

A FRAMEWORK FOR THE DESIGN AND ANALYSIS OF SOCIALLY
PERVASIVE GAMES

by

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A dissertation submitted to the faculty of
The University of North Carolina at Charlotte
in partial fulfillment of the requirements
for the degree of Doctor of Philosophy in
Information Technology

Charlotte

2012

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ABSTRACT

EVE POWELL. A framework for the design and analysis of socially pervasive games. (Under the direction of DR. TIFFANY BARNES)

Pervasive games have the potential to create large social impacts on players and non-players alike. However, this can only happen when the game becomes integrated and accepted within a social community - or in other words, is socially adopted in its target environment. A socially pervasive game must also adapt to allow people to play at their own convenience. In my research I describe Powell's Pervasive Play Lens (3PL), a framework for the design and analysis of socially pervasive games. 3PL is a powerful model that elaborates the magic circle to illustrate the concentric boundaries of play that surround socially pervasive games, helping designers understand when and how a person and a community might adopt a new pervasive game. This 3PL framework and theory have been applied to develop and refine Snag'em, a human scavenger hunt that has been applied to help students learn professional networking skills in several conferences over three years. I present my findings in a design research narrative that details the complex and rich social environments for Snag'em and the evolution of its design over several iterations. This narrative illustrates the application of 3PL and how designers can predict and measure how particular game elements create affordances that increase the acceptance, adoption, and adaptability of socially pervasive games.

ACKNOWLEDGEMENTS

Thank you Tiffany Barnes for... well... everything. While writing this book has been far from easy; it was because of you that it was possible. I truly believe that in some ways, you were more than my advisor, you were my Champion. I hope that some day, I can be for someone else what you were to me. Thanks. Thank you to my other committee members for helping me to finish this dissertation in a timely manner. I also thank the National Science Foundation for three years of funding, without which I probably would have stopped at Master's level. I also thank the members of the Games and Learning Lab for their ongoing support and motivation as I pursue a career in industry. Seeing everyone else getting cool jobs after I accepted my job offer was great motivation to wrap up my dissertation. I also really appreciate the several proof readings by several members of the lab. Many thanks also to the Snag'em Team in its many permutations. Snag'em really did become a community effort with design, development, and testing coming from many people within the Game Lab and outside of it (Winthrop University, NC State, Spelman College, Wilberforce, STARS, FDG, etc). Thank you all for the tremendous support.

Images used in my dissertation that are not cited were free to use and found under creative commons on the Internet. Thank you Internet and people on the Internet.

DEDICATION

This dissertation is dedicated to my mother. She may not think I appreciate her because I stay busy and often forget to call. But I do appreciate her... I really do.

Love you mom.

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CHAPTER 1: INTRODUCTION

“...we recognize unmistakably the imperishable need of man to live in beauty. There is no satisfying this need save in play.” -Johan Huizinga, *Homo Ludens*

The purpose of this dissertation is to explore the social implications of pervasive games, and how to support designers in anticipating and integrating social effects into pervasive game*¹ play. Without explicit consideration of models of social play in non-play contexts, socially pervasive games can suffer from low adoption*² among a potential player population and a lack of acceptance³ among non-players. In this dissertation, I present a model of social play boundaries that integrates findings from pervasive games research with the *magic circle theory* described by Huizinga [45] and Montola [63]. I illustrate the use of this model in the design, construction, and evaluation of two socially pervasive games, Snag'em and Table Tilt. In an integrated and iterative design process, I have explored and refined both the social play boundaries model and the design and evaluation of Snag'em and Table Tilt over several years in three classroom and six academic conference/event settings. In the next section, I ground the social play boundaries theoretical framework in the literature, based primarily on Huizinga's play theory and Montola's/ Magerkurth's pervasive games research.

¹Words marked with an asterisk are defined in the glossary of this text.

²a measure of play activity, including both first time and repeat activity

³a measure of tolerance of the play system

1.1 The Role of Play in Society

In 1955, John Huizinga wrote *Homo ludens*, an essay reflecting on the importance of rule-based game play in human nature. In order to establish the particular types of play he wished to discuss, Huizinga constructed a series of definitions related to play that are still recognized today. Huizinga defines play* as a free activity that stands outside of ordinary life into which one must not be forced to participate. Among other things, a play activity is restricted within boundaries of time and space, typically put into place by fixed rules. Socially, play is typically also separate from the ordinary, with members of a play space “surrounding themselves with secrecy to stress difference from the common world” [45]. This definition, used to define play for the remainder of my dissertation, encompasses the many different forms of play that shape play theory, from the imaginative and creative Lila (see Figure 1), a.k.a. paedic play*, to the structured ludic play* found in games. Here I discuss the vital role of play in human social and cultural development.

