0.1% from the $R^2$ of .503, “indicating that the cross-validity of this model is very good” (Field, 2013).
Table 14

**Multiple Regression Analysis**

<table>
<thead>
<tr>
<th>Model/Block</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>.003</td>
<td>.016</td>
<td>.182</td>
<td>.855</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Motivation Scale: Escapism</td>
<td>.497</td>
<td>.016</td>
<td>.503</td>
<td>30.646</td>
<td>.000</td>
</tr>
<tr>
<td>Hours Played Weekly</td>
<td>.367</td>
<td>.019</td>
<td>.311</td>
<td>18.938</td>
<td>.000</td>
</tr>
<tr>
<td>(Constant)</td>
<td>-.001</td>
<td>.015</td>
<td>-.048</td>
<td>.961</td>
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</tr>
<tr>
<td>Motivation Scale: Escapism</td>
<td>.430</td>
<td>.016</td>
<td>.435</td>
<td>26.380</td>
<td>.000</td>
</tr>
<tr>
<td>2</td>
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<td></td>
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</tr>
<tr>
<td>Hours Played Weekly</td>
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<td>.240</td>
<td>14.418</td>
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</tr>
<tr>
<td>Marathoned</td>
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<td>.016</td>
<td>.073</td>
<td>4.588</td>
<td>.000</td>
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<tr>
<td>Motivation Scale: Competition</td>
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<td>.017</td>
<td>.221</td>
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<tr>
<td>(Constant)</td>
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<td>.015</td>
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<td>.389</td>
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<tr>
<td>Hours Played Weekly</td>
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<td>.020</td>
<td>.196</td>
<td>11.824</td>
<td>.000</td>
</tr>
<tr>
<td>3</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marathoned</td>
<td>.047</td>
<td>.015</td>
<td>.048</td>
<td>3.049</td>
<td>.002</td>
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<tr>
<td>Motivation Scale: Competition</td>
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<td>.017</td>
<td>.172</td>
<td>10.096</td>
<td>.000</td>
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<tr>
<td>Motivation Scale: Achievement</td>
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<td>.017</td>
<td>.150</td>
<td>8.940</td>
<td>.000</td>
</tr>
<tr>
<td>7-Day Rewarding Memory</td>
<td>.134</td>
<td>.016</td>
<td>.136</td>
<td>8.586</td>
<td>.000</td>
</tr>
<tr>
<td>(Constant)</td>
<td>-.002</td>
<td>.015</td>
<td>-.163</td>
<td>.870</td>
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<td>Motivation Scale: Escapism</td>
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<td>.016</td>
<td>.367</td>
<td>22.104</td>
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<tr>
<td>Hours Played Weekly</td>
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<td>.020</td>
<td>.181</td>
<td>10.885</td>
<td>.000</td>
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<tr>
<td>Marathoned</td>
<td>.016</td>
<td>.016</td>
<td>.017</td>
<td>1.016</td>
<td>.310</td>
</tr>
<tr>
<td>4</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation Scale: Competition</td>
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<td>.017</td>
<td>.167</td>
<td>9.880</td>
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<tr>
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<td>.016</td>
<td>.138</td>
<td>8.273</td>
<td>.000</td>
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<tr>
<td>7-Day Rewarding Memory</td>
<td>.125</td>
<td>.016</td>
<td>.126</td>
<td>7.996</td>
<td>.000</td>
</tr>
<tr>
<td>Motivation Scale: Relationships</td>
<td>.108</td>
<td>.017</td>
<td>.110</td>
<td>6.286</td>
<td>.000</td>
</tr>
</tbody>
</table>

Note: $R^2=.412$ for block 1, $R^2=.459$ for block 2, $R^2=.494$ for block 3, $R^2=.502$ for block 4. Dependent variable: standardized Addiction Scale.
Table 15

**Multiple Regression ANOVA**

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>906.959</td>
<td>2</td>
<td>453.480</td>
<td>799.447</td>
<td>.000</td>
</tr>
<tr>
<td>Residual</td>
<td>1289.341</td>
<td>2273</td>
<td>.567</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2196.300</td>
<td>2275</td>
<td>.567</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regression</td>
<td>1011.931</td>
<td>4</td>
<td>252.983</td>
<td>485.089</td>
<td>.000</td>
</tr>
<tr>
<td>Residual</td>
<td>1184.369</td>
<td>2271</td>
<td>.522</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2196.300</td>
<td>2275</td>
<td>.522</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regression</td>
<td>1086.287</td>
<td>6</td>
<td>181.048</td>
<td>370.083</td>
<td>.000</td>
</tr>
<tr>
<td>Residual</td>
<td>1110.013</td>
<td>2269</td>
<td>.489</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2196.300</td>
<td>2275</td>
<td>.489</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regression</td>
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<td>7</td>
<td>157.743</td>
<td>327.589</td>
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</tr>
<tr>
<td>Residual</td>
<td>1092.102</td>
<td>2268</td>
<td>.482</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2196.300</td>
<td>2275</td>
<td>.482</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Only when all four models are included together does one predictor, the Marathoned variable, become non-significant ($t(2268) = 1.016, p = .310$). All other predictors retain significance (Table 16).

Table 16

**Multiple Regression Model Summary**

<table>
<thead>
<tr>
<th>Model /Block</th>
<th>R</th>
<th>$R^2$</th>
<th>Adjusted $R^2$</th>
<th>Std. Error of the Estimate</th>
<th>$R^2$ Change</th>
<th>$F$ Change</th>
<th>df1</th>
<th>df2</th>
<th>Sig. $F$ Change</th>
<th>Durbin-Watson</th>
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</thead>
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<tr>
<td>1</td>
<td>.643</td>
<td>.413</td>
<td>.412</td>
<td>.75315464</td>
<td>.413</td>
<td>797.447</td>
<td>2</td>
<td>2273</td>
<td>.000</td>
<td></td>
</tr>
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<td>2</td>
<td>.679</td>
<td>.461</td>
<td>.460</td>
<td>.72216246</td>
<td>.048</td>
<td>100.641</td>
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<td>2271</td>
<td>.000</td>
<td></td>
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<td>.493</td>
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<td>.034</td>
<td>75.996</td>
<td>2</td>
<td>2269</td>
<td>.000</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>.709</td>
<td>.503</td>
<td>.501</td>
<td>.69392103</td>
<td>.008</td>
<td>37.197</td>
<td>1</td>
<td>2268</td>
<td>.000</td>
<td>1.996</td>
</tr>
</tbody>
</table>
Multiple regression post-hoc power and effect size. Both post-hoc power and effect size were calculated on the current regression model. The online software Post-hoc Statistical Power Calculator for Multiple Regression (Soper, 2014b) and Effect Size Calculator for Multiple Regression (Soper, 2014a) were used, respectively. The post-hoc power of the current regression model is 1.0 with an effect size \( R^2 \) of .502, seven predictors, a probability level of 0.05, and a sample size of 2276. The effect size is 1.008 with an observed \( R^2 \) of .502 using the formula \( f^2 = R^2 / (1 - R^2) \), showing the large effect of the predictor variables on the Addiction Scale.

Summary

This chapter reported the results of a number of different analyses, including those on the instrument itself, the general demographics of respondents, Ingress-specific demographics, the motivations Ingress players have for playing, the indicators of positive gameplay, the indicators of problematic gameplay, and the learning and educational experiences of players. The survey was started on October 3, 2014 and responses were gathered for analysis on November 27, 2014. It was started a total of 3,487 times and completed 2,292 times, showing a 65% response rate. Tests ranged from simple correlational examinations to dimension reduction for component analysis to multiple regression that met all data assumptions. Cronbach’s alpha was used to measure the internal consistency of items identified by a principle component analysis. The full instrument is available in Appendix B.
Chapter 5: Findings, Conclusions, and Recommendations

This chapter provides a summary and implications of the findings. It also includes a discussion on the future directions of research in this field. Final conclusions follow at the end.

The present study explored the burgeoning field of the academic study of commercial augmented reality games, in particular Google’s emerging augmented reality game Ingress, the demographics of those who play them, what sorts of motivations lead them to play, whether there are any identifiable positive or problematic gameplay indicators, and what kind of implications this has for learning and the educational use of such games. As a worldwide and vastly popular inclusion in the category of emerging games, this study is both timely and relevant. A vast array of information was gathered throughout the process, which illuminates clearly the characteristics of many aspects of the ARG experience.

Findings

As a study of this nature and scale has not been performed at the time of this publication, all findings should be considered relevant and important. However, given the specific research intent of this study, some are more salient than others. What follows is a summary of the most relevant findings, an interpretation of these results, the context in which they should be considered, and what implications they have for further study.

Summary of findings. Follows is a description of how the data analyzed in chapter 4 and the theoretical framework presented in chapter 2 addresses each of the research questions posed by this study. These questions are:
1. What are the characteristics of those who play augmented reality massively multiplayer mobile games?
   a. Are there significant differences in the demographic characteristics (age, education level, income, family size, and social tendencies) and motivations of Ingress players?
   b. Are there indicators of positive gameplay identifiable in Ingress players’ characteristics, motivations, or behaviors?
   c. Are there indicators of problematic gameplay identifiable in Ingress players’ characteristics, motivations, or behaviors?

2. Using Gee’s learning criteria, what characteristics of people playing augmented reality games like Ingress suggest it may be used for educational means?

The findings in the present study are numerous and varied. Ranging from the fact that the ‘average’ ARG player is significantly different from the ‘average’ MMO player, to the identification of what behaviors and motivations are most likely to imply positive or problematic, addictive traits, to presence of demonstrable informal learning and the creation of organic, informal learning communities, there is much to be considered. Not least of all are the implications for what commercial ARGs can mean for the world of education.

**Question 1.** Question 1 asks: “What are the characteristics of those who play augmented reality massively multiplayer mobile games?” To address question 1, various analyses on the demographics of Ingress players showed the ‘typical’ player to be a married male, either 31 or 32 years old, employed full-time, Caucasian, from the United
States, and holding a Bachelor’s degree. The typical player is also non-religious and liberal in both political affiliation and morally. He is a level 10 player in the Enlightened faction who has not switched factions and does not plan on it. He plays just under 12 hours per week, drives to do it, plays alone but was invited by a friend, and has never cheated. Note that this description is simply generated by the most frequently reported responses to the demographic survey items.

**Question 1a.** Question 1a asks, “Are there significant differences in the demographic characteristics (age, education level, income, family size, and social tendencies) and motivations of Ingress players?” Ingress players’ demographics vary from demographics found in MMOs, generally. While the typical Ingress player is in his early 30s, the typical MMO player is in his mid-20s. While the age difference between males and females in MMOs tends to be significant (Yee, 2006b), there is no significant difference between male and female players of Ingress in terms of age. Nearly three quarters of Ingress players are employed full-time and just 10% are full-time students, in comparison to MMO players, of which half are employed full-time and nearly a quarter are full-time students (Yee, 2006b). Two thirds of Ingress players have received an Associate’s degree or beyond and a quarter of players topped $100,000 gross yearly income. Three quarters are married, have been married, or are in another form of partnership, and under half have children. In terms of social and political stance, Ingress players from the United States tend toward self-identifying as Democrat and the general Ingress population locate themselves most often closer to the liberal end of the spectrum,
with players from outside the US being statistically significantly more liberal than those from within.

When asked about their motivations to play, players’ responses manifested, through principle component analysis, ten different categories (components):
relationships, competition, escapism, immersion, achievement, leadership, entertainment, mechanics, pragmatism, and individuality. These are different from components derived by the answers given by players of MMOGs (the full comparison can be found in Appendix K). Additionally, the motivations for players from the United States are different to those from outside the country, as well as motivations being different between the genders, with males being more likely to play for competition and females more likely to play as a means of escape. There is also a difference in motivations based on faction choice, with Resistance players being significantly more motivated to play for relationship- and pragmatic-based reasons.

**Question 1b.** Question 1b asks, “Are there indicators of positive gameplay identifiable in Ingress players’ characteristics, motivations, or behaviors?” Ingress players reported a slight improvement to their interpersonal skills because of playing, with their leadership skills improving the most, and the ability to persuade others improving the least. Responses to some open-ended questions support the finding that players’ leadership skills improved. One example is Case 1474, who remarked, “At first I had no idea what I was doing. Now I find I can effectively teach others what I’ve learned, and play better myself.” Concerning the score on the Relationships component—the component most highly correlated with positive gameplay—there is a medium
positive correlation with those who play with friends \((r=.500)\) and a medium negative correlation with those who play alone \((r=-.319)\), suggesting the key to a positive gameplay is socialization and meaningful relationships.