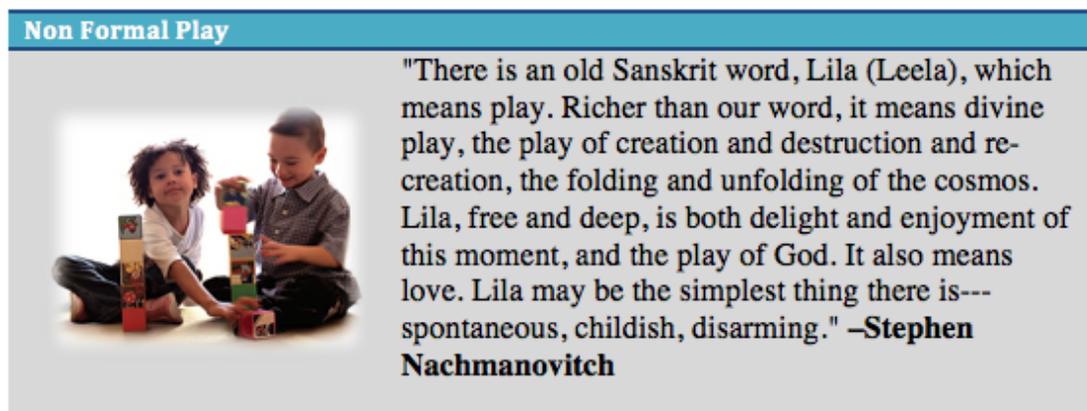


Figure 1: A quote from Nachmanovitch’s book, *Free Play* [69]. Lila, or paedic play, is just one of many ways that imaginative, explorative, and creative play is represented.

Several prominent researchers in psychology, including Carl Jung and Jean Piaget, have recognized play in its many forms, as having immeasurable impact on not only childhood development but also on human thought and behavior [49] [69] [40]. When discussing Lila, or paedic play, one can easily see its value in discovery, experimentation, and creation. Ludic play, however, endemic to humans, is special in its ability to equalize and neutralize unfairness [45]. Ludic play restricts the need for complete physical and intellectual perfection through the introduction of structure and rules in a closed environment. In either form, a play state can be argued to represent an *ideal* or even divine [69] human mindset.

It is a very human trait to strive to achieve a level of perfection within our environment [11][81]. One of the primary ways we try to reach for a level of divine existence is through play. While it may not be immediately obvious, play and the way it has evolved in humans is arguably the best demonstration of higher intellect in humanity as opposed to other animals [84] For example, both law and religion have play elements at their cores. Law is handled in a court room and is justice carried out in contest between two or more champions and an arbiter. Religion stresses the importance of magic circles, symbols, and attainment of something prize-like. Many cultural and social practices of humans (law, war, courting, fashion) can be reduced to the fundamentals of play [45]. It is because of our incorporation of play in everything we do, and our use of play in even the most earnest of tasks, that we find it within ourselves to imagine, surpass, achieve, grow, and excel [49] [87] [93]. The interesting element in all of this is that play is typically designed to be strongly bounded and separate from ordinary, but inevitably play *pervades* into our work, religion, and cul-

tural practices. Like many other researchers of pervasive games in computer science, I find this peculiarity about play to be of great interest.

1.2 The Magic Circle of Play

The phenomenon of play pervading into the ordinary existed long before the creation of the new field of pervasive games. Play has a way of affecting social and cultural practices. However, when considering how to *design* play so that it pervades into the ordinary, designers are often confounded by the boundaries they are trying to remove between play and the ordinary, that Huizinga refers to as the “magic circle of play”. Salen and Zimmerman define the magic circle as “what separates the ordinary from the ludic and what is real from what is playful.” [82]. Since the designer’s task is to create this magic circle, this definition implies that any cultural or social effects gained through play are simply artifacts or results of a design, not direct elements that can be designed into a game. I argue instead that pervasive game designers must consider these cultural and social effects, and design explicitly for them.

The challenge with pervasive games is that, outwardly, game designers appear to be removing the magic circle. By staging these games in reality, designers seek to make pervasive games playable anywhere and at any time. To the designer, this may be her overall goal: to make the game blend into or, even more radically, become indistinguishable from reality. This complete removal of the magic circle violates the very definition of play, so designers seeking to remove the magic circle’s bounds may find their games unappealing. But, if the designers’ purpose is not to remove the boundaries in pervasive games, then what are they trying to do?

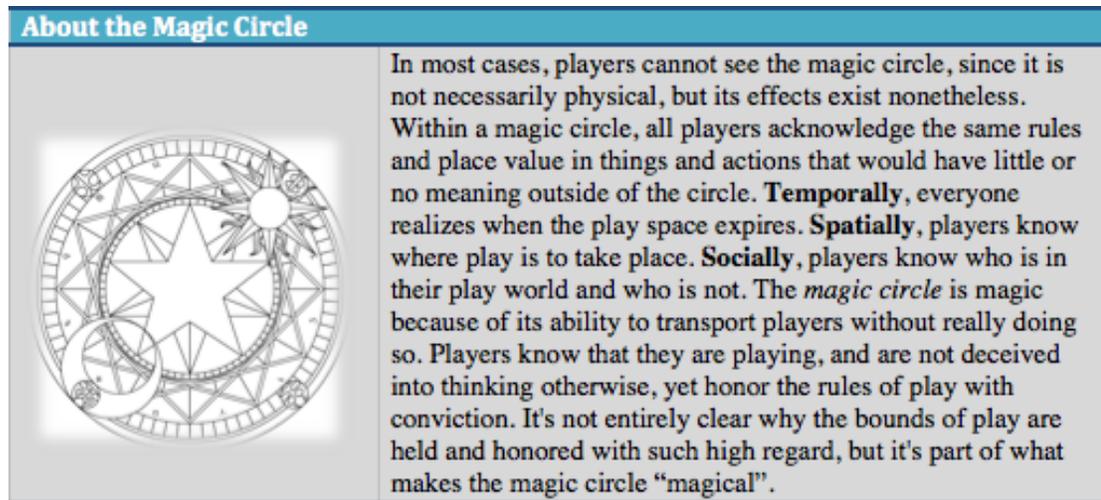


Figure 2: Description of the Magic Circle of Play based on Huizinga and Salen writings. In this figure, I paraphrase the description of the magic circle of play. Circle image from deviantart.com

Montola helps us gain insight into what pervasive game designers are doing. He defines pervasive games as those that *expand* the magic circle of play* either spatially, temporally, or socially [65] [64]. Even in pervasive games with these expanded boundaries, he argues, this circle is always assumed to exist, since it is integrally linked to play. It is only when the magic circle exists that play can exist, and where the symbolism of game play holds strong. In this dissertation, I focus on the concept of the magic circle and how a designer can think about its boundaries to design pervasive (play) experiences.

Feldspar Epstein, a research blogger, criticizes the magic circle of play, saying it is 'leaky' and unhelpful, since no one knows where the magic circle begins and where the magic circle ends. He also indicates that in certain contexts (e.g. ludic play) the circle is hard and rigid, where in others (e.g. child's play) the circle is porous and weak [31]. Epstein touches on an important point: that the magic circle of play is

shaped very differently in different contexts, and more understanding of this circle is necessary if it is to be used in any meaningful dialog. In this dissertation, I have begun to break down the components of this magic circle for pervasive games to create “Powell’s Pervasive Play Lens”, or 3PL. Through the analysis of the magic circle, I provide a deeper understanding of the magic circle, and begin a model for the construction of pervasive games that have high social value.

For academic purposes, pervasive games have spanned diverse and traditionally non-overlapping research fields, because of their usefulness in many non-play objectives. As seen in games using Mote sensors, pervasive games serve as test beds for novel context-aware solutions [66] [67]. In interactive systems research, pervasive games form social solutions that encourage collaboration and communication [16] [91]. Pervasive games additionally influence and encourage positive societal behaviors. They can impact social change and promote negabehavior, the removal of undesirable behavior from a community [80]. My own research suggests that pervasive games can act as tools for establishing a sense of community in academic settings [78] [36]. The impact of these games, however, is dependent on their ability to be adopted into social communities. This effect would be similar to the *network effect* found in most online social networks. As illustrated in Figure 3, when the network effect is present, as it is on Facebook or Google+, the value of the service is dependent on the number of others using it. It is when a game moves from closed laboratory play to social play, that understanding the boundaries of the magic circle becomes critical to the game’s success.