**Question 1c.** Question 1c asks, “Are there indicators of problematic gameplay identifiable in *Ingress* players’ characteristics, motivations, or behaviors?” Through multiple regression analysis, indicators of problematic gameplay were revealed as being significantly predicted by, in order, high scores on the Escapism motivation component and high number of hours played weekly, a high score on the Competition component and the tendency to ‘marathon,’ high scores on the Achievement component and the most rewarding memory of the past week being *Ingress*-related, and a high score on the Relationships component. That escapism, time spent playing, and a desire for immersion can contribute to problematic gameplay is established in the literature (Hellström et al., 2012; Kneer & Glock, 2013) and is supported here. However, it is important to note that escapism itself is not necessarily a sufficient indicator of problematic gameplay. It may be interpreted as a time to relax, for example, as opposed to an unhealthy retreat from reality. In line, Malone and Lepper (1987) have remarked that fantasy (in this case, escapism) is a key component of motivation for learning.

**Question 2.** Question 2 asks, “Using Gee’s learning criteria, what characteristics of people playing augmented reality games like *Ingress* suggest it may be used for educational means?” This question is addressed via two means: first, the development of a learning scale based on the work of Gee (2007b), and second, through an examination of open-ended question responses provided by recipients.
Gee argues that games are conducive for learning as players progress in-game “and, in doing so, will constantly be learning new things” (2007b, p. 61). He elaborates:

When learners learn a new skill set/strategy, they need to practice it over and over in varied contexts in order to make it operate at an almost unconscious routinized level. Then they are really good at it. But they are also in danger of resting on their laurels and learning nothing new. At this point, a good game throws a problem at the player where the routinized skill set/strategy won’t work. This forces the player to think consciously again about skills that have become unconscious, taken-for-granted, and routine. The player must then integrate his or her old skills with new ones, forming a new and higher skill set/strategy. (Gee, 2007b, p. 61)

In line with this, Gee developed a list of 36 principles that he identified in what he calls ‘good games,’ those that promote and support structured and self-directed learning in players as they navigate through the game space. This sort of experimentation and exploration is in line with the discovery learning principles of Bruner (1961), in which learners are active, motivated agents of their own learning through curiosity and dogged engagement.

_Ingress_ is a commercial, augmented reality game. That is to say, for the purposes of this study, it is a mobile application that overlays, both on the screen and in the mind of the player, a digital layer of information overtrop the real world, and was created simply for the players’ enjoyment and the developers’ gain, be it monetary or data-driven. It is also, at its core, a game about strategy and teamwork. It requires forethought,
planning, communication, and synergy in order to be played to the fullest once the gameplay and rules are understood. In line with the research of Adachi and Willoughby (2013b), the playing of strategy games is linked to increased problem solving skills. Additionally, with strong, significant, positive correlations of two learning scale items ("Ingress is constructed in such a way that, as I play, I learn not only about it but about myself and my potential" \(r=.508\) and “By playing Ingress, I feel I am part of a group bonded primarily through shared endeavors, goals, and practices” \(r=.548\)) to the Relationships motivation component, the strongest component in terms of loading items and reliability, a sense of teamwork and community is created. The responses to the instrument’s open-ended questions certainly bear this out. Playing with friends has been shown to not only ward against problematic gameplay, but may actually bolster positive feelings and behaviors (J. Snodgrass et al., 2011). The suggestion, then, is that commercial games like Ingress may be best received and utilized when paired with constructivist, group-based work, a direction well established with augmented reality games created specifically for education (Dunleavy & Dede, 2014).

As demonstrated by an examination of participants’ learner scores by player level in concert with responses to the open-ended questions, the argument could be made that Ingress falls quite neatly into the realm of discovery learning identified by Bruner (1961) and in particular, social, “guided discovery learning” (Mayer, 2004, p. 14). In the beginning phases of play (levels 1 and 2), players averaged 33 and 34 out of a total of 80 points on the learning scale. Upon reaching level 3, players’ mean scores ranged between 47 and 55 consistently through the maximum level, 16. At the same time, those players at
levels 1 and 2 also had considerably lower weekly playtime than players levels 3 and above. A response from Case 608 provides a personal experience that goes toward explaining why this is: “It is satisfying to have a thorough understanding of how the game works. In the beginning [I] made mistakes and want to be able to be more deliberate with my planning and execution of the game. Learning and becoming good at that has made the game more enjoyable [sic] for me.” This response is not atypical and the notion aligns with much of the reported benefits presented in the augmented reality case studies presented above.

In fact, when asked for open-ended responses to questions about their experience and growth while playing, participants responded with clear themes that focused on the organic development of informal learning communities through experimentation and discovery. Gee (2007b) describes how game designers (and, in this case, educators) should support players’ guided discovery-based experiences predicated by Bruner (1961) and Mayer (2004):

*Give people well designed visual and embodied experiences of a domain, through simulations or in reality (or both). Help them use these experiences to build simulations in their heads through which they can think about and imaginatively test out future actions and hypotheses. Let them act and experience consequences, but in a protected way when they are learners. Then help them to evaluate their actions and the consequences of their actions (based on the values and identities they have adopted as participants in the domain) in ways that lead them to build better simulations for better future action. Though this could be a recipe for*
teaching science in a deep way, it is [also] a recipe for an engaging and fun game.

(p. 81)

The organic development of informal learning communities—the coming together of players of all skill levels to teach each other—describes an environment in which learning is happening constantly, scaffolded by both the game design (described by Gee’s (2007b) learning principles) and the evidence of constructivist, discovery-based learning principles (like those described by Bruner (1961)). This lays the groundwork for future research on how to implement commercial games like Ingress in formal education.

**Real-world examples.** Much as World of Warcraft has been used to teach economics (Barnett & Archambault, 2010), Second Life to teach marketing (Schiller et al., 2013), games like Savannah utilize portable devices and augmented reality to teach STEM topics (Facer et al., 2004), and foreign language learning can be improved with the use of virtual worlds (Golonka et al., 2014), it is feasible that Ingress may be used in a similar way. One such example is finding the number of mind units earned in a square kilometer within a particular field by using Heron’s formula, a method of determining the area of a triangle. This is accomplished by knowing the distance between three points (lengths of each side of the triangle) and the number of mind units earned. This ‘homework’ was reported by Ingress’ official account on Google+

(https://plus.google.com/+Ingress/posts/Kafq5PU16xM) as assigned to a ten-year-old student. Another example, this time stepping away from STEM and toward the arts, was developed by an Australian educator Stuart King (2014). King took students to a local
area in which statues and other works of art abounded. His students reported a greater appreciation for art after visiting each work (which were, of course, portals).

The use of missions in *Ingress* can be bolstered for designing a more controlled experience. For example, it is entirely possibly to recreate Civil War battles using historical markers in Gettysburg, PA. By having each faction take a side, the portal capturing could become a history lesson. There is no shortage of landmarks and history that *Ingress* could address. From history (discovering historical locations) to mathematics (calculating how many L8 bursters it requires to fully deplete the energy in a L6 portal with two shields and three incoming links) to the arts (capturing portals of buildings that fall within one particular kind of architectural school), to an analysis of what culturally or historically significant landmarks in an area have been approved as portals and what have not and why that may be the case, the uses of *Ingress* for education is virtually limitless and requires only imagination and access. While using *Ingress* and commercial games like it for educational purposes does require considerable planning and effort, it appears to be worth it as it is “not the technology itself but the interplay between technology and pedagogical practice that affords possibilities for better experiential learning” (Lai et al., 2007, p. 335).

**Considerations.** Some considerations should be taken when attempting to integrate commercial games into educational settings. Specifically for *Ingress*, as a third-party software over which educators and students have very limited control, using the limited time and resources afforded to educators should be undertaken with care. For example, while *Ingress* could provide educators with a vast, sprawling “cultural tour” as
described by Olson and Wagler (2011) and potentially save time in design and frustration with technological issues due to the reliability of Ingress servers and applications, less control is had over the “structured” and “creative interactive encounters” (p. 307) than if it were created in-house.

This lack of control over user-created design should also be taken into consideration, as it has been identified as a key component in learning through the use of augmented reality gaming (Wagler & Mathews, 2011). While Ingress does afford a certain level of user-directed design (the ability to submit new portals or improve current portal descriptions, for example), it is certainly the case that this is neither a foolproof or expedient way of accomplishing such design as there is no guarantee user-submitted content will be approved by the game developers and approval staff. However, the fact that a fully developed, worldwide game with the support and expertise of a company like Google is available to simply pick up and begin using certainly suggests an improvement in cost benefit in terms of time and resources spent on research, design, and implementation.

While Ingress locates itself between what Dunleavy and Dede call “place-dependent” and “place-independent” (2014, p. 740) as it is both inexorably location-based in communities and ubiquitous as to be played anywhere, the nature of the game predicates outdoor play in public areas. This makes designed learning experiences like Czarnecki’s (2012) gamified library difficult, if not impossible to accomplish.

Finally, it must be understood that not all games are created equal in terms of their pedagogical potential and promotion of learning. This is especially true for commercial
games, be they console, mobile, augmented reality, or a combination thereof. A sound theoretical grounding in place before attempting to utilize games like *Ingress* is key to its success or failure in a formal educational setting. Even though this study presents the case that informal learning and communities of learners are naturally present and organically grow out of this particular commercial augmented reality game, how this best translates to classroom use is certainly a topic for further study.

**Recommendations**

The present study revealed much and a number of recommendations can be made because of it. One such recommendation is a paradigm shift in the publication of studies in fields like mobile technology. Others include recommendations of studies in the field of augmented reality. These are presented below.

**Publication lag.** The apparent discrepancy between when devices are used and when studies that employ their use are published in scholarly journals is striking when considering Motiwalla’s (2007) study (two years between study and publication). Bjork and Solomon (2013) found the average time between paper submission and journal publication in the social sciences to be roughly 14 months, which does not include the time researchers presumably develop, find funding for, implement, analyze, and write the paper, itself. In a field that uses mobile technology, even 14 months is an incredibly long time (the time between major Apple iPhone releases is generally roughly one year (“iOS: A visual history,” 2013), less than the time it takes to publish a paper). The result is newly published research in a field that’s largely emergent about technology that is, if not obsolete, then out of date. As summarized by Cochrane and Bateman (2010),
“pedagogical integration of m-learning into a course or curriculum requires a paradigm shift on behalf of the lecturers involved, and this takes significant time” (p. 11).

To combat this, there seems to be a return to anthologies as the source for the most up-to-date research and thinking on the field, such as The New Landscape of Mobile Learning: Redesigning Education in an App-based World (C. Miller & Doering, 2014). In the forward to Mobile Media Learning: Amazing Uses of Mobile Devices for Learning (2011), Eric Klopfer says,

I was sitting in a meeting recently listening to a presentation from a major media company talk about mobile device usage by kids. The crowd quickly reacted to the “dated” data on apps and devices, hankering for more up to date information. The data was only a year old, but in the rapidly moving space of mobile media, the data is already stale. While some may lament the rapid pace of change that seems to leave devices themselves to become quickly dated, I see the vast opportunities that this rapid change has created for both developers and users of mobile applications. (p. i)

In these texts, a number of authors present projects, case studies, collaborations, and suggestions for how to use mobile tools while not being left behind, though this in and of itself does take time. While not the traditional scholarly, peer-reviewed cycle that is so clearly not suited to a field that moves at such speed, it is a possible means by which to share ideas on using technology that becomes dated almost as soon as it is released.

**Augmented reality games.** While the present study sheds a great deal of light on ARGs and their players, more research is needed. Some topics include looking into the
potential health benefits of playing, what long-term impact the game has on players, how
gender impacts the experience of players, and how emerging and future technology will
change how ARGs are played.

**Health benefits.** The potential health benefits of playing active video games is
well documented (Daley, 2009; Graf et al., 2009; LeBlanc et al., 2013; Parisod et al.,
2014). As *Ingress* and, supposedly, future ARGs both educational and commercial
require the player to move around in a physical space, longitudinal research on improved
health like weight, cardiovascular and pulmonary fitness, and even psychological well-
being should be considered.

**Long-term effects.** Due to the rather nascent nature of ARGs, it is currently
unknown what—if any—long-term effects can be identified by playing, either positive or
negative. Longitudinal research in this area would be beneficial to the field, as well.

**Gender.** As *Ingress* has no avatars, simply ‘agent’ names and the real people
behind them, the field would benefit from future research in line with that of Fortim and
Grando (2013) in which female players of MMOs reported marked prejudice when
exposing their gender. Whether or not this feeling extends to games like *Ingress* where
there is no gendered aspect within the game is an interesting line of future research.

**Future technology.** Again noting that the ARG is in its relative infancy and
currently the most likely device used to play one is a smartphone, ongoing research into
how the technology itself impacts the field should be considered. With devices like
Google Glass, the Oculus Rift, and the secretive still-in-development *Magic Leap*
(http://www.magicleap.com) (an augmented reality system that purports the ability to
overlay images directly onto the world in real-time, though how this is done is, at the time of this study, to be determined), it is unclear how users will react when the virtual and the real become indistinguishable.

It is also likely that Ingress and other augmented reality games will move from the smartphone to other wearable technology. Whether this is Google Glass or some other form of visually-oriented wearable is yet to be seen. This would, if it occurred, bring together both the location-aware and vision-based styles of augmented reality discussed by Dunleavy and Dede (2014). It has already made the move to other non-vision based wearables (Statte, 2015).

**Use of commercial games.** While to date Google’s Ingress is currently the only game of its type and popularity, it is possibly that it will eventually be usurped by another or that it will be discontinued for some unknown reason. Maintaining research on commercial ARGs in order to quickly identify the affordances and uses of new, emerging games of this type in the future is warranted.

**Fostering community.** Players of Ingress appear to find communities—or create them, barring that—rather organically. These communities support positive gameplay and foster learning, but there is currently no way in-game for these communities to develop. It may be beneficial for games of this sort to provide players with more and easier opportunities to develop and maintain communities.

**Conclusion**

This study uncovers much that has been previously assumed but not necessarily known about players of commercial augmented reality games, in particular Google’s
*Ingress*. It has shown that the kinds of people who play are just as varied as those who play other types of games, but that the ‘typical’ gamer is considerably different. It has also shown what behaviors, qualities, and motivations of these players point toward healthy, positive gameplay and potentially unhealthy, problematic gameplay. This information could be beneficial to the creation and implementation of ‘serious’ or ‘educational’ ARGs and the appropriate use of ARGs in formal or informal educational settings because, as was stated at the beginning, “opportunity to study what people actually do when they choose to be in a virtual environment with thousands of other people cannot be overstated” (Yee, 2006b, p. 310).

The array of literature and real-world examples surrounding augmented reality and how it’s used has demonstrated its tremendous potential for bolstering learning and sound pedagogical practices both inside and outside the classroom. This study goes toward showing the potential of commercial augmented reality games and how they may be used in kind. Educators interested in incorporating this kind of technology into the classroom through discovery learning methods may find the present work illuminating and helpful in decision-making and implementation.

This study has also shown how large the realm of video game studies can be, from the far-reaching history of virtual worlds, to the popularity of games across demographics, and to the ease by which video games can be demonized and scapegoated for larger societal and cultural problems. By studying and learning more about these games, it may be possible for *good educators* to use *good games* for *good learning* and in
the process prepare themselves for the future of teaching using every technology and means at hand.
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Appendix A: Gee’s 36 Learning Principles

Follows is the full list of James Paul Gee’s 36 Learning Principles “built into good video games” (2007b, p. 8) as it appears in the appendix of What Video Games Have to Teach Us About Learning and Literacy. Those utilized in the construction of the Learning Scale found in this study have been marked as bold.

1) Active, Critical Learning Principle: All aspects of the learning environment (including ways in which the semiotic domain is designed and presented) are set up to encourage active and critical, not passive, learning.

2) Design Principle: Learning about and coming to appreciate design and design principles is core to the learning experience.

3) Semiotic Principle: Learning about and coming to appreciate interrelations within and across multiple sign systems (images, words, actions, symbols, artifacts, etc.) as a complex system is core to the learning experience.

4) Semiotic Domains Principle: Learning involves mastering, at some level, semiotic domains, and being able to participate, at some level, in the affinity group or groups connected to them.

5) Metalevel Thinking about Semiotic Domain Principle: Learning involves active and critical thinking about the relationships of the semiotic domain being learned to other semiotic domains.

6) "Psychosocial Moratorium" Principle: Learners can take risks in a space where real-world consequences are lowered.
7) Committed Learning Principle: Learners participate in an extended engagement (lots of effort and practice) as an extension of their real-world identities in relation to a virtual identity to which they feel some commitment and a virtual world that they find compelling.

8) Identity Principle: Learning involves taking on and playing with identities in such a way that the learner has real choices (in developing the virtual identity) and ample opportunity to meditate on the relationship between new identities and old ones. There is a tripartite play of identities as learners relate, and reflect on, their multiple real-world identities, a virtual identity, and a projective identity.

9) Self-Knowledge Principle: The virtual world is constructed in such a way that learners learn not only about the domain but also about themselves and their current and potential capacities.

10) Amplification of Input Principle: For a little input, learners get a lot of output.

11) Achievement Principle: For learners of all levels of skill there are intrinsic rewards from the beginning, customized to each learner's level, effort, and growing mastery and signaling the learner's ongoing achievements.

12) Practice Principle: Learners get lots and lots of practice in a context where the practice is not boring (i.e. in a virtual world that is compelling to learners on their own terms and where the learners experience ongoing success). They spend lots of time on task.
13. Ongoing Learning Principle: The distinction between the learner and the master is vague, since learners, thanks to the operation of the "regime of competency" principle listed next, must, at higher and higher levels, undo their routinized mastery to adapt to new or changed conditions. There are cycles of new learning, automatization, undoing automatization, and new re-organized automatization.

14) "Regime of Competence" Principle: The learner gets ample opportunity to operate within, but at the outer edge of, his or her resources, so that at those points things are felt as challenging but not "Undoable."

15) Probing Principle: Learning is a cycle of probing the world (doing something); reflecting in and on this action and, on this basis, forming a hypothesis; reprobing the world to test this hypothesis; and then accepting or rethinking the hypothesis.

16) Multiple Routes Principle: There are multiple ways to make progress or move ahead. This allows learners to make choices, rely on their own strengths and styles of learning and problem-solving, while also exploring alternative styles.

17) Situated Meaning Principle: The meanings of signs (words, actions, objects, artifacts, symbols, texts, etc.) are situated in embodied experience. Meanings are not general or decontextualized. Whatever generality meanings come to have is discovered bottom up via embodied experience.
18) Text Principle: Texts are not understood purely verbally (i.e. only in terms of the definitions of the words in the text and their text-internal relationships to each other) but are understood in terms of embodied experience. Learners move back and forth between texts and embodied experiences. More purely verbal understanding (reading texts apart from embodied action) comes only when learners have enough embodied experience in the domain and ample experiences with similar texts.

19) Intertextual Principle: The learner understands texts as a family ("genre") of related texts and understands any one text in relation to others in the family, but only after having achieved embodied understandings of some texts. Understanding a group of texts as a family ("genre") of texts is a large part of what helps the learner to make sense of texts.

20) Multimodal Principle: Meaning and knowledge are built up through various modalities (images, texts, symbols, interactions, abstract design, sound, etc.), not just words.

21) "Material Intelligence" Principle: Thinking, problem-solving and knowledge are "stored" in material objects and the environment. This frees learners to engage their minds with other things while combining the results of their own thinking with the knowledge stored in material objects and the environment to achieve yet more powerful effects.

22) Intuitive Knowledge Principle: Intuitive or tacit knowledge built up in repeated practice and experience, often in association with an affinity group,
counts a good deal and is honored. Not just verbal and conscious knowledge is rewarded.

23) Subset Principle: Learning even at its start takes place in a (simplified) subset of the real domain.

24) Incremental Principle: Learning situations are ordered in the early stages so that earlier cases lead to generalizations that are fruitful for later cases. When learners face more complex cases later, the learning space (the number and type of guess the learner can make) is constrained by the sorts of fruitful patterns or generalizations the learned has founded earlier.

25) Concentrated Sample Principle: The learner sees, especially early on, many more instances of the fundamental signs and actions than should be the case in a less controlled sample. Fundamental signs and actions are concentrated in the early stages so that learners get to practice them often and learn them well.

26) Bottom-up Basic Skills Principle: Basic skills are not learned in isolation or out of context; rather, what counts as a basic skill is discovered bottom up by engaging in more and more of the game/domain or games/domains like it. Basic skills are genre elements of a given type of game/domain.

27) Explicit Information On-Demand and Just-in-Time Principle: The learner is given explicit information both on-demand and just-in-time, when the learner needs it or just at the point where the information can best be understood and used in practice.
28) **Discovery Principle**: Overt telling is kept to a well-thought-out minimum, allowing ample opportunities for the learner to experiment and make discoveries.

29) **Transfer Principle**: Learners are given ample opportunity to practice, and support for, transferring what they have learned earlier to later problems, including problems that require adapting and transforming that earlier learning.

30) **Cultural Models about the World Principle**: Learning is set up in such a way that learners come to think consciously and reflectively about some of their cultural models regarding the world, without denigration of their identities, abilities or social affiliations, and juxtapose them to new models that may conflict with or otherwise relate to them in various ways.

31) **Cultural Models about Learning Principle**: Learning is set up in such a way that learners come to think consciously and reflectively about their cultural models about learning and themselves as learners, without denigration of their identities, abilities, or social affiliations, and juxtapose them to new models of learning and themselves as learners.

32) **Cultural Models about Semiotic Domains Principle**: Learn about their cultural models about a particular semiotic domain they are learning, without denigration of their identities, abilities, or social affiliations, and juxtapose them to new models about this domain.

33) **Distributed Principle**: Meaning/knowledge is distributed across the learner, objects, tools, symbols, technologies, and the environment.
34) Dispersed Principle: Meaning/knowledge is dispersed in the sense that the learner shares it with others outside the domain/game, some of whom the learner may rarely or never see face-to-face.

35) Affinity Group Principle: Learners constitute an "affinity group," that is, a group that is bonded primarily through shared endeavors, goals, and practices and not shared race, gender, nation, ethnicity, or culture.

36) Insider Principle: The learner is an "insider," "teacher," and "producer" (not just a consumer) able to customize the learning experience and the domain/game from the beginning and throughout the experience.
Appendix B: Survey Instrument and Consent Form

Follows is the survey instrument and consent form used in this study. Screenshots begin on the next page.
Intro and demographics, part 1

The purpose of this survey is to determine player demographics, behaviors, attitudes, and motivations in Google's Niantic Lab's augmented reality game Ingress.

Information gathered in this survey is for research purposes only and is strictly anonymous. It should take approximately 7-15 minutes to complete and presents no risks or discomforts. By agreeing to the question below, completing, and submitting the survey it indicates that you have read and agree to this disclaimer and are aware that your responses will be used for research purposes and/or publication. No identifiable information is mandatory and responses are kept confidential. You must be 18 years or older to participate in this survey. There is no compensation for completion, though your participation is greatly appreciated. Follow-up communications may be sent if you agree to potentially be contacted. The researcher in this study is Ryan Straight, a doctoral candidate in Instructional Technology at Ohio University. His advisor is Dr Teresa Franklin (franklir@ohio.edu). If you have any questions regarding this study, please contact the researcher at straigh@ohio.edu.

Please take your time and answer completely and honestly. Thank you!

(Consent form dated August 10, 2014)

I have read and agree to the consent form above.
☐ Yes! Please continue to the survey.

This survey gathers a great deal of data on a wide variety of aspects related to Ingress. The progress bar at the bottom will let you know how much you have completed so far. Your participation is greatly appreciated!

Demographics

The following questions are intended to simply understand the demographics of Ingress players.

Gender
☐ Male
☐ Female
☐ Other
☐ Prefer not to answer

Age

What is your ethnicity? (Select all that apply.)
☐ White/Caucasian
☐ African American
☐ Hispanic
In which country do you reside?

In what state do you currently reside?

Choose how accurately the statements below describe you.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Completely unlike me</th>
<th>Mostly unlike me</th>
<th>Pretty unlike me</th>
<th>Somewhat unlike me</th>
<th>Somewhat like me</th>
<th>Pretty like me</th>
<th>Mostly like me</th>
<th>Exactly like me</th>
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<tbody>
<tr>
<td>I find myself having meaningful conversations with others.</td>
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<td>I have made some good friends in the game.</td>
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<td>I like to say funny things in chat.</td>
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<td>I spend increasingly more time playing.</td>
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<td>Doing massive amounts of damage is very satisfying.</td>
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<tr>
<td>I usually don't chat much with group members.</td>
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<td>I can't stand those people who only care about seeing their name everywhere.</td>
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<tr>
<td>I try to optimize my AP gain or earn better badges as much as possible.</td>
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<td>I think about playing all day long.</td>
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<td>I would rather lead than follow.</td>
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</table>

Demographics, part 2

Occupational status

What is your average yearly household income before taxes?

https://ohio.qualtrics.com/ControlPanelAjax.php?action=GetSurveyPrintPreview&AT=56C0eCCHw2P50acQp4WV
What is the highest degree or level of schooling you have completed?

Relationship status

Do you have any children?
- Yes (how many?)
- No
- Prefer not to answer

Religious preference

With which major or minor political party do you identify?

Where do you stand on most social issues?

Choose how accurately the statements below describe you.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Completely unlike me</th>
<th>Very unlike me</th>
<th>Unlike me</th>
<th>Somewhat unlike me</th>
<th>Somewhat like me</th>
<th>Like me</th>
<th>Very like me</th>
<th>Exactly like me</th>
</tr>
</thead>
<tbody>
<tr>
<td>I researched everything about the factions before starting the game.</td>
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<tr>
<td>I talk to my friends in the game about personal issues.</td>
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<td>I would make maps if they weren't available.</td>
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<tr>
<td>I understand real-life group dynamics much more after playing the game.</td>
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<tr>
<td>I like to be immersed in a fantasy world.</td>
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<tr>
<td>Playing the game lets me forget some of the real-life</td>
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</tbody>
</table>

https://ohio.qualtrics.com/ControlPanelAjax.php?action=GetSurveyPrintPreview&AT=5669c6c4f1c27f890c5e4e7c0eb7b47d
Ingress demographic questions

What faction are you?
- Enlightened
- Resistance

What level are you? (Options reflect the new leveling system put into effect in 2014.)

How did you come to play Ingress?
- Received an invite from Google
- Was invited by a friend
- Received an invite as reward for art
- Randomly received one online
- Joined after game changed to open beta (no invite needed)
- Other

What platforms do you use to play? (Select all that apply.)
- Android-based device
- iOS-based device
- Other non-official platform

Have you switched factions?
- No, and don’t plan to
- No, but would consider it
- No, but planning on it
- Yes, I chose faction by mistake
When did you begin playing Ingress?

Year

Month

Roughly how many hours per week do you play? (Give a general estimate.)

I have "marathoned" (played more than 10 hours continuously or spent an entire day/weekend devoted to playing).

True

False

Have you experienced "burn-out?" (Stopped playing for a prolonged period of time?)

Yes

No

Please explain why and how many times.

Have you participated in cross-faction events?

Yes

No

Have you traveled out of state or more than 100 miles specifically to play Ingress?

Yes

No

Choose how accurately the statements below describe you.

I bag for items in the game.

I am uninterested in targeting specific players.
<table>
<thead>
<tr>
<th>1/4/2015</th>
<th>Qualtrics Survey Software</th>
</tr>
</thead>
<tbody>
<tr>
<td>I find myself soloing a lot.</td>
<td>![Rating Options]</td>
</tr>
<tr>
<td>It's very important for me to get the best gear available.</td>
<td>![Rating Options]</td>
</tr>
<tr>
<td>Playing the game lets me vent and relieve stress from the day.</td>
<td>![Rating Options]</td>
</tr>
<tr>
<td>I make up stories and a history for my agent/character.</td>
<td>![Rating Options]</td>
</tr>
<tr>
<td>I have learned things about myself from playing this game.</td>
<td>![Rating Options]</td>
</tr>
<tr>
<td>It's important for me to achieve things with as little help from other people as possible.</td>
<td>![Rating Options]</td>
</tr>
<tr>
<td>I play to forget about real life.</td>
<td>![Rating Options]</td>
</tr>
<tr>
<td>Other have unsuccessfully tried to reduce my gaming time.</td>
<td>![Rating Options]</td>
</tr>
</tbody>
</table>

Do you use devices other than your phone to play (excluding using a device to simply look at the Ingress map)? Choose all that apply.
- [ ] No
- [ ] Yes, another phone
- [ ] Yes, a tablet
- [ ] Yes, other

Do you play other video games? Choose all that apply.
- [ ] Yes, console/PC games
- [ ] Yes, social games (on Facebook, for example)
- [ ] Yes, other mobile games
- [ ] No

Roughly how many hours a week do you spend playing video games Including Ingress?

Was Ingress your introduction to mobile gaming? (Playing games on a mobile device, not location-based games like geo-caching.)
- [ ] Yes
- [ ] No

Have you played other geo-location based games before? (For example, geo-caching.)
- [ ] Yes
- [ ] No
What is your main method of playing? (If two are even, choose the one you'd be more likely to do, given the choice.)

- Vehicle (private)
- Vehicle (public transit)
- Bicycle
- Walking
- Other

---

Choose how accurately the statements below describe you.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Completely unlike me</th>
<th>Very unlike me</th>
<th>Unlike me</th>
<th>Somewhat unlike me</th>
<th>Somewhat like me</th>
<th>Like me</th>
<th>Very like me</th>
<th>Exactly like me</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am an effective group leader.</td>
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<td>I like to feel powerful in the game.</td>
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<tr>
<td>I like to try out new roles and personalities with my agent/character.</td>
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<td>I like to dominate other players.</td>
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<td>I like wandering and exploring.</td>
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<tr>
<td>I try to prevent the other faction from gaining high-level items or</td>
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<td>maintaining a high-level farm.</td>
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<tr>
<td>I like the escapism aspect of the game.</td>
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<tr>
<td>I'm fascinated by the game mechanics, and love charts and tables.</td>
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<td>I feel badly when I'm unable to play.</td>
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<td>I have fought with others (e.g., family, friends) over the time I spend</td>
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<tr>
<td>gaming.</td>
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Please choose how often you play based on the following criteria. (This means in-person and does not reference how often you use a chat program, for example.)

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Most of the Time</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>I play alone.</td>
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<tr>
<td>I play with a family member.</td>
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<tr>
<td>I play with a romantic partner.</td>
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<tr>
<td>I play with friends.</td>
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<tr>
<td>I play with co-workers.</td>
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</tbody>
</table>

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I have become romantically involved (dated) someone I first met through Ingress.
Have you experienced relationship problems because of playing?
- No
- Yes, because of my play.
- Yes, because of their play.
- Yes, because of both our play.

Have any of your friendships been negatively impacted because of playing?
- No
- Yes, because of my play.
- Yes, because of their play.
- Yes, because of both our play.

The most rewarding/satisfying experience I can remember in the past 7 days occurred while playing Ingress.
- True
- False

The most rewarding/satisfying experience I can remember in the past 30 days occurred while playing Ingress.
- True
- False

The most annoying/infuriating experience I can remember in the past 7 days occurred while playing Ingress.
- True
- False

The most annoying/infuriating experience I can remember in the past 30 days occurred while playing Ingress.
- True
- False

Choose the most appropriate statement to match whether the following abilities or experiences have been improved "in real life" because of playing Ingress.

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>A bit</th>
<th>A lot</th>
<th>Entirely</th>
</tr>
</thead>
<tbody>
<tr>
<td>My ability to mediate or resolve in-group tension.</td>
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<tr>
<td>My ability to persuade other people.</td>
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</tbody>
</table>
1/4/2015

Choose how much you agree with the following statements.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Completely disagree</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Somewhat disagree</th>
<th>Somewhat agree</th>
<th>Agree</th>
<th>Strongly agree</th>
<th>Completely agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>It's just a game.</td>
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<tr>
<td>The way I am in the game is the way I am in real life.</td>
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<tr>
<td>The game mechanics are too complicated for the average player.</td>
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<tr>
<td>Fiction-balancing issues do not interest me.</td>
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<tr>
<td>People who role-play extensively bother me.</td>
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<tr>
<td>Friends in the game have offered me support when I had a real-life problem or crisis.</td>
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The following few questions deal with cheating in its many forms. Remember that your responses are confidential, anonymous, and used only for research purposes to paint a better picture of Ingress players as a whole. Please be as honest and candid as you can; you are not in danger of reproach or punishment.

Have you cheated?
- No
- Yes

How did you cheat? (Select all that apply.)
- GPS spoofing
- Having multiple accounts
- Sharing accounts
- Spying on or infiltrating the opposing faction
- Win-trading
- Using an altered or modded Ingress application
- Broken a law in order to play (i.e., trespassing)
- Other

Have you gotten caught?
Were you punished? (Select all that apply.)

☐ No.
☐ Yes, by players of the opposing faction.
☐ Yes, by players of my faction.
☐ Yes, by the developers.

Are you still cheating or have you stopped?

☐ I no longer cheat.
☐ I continue to cheat.

Now you'll be asked about how you feel you've experienced, grown, and learned while playing Ingress.

Statements derived from Gas (2007).

Choose how much you agree with the following statements.

<table>
<thead>
<tr>
<th>The ability to understand the interaction between words, images, and symbols as a system is a core aspect to being successful in Ingress.</th>
<th>Completely disagree</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Somewhat disagree</th>
<th>Somewhat agree</th>
<th>Agree</th>
<th>Strongly agree</th>
<th>Completely agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>By putting in lots of effort and practice, I create a sense of commitment in the compelling virtual world of Ingress.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>I often feel as though accomplishing things with my resources can be challenging but is never impossible.</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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</tr>
<tr>
<td>Frequently, what I have learned by playing has been due to experiment and discovery rather than being told what to do.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>My ability to play has been bolstered by attempting to accomplish something, failing, then retrying with a different strategy.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>1/4/2015</td>
<td>Qualtrics Survey Software</td>
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<tr>
<td>Ingress allows me to progress by relying on my own strengths and style, while allowing me to still try alternatives.</td>
<td>〇 〇 〇 〇 〇 〇 〇 〇 〇 〇</td>
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</tr>
<tr>
<td>In Ingress, in terms of other players, experience is rewarded over knowledge.</td>
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</tr>
<tr>
<td>I feel the rewards I receive from playing increase, as I get better.</td>
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</tr>
<tr>
<td>By playing Ingress, I feel I am part of a group bonded primarily through shared endeavors, goals, and practices.</td>
<td>〇 〇 〇 〇 〇 〇 〇 〇 〇 〇</td>
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</tr>
<tr>
<td>Ingress is constructed in such a way that, as I play, I learn not only about it but about myself and my potential.</td>
<td>〇 〇 〇 〇 〇 〇 〇 〇 〇 〇</td>
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</table>

**Closing questions**

The follow questions are open-ended and optional, though answers are appreciated!

Remember: you must click the (>>) NEXT button below to complete the survey!

Ingress is often referred to as more than just a game, and sometimes as a lifestyle. Do you agree? Has your lifestyle changed because of the game?

[Blank Space]

Has your life improved due to playing Ingress? How? If it has not, has it had a detrimental impact? How?

[Blank Space]

How has playing Ingress changed your view of technology and/or social networking?

[Blank Space]

Describe how your experience when first starting to play Ingress is different from your current experience. What’s changed? Is it better, worse, or just different?

[Blank Space]
1/4/2015

Qualtrics Survey Software

Do you consider yourself a gamer because of Ingress? Why or why not? Is gamer the wrong word?

What does Ingress—the game, the lifestyle, the friendships, the battles, all of it—mean to you?

Please enter your email address if you are interested in volunteering to potentially be contacted to answer follow-up questions. Though there is the possibility of compensation for participating in a follow-up, providing your email address does not guarantee you will be chosen.

That's it! Please click the (>>) NEXT button below to complete the survey. Your survey will not be marked complete until you do this!

Thank you for participating!

Ingress motivation survey - Thank you for participating!
Appendix C: Personal Communications

Communications with Brian Rose of Niantic Labs to request assistance in promoting and distributing the study. A brief discussion was previously had in the comments Google+ post where the author brought up the idea of the study and was told to continue communication via email.

Date: May 23, 2013
From: Ryan Straight
To: Brian Rose
Subject: Doctoral study using Ingress?

Hi Brian,

Thanks for taking the time. I'm uber excited about the possibility of using Ingress in my doctoral work. As I said, I'd chatted with Brandon about this back in December and he was on board with me picking the brains of the Niantic folks (it was just brainstorming at the time) but I've failed to get back in touch with him about it since. It's great to possibly get the ball rolling again! Anyway, some background:

I'm working on my Ph.D in Instructional Technology at Ohio University (though I work at the University of Arizona in Tucson). My focus is using commercial games (more broadly, games not intended to be "educational") as educational texts. An example is using a commercial off-the-shelf video game in a classroom to teach, say, narrative structure or the "hero's journey," or using characters in the game as psychological case studies.

So, when I found out about Ingress, the cogs in my head started spinning wildly, as you can imagine. Ingress (and, by extension, Field Trip) has so much potential in this area that I felt I would be remiss if I didn't take a shot at connecting with you all.

Long story short, is this something you would be willing and/or able to get in on? I know Google's all about education, so it seems like a perfect fit.

Looking forward to hearing back! And thank you, again!

Date: May 24, 2013
From: Brian Rose
To: Ryan Straight
Subject: Re: Doctoral study using Ingress?

Sounds great. I may have to vet some things with our team since I can only share publicly
available info, but I'd love to help. Just a heads up that I'll be out of the office until
Tuesday, but I'll be checking email. Thanks Ryan!

Communications with Nick Yee to request permission to utilize and alter his
original MMORPG survey:

Date: November 10, 2013
From: Ryan Straight
To: Nick Yee
Subject: Use/alteration of survey for doctoral research?

Hello Dr Yee,

I’m a doctoral student at Ohio University working toward my Ph.D in Instructional
Technology. I’m currently working with Google for my dissertation on their new
augmented reality game Ingress and would like to use a portion of your 2006 World of
Warcraft motivation survey instrument in my study. Some questions would be left as-is
and some would be altered to fit the nature of Ingress (as some questions are very
particular to World of Warcraft).

I look forward to your response, and thank you for doing such wonderful research!
Ryan

Date: November 10, 2013
From: Nick Yee
To: Ryan Straight
Subject: Re: Use/alteration of survey for doctoral research?

That's totally fine with me. All the best with your research!

Nick
Communications with Jeroen Lemmens for permission to utilize and alter his survey instrument on gaming addiction:

Date: July 8, 2014
From: Ryan Straight
To: Jeroen Lemmens
Subject: Request to use 7-item game instrument in dissertation survey instrument

Dr Lemmens,

Your work on gaming addiction in adolescents is proving very useful in my scholarly work and I wanted to express my appreciation for it. I am currently constructing my dissertation on mobile, augmented reality gaming and was hoping to include in my survey instrument, with your permission, a statement-based version of the 7-item addiction scale you published in the 2009 article “Development and Validation of a Game Addiction Scale for Adolescents.” I would be happy to share the aggregated results with you upon finishing my study.

Looking forward to your response,
Ryan

Date: July 24, 2014
From: Jeroen Lemmens
To: Ryan Straight
Subject: Re: Request to use 7-item game instrument in dissertation survey instrument

Dear Ryan,

Thank you for your interest in our game addiction scale. Please feel free to use and adapt the scale as you please. We have used it in further studies and it worked great.

If you click on English Publications (on the left) you will find all our published articles on pathological gaming (or game addiction). You may find these interesting.


I would be very interested in anything you may find. Best of luck with your research!

Kind regards,
Jeroen
Appendix D: Yee’s Game Motivations Items, Coding, and Scoring

Follows is the both the 40-item survey instrument used in *The Demographics, Motivations, and Derived Experiences of Users of Massively Multi-User Online Graphical Environments* (Yee, 2006b, pp. 327–328) and the coding and scoring used on the 39-item version used in *Motivations for Play in Online Games* (Yee, 2006a) located at [http://www.nickyee.com/pubs/game%20motivations%2039%20items%20version.pdf](http://www.nickyee.com/pubs/game%20motivations%2039%20items%20version.pdf).

1. I find myself having meaningful conversations with others.
2. I usually don’t chat much with group members.
3. I have made some good friends in the game.
4. I find myself soloing a lot.
5. I like to say funny things in group/guild chat.
6. I talk to my friends in the game about personal issues.
7. Friends in the game have offered me support when I had a RL problem or crisis.
8. I am an effective group leader.
9. I would rather follow than lead.
10. I like to feel powerful in the game.
11. Doing massive amounts of damage is very satisfying.
12. I constantly try to set and reach goals.
13. I can’t stand those people who only care about leveling.
14. It’s very important to me to get the best gear available.
15. I try to optimize my XP gain as much as possible.
16. I’m fascinated by the game mechanics, and love charts and tables.

17. I research everything about a class before starting the character.

18. Class-balancing or realm-balancing issues do not interest me.

19. This game is too complicated.

20. I like wandering and exploring the world.

21. I would make maps if they weren’t available.

22. I have learned things about myself from playing the game.

23. I understand real-life group dynamics much more after playing the game.

24. I like the escapism aspect of the game.

25. I like to be immersed in a fantasy world.

26. Playing the game lets me vent and relieve stress from the day.

27. Playing the game lets me forget some of the real-life problems I have.

28. I like to try out new roles and personalities with my characters.

29. The way I am in the game is the way I am in real life.

30. People who role-play extensively bother me.

31. I like the feeling of being part of a story.

32. I make up stories and histories for my characters.

33. I like to manipulate other people so they do what I want them to.

34. I like to dominate other characters/players.

35. I like to taunt or annoy other players.

36. I scam other people out of their money or equipment.

37. I beg for money or items in the game.
38. It’s important to me to achieve things with as little help from other people as possible.

39. It’s just a game.

40. I am uninterested in player-killing.
Scoring Instructions

For all the response options:

- Not At All Important / Never / Not Enjoyable At All / Not At All / Much Rather Solo = 1
- Extremely Important / Always / Extremely Enjoyable / A Great Deal / Much Rather Group = 5

Reverse code the following items (i.e., score = 6 – raw score):

- Q5 (solo well), Q19 (self-sufficient)

Simple Method: Create the factor scores by averaging the following items for each factor:

- Achievement: Q14, Q15, Q16, Q17, Q7, Q29
- Mechanics: Q1, Q2, Q3, Q18
- Competition: Q25, Q39, Q26, Q31
- Socializing: Q23, Q22, Q24, Q28
- Relationship: Q32, Q33, Q34
- Teamwork: Q4, Q5, Q6, Q19
- Discovery: Q11, Q12, Q13, Q27
- Role-Playing: Q30, Q20, Q35, Q36
- Customization: Q8, Q9, Q10
- Escapism: Q37, Q38, Q21

More Precise Method: Weigh each item by its factor loading, add them up, and then calculate the z-score (i.e., [score - mean]/standard deviation) for each aggregate for each participant.

- Achievement: Q14*0.68 + Q15*0.77 + Q16*0.81 + Q17*0.69 + Q7*0.53 + Q29*0.60
- Mechanics: Q1*0.78 + Q2*0.65 + Q3*0.67 + Q18*0.69
- Competition: Q25*0.64 + Q39*0.81 + Q26*0.72 + Q31*0.82
- Socializing: Q23*0.82 + Q22*0.65 + Q24*0.77 + Q28*0.63
- Relationship: Q32*0.71 + Q33*0.88 + Q34*0.86
- Teamwork: Q4*0.79 + Q5*0.77 + Q6*0.60 + Q19*0.63
- Discovery: Q11*0.82 + Q12*0.77 + Q13*0.55 + Q27*0.80
- Role-Playing: Q30*0.66 + Q20*0.62 + Q35*0.83 + Q36*0.85
- Customization: Q8*0.73 + Q9*0.81 + Q10*0.80
- Escapism: Q37*0.81 + Q38*0.62 + Q21*0.83

Appendix E: Data Coding

Response options and related numbering schemes are displayed in the survey instrument found in Appendix B. The following response choices in the survey are reverse coded for analysis by taking the absolute value of 9 – raw score on a scale of 1-8 (ie, a response valued at 3 would be coded as $3 - 9 = |-6| = 6$), with the lowest value of 1 represented by *Not at all like me* or *Completely disagree* and the highest value of 8 represented by *Just like me* or *Completely agree*. Components were generated using the following combinations and the “simple” method applied by Yee in Appendix D. Note that this list is *all* items that were reverse coded for the purposes of analysis, not necessarily a list of those used in the final analysis.

<table>
<thead>
<tr>
<th>Original</th>
<th>Reverse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Likert1_6: I usually don’t chat with group members.</td>
<td>Likert1_6X: I chat a lot with group members.</td>
</tr>
<tr>
<td>Likert3_1: I bet for items in the game.</td>
<td>Likert3_1X: I do not beg for items in the game.</td>
</tr>
<tr>
<td>Likert3_2: I am uninterested in targeting specific players.</td>
<td>Likert3_2X: I am interested in targeting specific players.</td>
</tr>
<tr>
<td>Likert3_3: I find myself solo’ing a lot.</td>
<td>Likert3_3X: I don’t find myself solo’ing a lot.</td>
</tr>
<tr>
<td>Likert5_1: It’s just a game.</td>
<td>Likert5_1X: It’s not just a game.</td>
</tr>
<tr>
<td>Likert5_3: The game mechanics are too complicated for the average player.</td>
<td>Likert5_3X: The game mechanics are not too complicated for the average player.</td>
</tr>
<tr>
<td>Likert5_5: People who role-play extensively bother me.</td>
<td>Likert5_5X: People who role-play extensively don’t bother me.</td>
</tr>
</tbody>
</table>
Appendix F: IRB Approval Form

A determination has been made that the following research study is exempt from IRB review because it involves:

Category 2: research involving the use of educational tests, survey procedures, interview procedures or observation of public behavior

Project Title: An Exploratory Study of Augmented Reality and Mobile Games Examining Ingress Player Motivation and Potential Educational Value

Primary Investigator: Ryan Michael Straight

Co-Investigator(s):

Advisor: Teresa Franklin

Department: Educational Studies--Instructional Technology

Robin Stack, CIP, Human Subjects Research Coordinator
Office of Research Compliance

Aug. 13, 2014

Date

The approval remains in effect provided the study is conducted exactly as described in your application for review. Any additions or modifications to the project must be approved (as an amendment) prior to implementation.
**Appendix G: List of Countries by Frequency**

<table>
<thead>
<tr>
<th>List of Countries</th>
<th>Frequency</th>
<th>Percent</th>
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</thead>
<tbody>
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<td>Country</td>
<td>Count</td>
<td>Percentage</td>
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<td><strong>Total</strong></td>
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</table>
Appendix H: List of States by Frequency

Note that only those respondents who chose “United States” as their country are listed here. All others are marked as missing.

*In what state do you currently reside?*

<table>
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<tr>
<th>State</th>
<th>Frequency</th>
<th>Percent</th>
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<td><strong>Total</strong></td>
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Appendix I: Motivation Scale Item Means, Standard Deviations, Alpha Levels

All motivation item scale means and standard deviations on a scale of 1-8 from strongly disagree to strongly agree, the median being a score of 4.5. Included are alpha levels from the original, all-inclusive loading and alpha level if item deleted. Items deleted in final analysis are bolded. Note that some items listed below did not factor in final principle component analysis.

<table>
<thead>
<tr>
<th>Motivation Scale Item Means and Standard Deviations</th>
<th>Mean</th>
<th>SD</th>
<th>Component Alpha</th>
<th>Alpha if Deleted</th>
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<tbody>
<tr>
<td>I find myself having meaningful conversations with others.</td>
<td>5.93</td>
<td>1.540</td>
<td>.830</td>
<td>.823</td>
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<tr>
<td>I have made some good friends in the game.</td>
<td>5.73</td>
<td>1.870</td>
<td>.830</td>
<td>.789</td>
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<tr>
<td>I like to say funny things in chat.</td>
<td>5.30</td>
<td>2.102</td>
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<tr>
<td>Doing massive amounts of damage is very satisfying.</td>
<td>6.24</td>
<td>1.701</td>
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<td>.298$^c$</td>
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<td>I chat a lot with group members.</td>
<td>5.46</td>
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<tr>
<td>I can't stand those people who only care about seeing their name everywhere.</td>
<td>4.47</td>
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<tr>
<td>I try to optimize my AP gain or earn better badges as much as possible.</td>
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<tr>
<td>I would rather lead than follow.</td>
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<td>1.771</td>
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<td>$^b$</td>
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<tr>
<td><strong>I researched everything about the factions before starting the game.</strong></td>
<td><strong>3.05</strong></td>
<td><strong>2.086</strong></td>
<td><strong>.594</strong></td>
<td><strong>.590$^a$</strong></td>
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<td>I talk to my friends in the game about personal issues.</td>
<td>3.56</td>
<td>2.065</td>
<td>.830</td>
<td>.799</td>
</tr>
<tr>
<td>I would make maps if they weren't available.</td>
<td>4.76</td>
<td>2.115</td>
<td>.141</td>
<td>$^b$</td>
</tr>
<tr>
<td>I understand real-life group dynamics much more after playing the game.</td>
<td>4.35</td>
<td>1.921</td>
<td>.830</td>
<td>.815</td>
</tr>
<tr>
<td><strong>I like to be immersed in a fantasy world.</strong></td>
<td><strong>4.72</strong></td>
<td><strong>2.017</strong></td>
<td><strong>.716</strong></td>
<td><strong>.739</strong></td>
</tr>
<tr>
<td>I constantly try to set and reach goals.</td>
<td>5.43</td>
<td>1.749</td>
<td>.605</td>
<td>.485</td>
</tr>
<tr>
<td>I like the feeling of being part of a story.</td>
<td>4.59</td>
<td>2.058</td>
<td>.594</td>
<td>.529</td>
</tr>
<tr>
<td>I like to manipulate other people so they do what I want them to.</td>
<td>3.15</td>
<td>1.962</td>
<td>.699</td>
<td>.649</td>
</tr>
<tr>
<td>I like to taunt or annoy other players.</td>
<td>2.77</td>
<td>1.948</td>
<td>.699</td>
<td>.641</td>
</tr>
<tr>
<td><strong>I do not beg for items in the game.</strong></td>
<td><strong>7.08</strong></td>
<td><strong>1.351</strong></td>
<td><strong>.594</strong></td>
<td><strong>.599</strong></td>
</tr>
</tbody>
</table>
I am interested in targeting specific players. 4.46  2.158  .699  .720
I don't find myself solo'ing a lot. 3.08  1.717  .284  .206
It's very important for me to get the best gear available. 4.78  1.909  .605  .570
Playing the game lets me vent and relieve stress from the day. 5.06  1.926  .716  .672
I make up stories and a history for my agent/character. 1.79  1.420  .594  .486
I have learned things about myself from playing this game. 4.01  2.103  .830  .822
It's important for me to achieve things with as little help from other people as possible. 4.05  2.042  .305  .300
I play to forget about real life. 2.94  1.973  .716  .616
I am an effective group leader. 5.06  1.795  .732  .732
I like to feel powerful in the game. 4.65  1.854  .699  .652
I like to try out new roles and personalities with my agent/character. 2.42  1.706  .594  .477
I like to dominate other players. 3.08  1.990  .699  .606
I like wandering and exploring. 6.71  1.315  .264  .207
I try to prevent the other faction from gaining high-level items or maintaining a high-level farm. 5.42  1.993  .699  .678
I like the escapism aspect of the game. 4.38  2.023  .716  .573
I'm fascinated by the game mechanics, and love charts and tables. 5.13  2.015  .605  .588
It's just a game. 2.74  1.811  .284  .173
The way I am in the game is the way I am in real life. 5.91  1.722  .141  .141
The game mechanics are not too complicated for the average player. 6.09  1.515  .264  .157
Faction-balancing issues do not interest me. 4.34  2.057  .284  .251
People who role-play extensively don't bother me. 5.20  2.042  .264  .207
Friends in the game have offered me support when I had a real-life problem or crisis. 4.68  2.390  .830  .803

Note. Item descriptions listed include recoded versions. a Component alpha raised to .621 with subsequent removal of this item. b Loaded with two items. c Loaded to different component after subsequent reliability tests.

Appendix J: Rotated Component Matrix

Components 1-5 of motivation scale principle component analysis.
<table>
<thead>
<tr>
<th>Component</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have made some good friends in the game.</td>
<td>.830</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Friends in the game have offered me support when I had a real-life</td>
<td>.715</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>problem or crisis.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I talk to my friends in the game about personal issues.</td>
<td>.712</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I chat a lot with group members.</td>
<td>.699</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I like to say funny things in chat.</td>
<td>.575</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I find myself having meaningful conversations with others.</td>
<td>.564</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I understand real-life group dynamics much more after playing the game.</td>
<td>.523</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I find myself solo'ing a lot.</td>
<td>- .482</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have learned things about myself from playing this game.</td>
<td>.447</td>
<td>.402</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I like to dominate other players.</td>
<td></td>
<td>.737</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I like to taunt or annoy other players.</td>
<td></td>
<td>.689</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I like to manipulate other people so they do what I want them to.</td>
<td></td>
<td>.624</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I like to feel powerful in the game.</td>
<td></td>
<td>.579</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I try to prevent the other faction from gaining high-level items or</td>
<td></td>
<td>.529</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>maintaining a high-level farm.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I play to forget about real life.</td>
<td>.809</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I like the escapism aspect of the game.</td>
<td>.751</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Playing the game lets me vent and relieve stress from the day.</td>
<td>.646</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I make up stories and a history for my agent/character.</td>
<td></td>
<td>.750</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I like to try out new roles and personalities with my agent/character.</td>
<td></td>
<td>.710</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I like the feeling of being part of a story.</td>
<td></td>
<td>.503</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I researched everything about the factions before starting the game.</td>
<td></td>
<td>.445</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I beg for items in the game.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I try to optimize my AP gain or earn better badges as much as possible.</td>
<td>.788</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I constantly try to set and reach goals.</td>
<td>.647</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It's very important for me to get the best gear available.</td>
<td>.469</td>
<td>.480</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am an effective group leader.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would rather lead than follow.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The game mechanics are not too complicated for the average player.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doing massive amounts of damage is very satisfying.</td>
<td>.445</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>People who role-play extensively bother me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I like wandering and exploring.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would make maps if they weren't available.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The way I am in the game is the way I am in real life.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I'm fascinated by the game mechanics, and love charts and tables.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.409</td>
</tr>
<tr>
<td>Faction-balancing issues do not interest me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It's just a game.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can't stand those people who only care about seeing their name</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.325</td>
</tr>
<tr>
<td>everywhere.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It's important for me to achieve things with as little help from other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>people as possible.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Components 6-10 of motivation scale principle component analysis.

<table>
<thead>
<tr>
<th>Rotated Component Matrix</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have made some good friends in the game.</td>
<td>6</td>
</tr>
<tr>
<td>Friends in the game have offered me support when I had a</td>
<td>7</td>
</tr>
<tr>
<td>real-life problem or crisis.</td>
<td>8</td>
</tr>
<tr>
<td>I talk to my friends in the game about personal issues.</td>
<td>9</td>
</tr>
<tr>
<td>I chat a lot with group members.</td>
<td>10</td>
</tr>
<tr>
<td>I like to say funny things in chat.</td>
<td></td>
</tr>
<tr>
<td>I find myself having meaningful conversations with others.</td>
<td></td>
</tr>
<tr>
<td>I understand real-life group dynamics much more after</td>
<td></td>
</tr>
<tr>
<td>playing the game.</td>
<td></td>
</tr>
<tr>
<td>I find myself solo'ing a lot.</td>
<td></td>
</tr>
<tr>
<td>I have learned things about myself from playing this game.</td>
<td>.403</td>
</tr>
<tr>
<td>I like to dominate other players.</td>
<td></td>
</tr>
<tr>
<td>I like to taunt or annoy other players.</td>
<td></td>
</tr>
<tr>
<td>I like to manipulate other people so they do what I want</td>
<td></td>
</tr>
<tr>
<td>them to.</td>
<td></td>
</tr>
<tr>
<td>I like to feel powerful in the game.</td>
<td></td>
</tr>
<tr>
<td>I try to prevent the other faction from gaining high-level</td>
<td></td>
</tr>
<tr>
<td>items or maintaining a high-level farm.</td>
<td></td>
</tr>
<tr>
<td>I play to forget about real life.</td>
<td></td>
</tr>
<tr>
<td>I like the escapism aspect of the game.</td>
<td></td>
</tr>
<tr>
<td>Playing the game lets me vent and relieve stress from the</td>
<td></td>
</tr>
<tr>
<td>day.</td>
<td></td>
</tr>
<tr>
<td>I make up stories and a history for my agent/character.</td>
<td></td>
</tr>
<tr>
<td>I like to try out new roles and personalities with my agent/character.</td>
<td></td>
</tr>
<tr>
<td>I like the feeling of being part of a story.</td>
<td></td>
</tr>
<tr>
<td>I researched everything about the factions before starting the game.</td>
<td>.400</td>
</tr>
<tr>
<td>I beg for items in the game.</td>
<td></td>
</tr>
<tr>
<td>I try to optimize my AP gain or earn better badges as much as possible.</td>
<td></td>
</tr>
<tr>
<td>I constantly try to set and reach goals.</td>
<td></td>
</tr>
<tr>
<td>It's very important for me to get the best gear available.</td>
<td></td>
</tr>
<tr>
<td>I am an effective group leader.</td>
<td>.773</td>
</tr>
<tr>
<td>I would rather lead than follow.</td>
<td>.765</td>
</tr>
<tr>
<td>The game mechanics are not too complicated for the average player.</td>
<td>.586</td>
</tr>
<tr>
<td>Doing massive amounts of damage is very satisfying.</td>
<td>.483</td>
</tr>
<tr>
<td>People who role-play extensively bother me.</td>
<td>-.469</td>
</tr>
<tr>
<td>I like wandering and exploring.</td>
<td>.448</td>
</tr>
<tr>
<td>I would make maps if they weren't available.</td>
<td>.623</td>
</tr>
<tr>
<td>The way I am in the game is the way I am in real life.</td>
<td>.521</td>
</tr>
<tr>
<td>I'm fascinated by the game mechanics, and love charts and</td>
<td>.468</td>
</tr>
<tr>
<td>tables.</td>
<td></td>
</tr>
<tr>
<td>Faction-balancing issues do not interest me.</td>
<td></td>
</tr>
<tr>
<td>It's just a game.</td>
<td></td>
</tr>
<tr>
<td>I can't stand those people who only care about seeing their name everywhere.</td>
<td>.837</td>
</tr>
<tr>
<td>It's important for me to achieve things with as little help from other people as possible.</td>
<td>.322</td>
</tr>
</tbody>
</table>
### Appendix K: Comparison of Item Loadings Between Studies

This table provides a look at what items loaded to what component in each study, and their associated loadings.

*Comparison of question loadings between studies* \(^{a}\)

<table>
<thead>
<tr>
<th>Item</th>
<th>Yee (2006b) Study</th>
<th>Current Study</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Component</td>
<td>Loading (^{b})</td>
</tr>
<tr>
<td>I have made some good friends in the game.</td>
<td>Relationship</td>
<td>.58</td>
</tr>
<tr>
<td>Friends in the game have offered me support when I had a real-life problem or crisis.</td>
<td>Relationship</td>
<td>.74</td>
</tr>
<tr>
<td>I talk to my friends in the game about personal issues.</td>
<td>Relationship</td>
<td>.79</td>
</tr>
<tr>
<td>I chat a lot with group members.</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>I like to say funny things in chat.</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>I find myself having meaningful conversations with others.</td>
<td>Relationship</td>
<td>.57</td>
</tr>
<tr>
<td>I understand real-life group dynamics much more after playing the game.</td>
<td>Learn</td>
<td>.58</td>
</tr>
<tr>
<td>I have learned things about myself from playing this game.</td>
<td>Learn</td>
<td>.50</td>
</tr>
<tr>
<td>I like to dominate other players.</td>
<td>Manipulation</td>
<td>.65</td>
</tr>
<tr>
<td>I like to taunt or annoy other players.</td>
<td>Manipulation</td>
<td>.63</td>
</tr>
<tr>
<td>I beg for items in the game.</td>
<td>Manipulation</td>
<td>.46</td>
</tr>
<tr>
<td>I like to manipulate other people so they do what I want them to.</td>
<td>Manipulation</td>
<td>.59</td>
</tr>
<tr>
<td>I like to feel powerful in the game.</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>I try to prevent the other faction from obtaining high-level items or maintaining a high-level farm.</td>
<td>Manipulation</td>
<td>.61</td>
</tr>
<tr>
<td>I play to forget about real life.</td>
<td>Escapism</td>
<td>.65</td>
</tr>
<tr>
<td>I like the escapism aspect of the game.</td>
<td>Escapism</td>
<td>.59</td>
</tr>
<tr>
<td>Playing the game lets me vent and relieve stress from the day.</td>
<td>Escapism</td>
<td>.52</td>
</tr>
<tr>
<td>I make up stories and a history for my agent/character.</td>
<td>Immersion</td>
<td>.63</td>
</tr>
<tr>
<td>I like to try out new roles and personalities with my agent/character.</td>
<td>Immersion</td>
<td>.59</td>
</tr>
</tbody>
</table>
I like the feeling of being part of a story.  

Immersion  .46 Immersion  .503

I try to optimize my AP gain or earn better badges as much as possible.  

Achievement  .59 Achievement  .788

I constantly try to set and reach goals.  

Achievement  .647

It’s very important for me to get the best gear available.  

Achievement  .480

I am an effective group leader.  

Leadership  .773

I would rather lead than follow.  

Leadership  .765

The game mechanics are not too complicated for the average player.  

Entertainment  .586

Doing massive amounts of damage is very satisfying.  

Achievement  .46 Entertainment  .483

People who role-play extensively don’t bother me.  

Immersion  .53c Entertainment  .469

I like wandering and exploring.  

Entertainment  .448

I would make maps if they weren’t available.  

Mechanics  .623

I’m fascinated by the game mechanics, and love charts and tables.  

Mechanics  .468

Faction-balancing issues do not interest me.  

Pragmatics  .740

It’s just a game.  

Pragmatics  .404

I can’t stand those people who only care about seeing their name everywhere.  

Individuality  .837

It’s important for me to achieve things with as little help from other people as possible.  

Individuality  .341

I find myself soloing a lot.  

Solo/Group  .58c

It’s important to me to achieve goals with as little help from other people as possible.  

Solo/Group  .55c

I researched everything about the factions before starting the game.  

--

I am uninterested in targeting specific players.  

--

The way I am in the game is the way I am in real life.  

--

Note.

a Items are listed with present study’s variation.
b Loadings from Yee’s study (2006a) were reported at a two-decimal point level.
c Reverse coded in original instrument.
Appendix L: Learning Item Scale

The following table is a list of Learning Scale (Scale $M = 51.18$, $\alpha = .834$) items means, standard distributions, scale mean if deleted, and alpha levels if deleted. Mean of item means is 5.118. A neutral score on the scale is 4.5.

<table>
<thead>
<tr>
<th>Item Statistics</th>
<th>Mean</th>
<th>SD</th>
<th>Scale Mean if Deleted</th>
<th>Alpha if Deleted</th>
</tr>
</thead>
<tbody>
<tr>
<td>The ability to understand the interrelation between words, images, and symbols</td>
<td>4.35</td>
<td>1.799</td>
<td>46.84</td>
<td>.829</td>
</tr>
<tr>
<td>as a system is a core aspect to being successful in Ingress.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>By putting in lots of effort and practice, I create a sense of commitment in the</td>
<td>4.67</td>
<td>1.825</td>
<td>46.52</td>
<td>.806</td>
</tr>
<tr>
<td>compelling virtual world of Ingress.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I often feel as though accomplishing things with my resources can be challenging</td>
<td>5.46</td>
<td>1.712</td>
<td>45.73</td>
<td>.813</td>
</tr>
<tr>
<td>but is never impossible.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequently, what I have learned by playing has been due to experiment and</td>
<td>5.79</td>
<td>1.603</td>
<td>45.40</td>
<td>.825</td>
</tr>
<tr>
<td>discovery rather than being told what to do.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My ability to play has been bolstered by attempting to accomplish something,</td>
<td>5.39</td>
<td>1.732</td>
<td>45.80</td>
<td>.815</td>
</tr>
<tr>
<td>failing, then retrying with a different strategy.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ingress allows me to progress by relying on my own strengths and style, while</td>
<td>5.60</td>
<td>1.449</td>
<td>45.59</td>
<td>.814</td>
</tr>
<tr>
<td>allowing me to still try alternatives.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In Ingress, in terms of other players, experience is rewarded over knowledge.</td>
<td>4.98</td>
<td>1.550</td>
<td>46.20</td>
<td>.832</td>
</tr>
<tr>
<td>I feel the rewards I receive from playing increase, as I get better.</td>
<td>4.74</td>
<td>1.734</td>
<td>46.45</td>
<td>.819</td>
</tr>
<tr>
<td>By playing Ingress, I feel I am part of a group bonded primarily through shared</td>
<td>5.74</td>
<td>1.697</td>
<td>45.45</td>
<td>.823</td>
</tr>
<tr>
<td>endeavors, goals, and practices.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ingress is constructed in such a way that, as I play, I learn not only about it</td>
<td>4.49</td>
<td>1.877</td>
<td>46.70</td>
<td>.805</td>
</tr>
<tr>
<td>but about myself and my potential.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix M: Ingress the Game

It is understood that not everyone who reads this study will have played Ingress or even be familiar with it. Follows here is a narrative by the author of what the game is, what the player (‘agent’) experiences, and how it can potentially be played, as a description is in part provided in chapter three. A nearly comprehensive list of Ingress terminology is found in chapter one.

In essence, Ingress is a geo-locative, worldwide, team-based capture-the-flag game. That is, players must physically move to a location in order to play, a much different experience than most games that allow the player to sit on a couch or, at least, do not take into consideration the player’s location. Though there are two teams—factions—the game can be played alone or in groups. Some aspects of the game like building a level 8 portal are only attainable with multiple people. This is not to say these people must actually play together simultaneously, only that they are required. Eight different level eight players could each drop one level 8 resonator on a given portal at different times throughout the day, though this would mean that the last player to do so would reap the benefits of hacking the newly formed level 8 portal. For this reason, with the exception of building portals up to be more difficult for the enemy to take down, this doesn’t happen all that often.

A typical Ingress session begins with a look at the Intel map (http://www.Ingress.com/intel) to identify which, if any, portals within a reasonable range (given the agent’s ability and willingness to travel) should be hacked, attacked, deployed upon, or linked. The choice that is made is often dependent on whether the
agent is focusing on gathering AP at lower levels, performing specific actions in order to obtain particular achievements at higher levels (linking X number of times, destroying Y number of enemy resonators, etc.), farming to gain equipment, or neutralizing enemy portals. It often also depends on how much time the agent has: whether it’s playing while walking during a lunch break or attending an event specifically to play.

There is a science fiction background story to the world of *Ingress*, though the game is playable and enjoyable whether the agent pays attention or even cares. While the narrative influences special events or temporary changes in game mechanics (a portal burn-out time being halved for a weekend, for example), players do not have to appreciably change in accordance.

Often in any given area there is a faction that dominates either in part or in whole. This can be due to luck or that players in a specific location like a university campus or military base recruit others to build up the population. This can produce some lopsided faction balance. Some cities, for example, are well known for being ‘mostly green’ or ‘always blue.’ Not only are these locations almost always the same color, it can be problematic for new players from the opposing faction to enjoy the game as the difficulty is unrealistically high: it is nigh impossible for a level one player to take down a single shielded level eight portal, much less one that has links, is weaponized, and within range of other weaponized portals, and is being recharged by any number of enemy agents.

The key to enjoying *Ingress* is understanding that everything—the owner of a portal, who’s in control of an area, who is playing, what portals exist, even the mechanics
of the game itself—is in constant flux. Accepting this and being part of the community make for an interesting and entertaining time.
Appendix N: Pilot Study

The pilot study was performed between the dates of May 12, 2014 and May 26th, 2014, allowing two weeks for those contacted to complete the survey. Immediately upon receiving an IRB approval to perform the pilot study, the researcher began data collection. Data was collected via a survey built on the Qualtrics website, distributed primarily through posts shared to an online social network. The researcher directed posts to Arizonan Ingress communities on Google+. This option was chosen due to convenience, the researcher living in Arizona and having a familiarity with those groups. Posts contained a basic description of the survey and an anonymous link to the survey instrument located on the Qualtrics website (http://www.qualtrics.com). Users were asked not to share the survey link widely in order to prevent it from reaching the full population of Ingress players, thereby attempting to mitigate a lower response rate because players assumed they were repeating the survey when it is eventually published. Responses were collected beginning May 12, 2014, and the survey was closed to new responses on May 26th, 2014. Participants were informed that the survey they were responding to was a pilot and they may be notified of a new, full survey in the coming months via the same channels as the pilot.

The survey link was posted on Google+ to the researcher’s contacts and in a total of five Google+ communities: Tucson Enlightenment Operations (Tucson-based, Enlightened faction only, 109 members), Southern Territory Organized Resistance Movement (STORM) (Tucson-based, Resistance faction only, 117 members), Ingress – Tucson Agents (Tucson-based, cross-faction, 254 members), The United Enlightened
Front (Phoenix-based, Enlightened faction only, 394 members), and Valley Resistance Movement (Phoenix-based, Resistance faction only, 345 members). There is nearly complete overlap between communities (membership in a Tucson-based community does not preclude membership in a Phoenix-based community, for example), making the total number of those who had access to view the survey 739. A total of 121 respondents began the survey and 97 response sets were retained. Of those discarded, 23 were incomplete to varying degrees and one was a duplicate, resulting in a viable response rate of 13%, which falls within typical internet survey response rates for online surveys (Sánchez-Fernández, Muñoz-Leiva, & Montoro-Ríos, 2012; Sauermann & Roach, 2013; Shih & Fan, 2009).

To analyze the results of the pilot study, the researcher used IBM SPSS 21. Many of the same analyses performed in Yee’s (2006b) original survey were also performed to allow for comparison of not simply the survey instrument (if the same factor loadings were identified, for example) but also the players of Ingress against players of MMORPGs. These analyses included general demographic descriptive examinations of age ranges, distributions, gender identification, employment status, relationship status, family size and composition, and race. Also included were descriptive analyses of self-reported, game-related activities like time spent playing per week, how often people played alone, with others, and with whom (friend, co-worker, romantic partner, etc.), the results of which follow. To mitigate issues with arbitrary coding (i.e., 1 for male, 2 for female), t values are displayed as their absolute values. Missing data was removed case-wise as attrition was accounted for by either drop-outs or survey links that were begun by
clicking the link but no items were answered. There was one case, also removed, entered as a duplicate.

Of the 97 valid responses analyzed, the majority self-identified as male (71.1%, \(n = 69\)) and the average age of all respondents was 35.91 (\(n = 97, SD = 9.03\)), with a range from 17 to 62 and a median of 35. By comparison, the average age in Yee’s (2006b) survey across MMORPGs was 26.57, almost a full ten years younger than the average Ingress player, though unlike Yee’s survey, there is no significant difference in age between genders of Ingress players (\(t(.378), p = .706\)). At its inception, Ingress was an invitation-only game and invitations were relatively difficult to come by. Both males (44.9%, \(n = 31\)) and females (57.1%, \(n = 16\)) were most often invited by a friend to play. The second most popular method of coming to play was joining after it changed to open beta for males (21.7%, \(n = 15\)) and, for females, receiving an invitation from Google (as opposed to receiving an invitation from a friend) for the closed, invitation-only beta test (17.9%, \(n = 5\)). The average Ingress player is employed full-time (71.1%, \(n = 69\)), married (53.6%, \(n = 52\)), has children (52.6%, \(n = 51\)), and holds a bachelor’s degree (30.9%, \(n = 30\)). There is no significant difference in the amount of time spent per week playing Ingress in particular between males \((M = 12.79, SD = 9.41)\) and females \((M = 14.43, SD = 11.23)\), \(t(.731), p = .466\), nor is there a significant difference in the amount of time spent per week playing video games in general between males \((M = 21, SD = 14.69)\) and females \((M = 18.86, SD = 12.1)\), \(t(.614), p = .541\). The self-reported amount of time playing video games has been shown to be under-reported (Kahn, Ratan, & Williams, 2014), but the use of a web-based survey has been shown to mitigate this,
suggesting these reports are accurate. Overall, there does not appear to be a considerable
difference between male and female players of *Ingress* in terms of demographics.

Regarding how people actually play *Ingress*, the majority most often uses private
vehicles (personally owned cars, trucks, vans, etc.) (68%, n = 66), followed by walking
(24.7%, n = 24), and there is no significant difference between males and females
(t(.164), p = .870). How people play in terms of being alone or with others is significantly
different, with females being more likely to play with a family member (M = 2.50, SD =
1.14, t(3.437), p = 0.001) or romantic partner (M = 2.64, SD = 1.14, t(3.315), p = 0.001),
while males were more likely to play with co-workers (M = 1.93, SD = 1.02), t(3.301), p
= 0.002). Both genders were equally likely to play alone or with friends. A total of 13.4%
(n = 13) players have become romantically involved with someone they first met while
playing *Ingress*, with females (25%, n = 7) slightly outnumbering males (8.7%, n = 6).
The difference between males and females seems mostly to focus around deriving
meaning in their personal lives from playing, but there is another inherent binary
grouping among *Ingress* players: faction.
### T-tests of factors between genders of Ingress players in pilot study

<table>
<thead>
<tr>
<th>Factor</th>
<th>Male</th>
<th>Female</th>
<th>t</th>
<th>p</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Escapism</td>
<td>M = 4.52, SD = 1.22</td>
<td>M = 4.97, SD = 1.14</td>
<td>1.693</td>
<td>.094</td>
<td>.17</td>
</tr>
<tr>
<td>Social Interaction</td>
<td>M = 5.17, SD = 1.12</td>
<td>M = 5.64, SD = 1.06</td>
<td>1.929</td>
<td>.057</td>
<td>.19</td>
</tr>
<tr>
<td>Aggression</td>
<td>M = 3.53, SD = 1.10</td>
<td>M = 3.46, SD = 1.37</td>
<td>0.258</td>
<td>.797</td>
<td>-.03</td>
</tr>
<tr>
<td>Roleplay</td>
<td>M = 3.57, SD = 1.07</td>
<td>M = 3.73, SD = 1.12</td>
<td>0.634</td>
<td>.527</td>
<td>.07</td>
</tr>
<tr>
<td>Self-Actualization</td>
<td>M = 3.75, SD = 0.90</td>
<td>M = 4.35, SD = 1.23</td>
<td>2.660</td>
<td>.009</td>
<td>.26</td>
</tr>
<tr>
<td>Meaningful</td>
<td>M = 3.77, SD = 1.12</td>
<td>M = 4.76, SD = 1.25</td>
<td>3.797</td>
<td>.000</td>
<td>.36</td>
</tr>
<tr>
<td>Relationships</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leading</td>
<td>M = 4.49, SD = 0.98</td>
<td>M = 4.80, SD = 1.29</td>
<td>1.261</td>
<td>.211</td>
<td>.13</td>
</tr>
</tbody>
</table>

In terms of what method is used to play (bicycling, private vehicle, walking, etc.), there is no significant difference between factions ($N_{enlightened} = 47$, $N_{resistance} = 50$), nor is there any significant difference between factions in age, whether players have children, level of education attained, or relationship status, though females tend toward the Enlightened faction ($M = 1.38$, $SD = .491$) over the Resistance ($M = 1.20$, $SD = .404$), ($t(1.996)$, $p = 0.049$). There is also no significant difference between factions in terms of how much they play *Ingress*, play video games in general, or how often they participate in cross-faction events. However, the Enlightened ($M = 1.47$, $SD = .504$) are significantly more likely than the Resistance ($M = 1.68$, $SD = .471$) to travel large distances specifically to play *Ingress* ($t(2.135)$, $p = 0.035$). Motivational factors are somewhat split along faction lines, as well.

In the Escapism, Aggression, Roleplay, Self-Actualization, and Leadership factors, there is no significant difference between the factions. However, the Enlightened
score significantly higher in the Social Interaction ($M = 5.61, SD = .996, t(2.715), p = 0.008$) and Meaningful Relationships ($M = 4.39, SD = 1.30, t(2.679), p = 0.009$) factors.
Appendix O: Official and Unofficial Ingress Terminology

The Google Ingress support team has provided an official glossary, replicated here as it appeared on the site (https://support.google.com/Ingress/answer/2808255) in February 2015.

Official Ingress Terminology

Access Level: The Access Level defines your agent level and the level of objects that you are allowed to use. Your Access Level increased in the game as you earn Access Points (AP).

AP (Access Points): Points earned as you accomplish tasks such as claiming Portals, creating Links, and forming Fields.

COMM: The communication panel for communicating with other agents.

Cool Down Period: A mandatory waiting period after hacking a Portal before you can hack the same Portal again in an attempt to acquire items. This period gets progressively longer if you are performing repeated Hacks.

Control Field: Link three Portals to form a Control Field. Establishing a Control Field increases the Mind Unit score for your faction based upon the human population density encompassed by the field.

Decay: Resonators will naturally decay and lose their XM health over time if they are not recharged.

Deploy: The act of installing an object. Resonators are deployed on Portals to control the Portal.
**DEVICE Settings**: Settings view in the OPS panel where game options and settings are controlled.

**Enlightened**: Faction attempting to help the Shapers infiltrate Earth. Followers believe that the Shapers bring a powerful Enlightenment that will lead to an evolution of humankind.

**Faction**: There are two main factions, or global teams, battling for control: The Resistance and the Enlightened.

**Hacking**: A mechanism for acquiring items from a Portal. Not every hack will be successful.

**INTEL**: A view showing the current scores. Displays the Mind Unit scores for both the Resistance and the Enlightened.

**Intel Map**: A web site that allows agents to view the current global state of the conflict and communicate with other agents.

**Investigation Board**: A site where truth seekers post their discoveries about their findings. Found at http://www.nianticproject.com.

**ITEMS**: An inventory of the game objects held by an agent. The ITEMS view is accessible via the OPS panel.

**Jarvis Virus / ADA Refactor**: Very rare game objects that will flip a Resistance Portal to Enlightened control / Enlightened Portal to Resistance control.

**Mind Units**: A measure of the human population that lives under a Control fields. The global score of Mind Units is shown on the INTEL view and on the Intelligence Map.
MISSIONS: A list of Missions available in the OPS panel. This includes the training missions that agents receive when they are first contacted.

MOD: An object that can be installed to increase the power or capability of another object. For example, installing a Shield MOD on a Portal will increase the defensive power of the Portal.

NIA: National Intelligence Agency: A black budget intelligence agency which appears to be a mundane administrative unit that coordinates International Intelligence. It is, in fact, the Agency that has been assigned to investigate ‘low probability/high risk’ threats -- like transdimensional activity or paranormal threats.

NIANTIC Project: This is the secret experiment in France that starts our story. The original purpose is to study strange energy anomalies. It is run by DR. BOGDANOVITCH, and consists of 13 INVESTIGATORS. It goes horribly awry, in part, because a secret parallel project has been going on inside of it in which CALVIN is testing the effects of Shaper Infection (the NIA term for it) on the researchers.

OPS: The “Operations” panel that is integrated into the Scanner application. The OPS panel includes the INVENTORY, AGENT, MISSIONS, INTEL, RECRUIT, PASSCODE and DEVICE information tabs.

Portal: Portals manifest themselves usually as public art such as statues and monuments, unique architecture, outdoor murals, historic buildings, and unique local businesses. Portals are places where human creativity and ingenuity is expressed and Exotic Matter (XM) emanates. In your Scanner, Portals will appear as either green (Enlightened), blue
(Resistance) or gray (neutral). Interact with Portals by claiming them for your faction, linking them together to form Control Fields and Hacking to obtain items.

*Portal Key:* An object that allows for the creation of a Link to the Portal. It can also allow for remote recharging of the Resonators attached to the Portal. A Portal Key can be obtained by Hacking the Portal.

*Portal Level:* A summary level based on the various Resonator levels deployed on a specific Portal. Higher level ITEMS are usually received when higher level Portals are Hacked.

*Power Cube:* Power Cubes contain XM and are obtained through HACKING. Using a Power Cube will transfer all of its XM energy to your Scanner XM health bar. They are one-time use, and any energy that is left over after your XM health bar is full will be lost.

*Recharging:* Resonators must be periodically Recharged to maintain their power and control a Portal. If Resonators lose too much XM, then they will be at risk of easy destruction during enemy attacks. If all the Resonators on a Portal drop in XM health to the Critical level, then Links from the Resonators’ Portal will fail. Recharging a Resonator involves transferring XM from your Player reserve to the Resonator(s) on a Portal.

*Resistance:* Faction defending the Earth from the Shaper *Ingression*. They are seen by some as being fearful of change or progress, but the Resistance is firm in its belief that it is protecting humanity.
**Resonator:** A high energy particle accelerator that is used to control the XM energy emitted by Portals. Deploying a Resonator on a Portal allows you to claim the Portal for your Faction.

**Scanner:** The core technology for your phone, the Scanner can detect Portals and interact with Exotic Matter (XM) and XM constructs such as Resonators and XMPs.

**Shaper:** A code name assigned by ADA or the NIA for the transdimensional intelligence that may be infiltrating our dimension through XM Portals. At present, we have no visualization for Shapers. We only seem to see them when manifested in their human identities (i.e., we see the scientist, not the idea virus inside).

**Shield MOD:** A type of MOD that can be installed on a Portal to increase its defense against attacks.

**Target:** An action that will direct the agent to the targeted location or object.

**Upgrade:** The ability to replace objects with items with a more powerful tech level. For example, Resonators and Mods, such as Shields, can be upgraded to increase the defensive strength of a Portal.

**XM (Exotic Matter):** A rare and powerful form of tri-polar energy leaking into our universe from another dimension. This energy forms the basis for all Shaper technology. XM is needed to power your Scanner as well as to fire XMP and deploy Resonators. If XM falls below critical levels, your Scanner will be disabled. You can collect XM (represented by glowing orbs on the Scanner Map) by moving through those areas. The XM will be automatically harvested by your Scanner. You can also collect XM by recycling Items.
**XMP:** Non-polarized energy field weapon. Fires off in moving wave of 360 radius. As the weapon is upgraded, the energy wave’s power and radius of effect grow larger.

**Unofficial *Ingress* Terminology**

Following is terminology not officially listed on the support page but is either used frequently or is in the survey instrument. These may change with game or narrative updates, or with paradigm shifts in player culture.

*Agent:* In-game representation of players, a reference to the narrative backstory. Agent names are the equivalent of usernames.

*Burn-out:* To stop playing the game for a prolonged period of time. Not to be confused with the *burn out* applied to portals when the hacking limit has been reached.

*Cross-faction events:* Social events that are specifically organized with players of both factions in mind. Whether the locations of these events have portals nearby is a serious consideration. Locations with no portals are sometimes chosen to keep players focused on the social aspect of the event, while locations with portals are sometimes chosen in order when players agree to power up a portal with mods and spend the time hacking, though attacking is discouraged.

*Faction-balancing:* A form of social engineering to keep one faction from becoming considerably more powerful than the other, often within a given geographic area like a town or city. This may range from cross-faction agreements to create non-combatant zones for low-level players to play in without coming across heavily fortified level 8 portals, or events hosted to recruit new players to the weaker faction.
Farm: An area with a high density of portals that allows for efficient inventory bolstering and AP gain through linking and fielding.

Fielding: The act of creating control fields.

GPS spoofing: Ingress is predicated almost entirely on the use of a smartphone’s GPS. Some players have been known to install third-party software on their phones that allows them to manipulate their reported GPS location. This lets them appear to be anywhere in the world they would like without having to physically go there. It is considered a form of cheating.

Linking: The act of linking portals together.

Marathoning: Having played for an extended period of time, typically an entire day or weekend.

Mules/mule accounts: A form of cheating by which players create a secondary account that is used for the express purpose of holding inventory, as a single account can hold no more than 2,000 items at a time.

Solo’ing: Players may choose to frequently act alone. While these players may be able to do substantial damage by themselves, their ability to create portals is limited due to the maximum number of resonators allowed by a single player on any portal: one level 8 resonator, one level 7 resonator, two level 6 resonators, two level 5 resonators, and two level 4 resonators, the average of which producing a level 5 portal (total resonator level (45) divided by number of resonators (8) produces the portal level (5.625); portal levels round down).
Win-trading: Another form of cheating, involving players of both factions repeatedly destroying and re-capturing a portal with the sole intent of gaining AP.