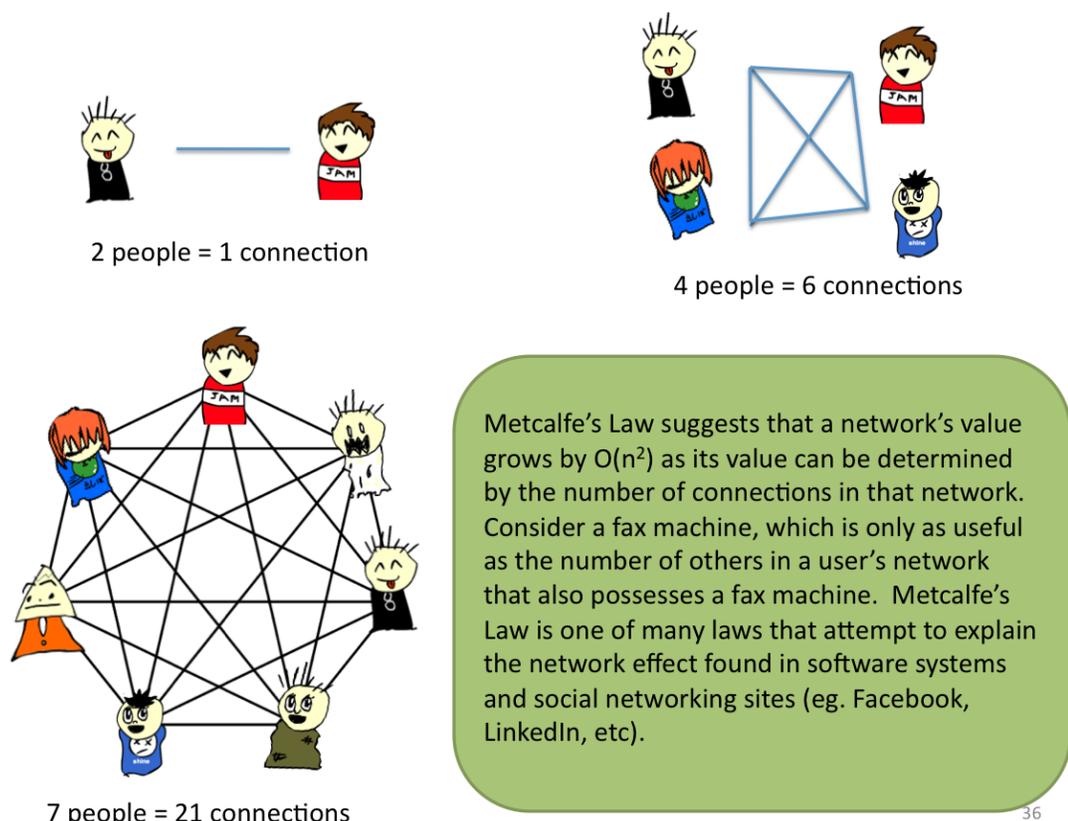


Figure 3: The network effect is derived from Metcalfe's law, suggesting that the value of services like Facebook is dependent on the number of connected members [98] [3].

1.3 Defining (or refining) the Problem Space

I began the construction of this model by separating pervasive games research in a perceived dichotomy of technology-dominant research and game design research. As a computer scientist interested in socially pervasive games, both areas were of interest but during my literature review, rarely did these two research interests overlap. There are research areas in which adoption, acceptance, and overall integration are not yet primary goals. I refer to this subset of games research as Tech Major games, where the designer is primarily focused on the technical design of a pervasive experience. As more is learned about what systems can technically do, however, meaningful play

experiences and high system value become important goals for the pervasive game designer. Games research focused on game and play experiences and implications of game interactions are referred to in this dissertation as tech minor games.

1.3.1 Tech Major

Tech Major (TM) games rely on the implementation of hardware, sensors, or context-aware systems to create immersive game experiences. Montola describes a variety of games as either *technology sustained* or *technology supported* [64]. While this is a useful distinction within the area of Information Technology, how technology is used in games has little to do with a game’s meaning or intent. Naturally, even game designers outside of Information Technology research will use technology as a way of interfacing with their game. I define a Tech Major (TM) game as a game where the designer places value on technical novelty and acceptance by one to few players in a controlled lab environment. Invisibility of the tool, an important factor of ubiquitous computer systems as defined by Weiser, is quite literal. Context awareness, size, and use of multiple or distributed hardware/sensors are often the focal points of such research. For the designers of Tech Major games, not only are their research questions and motivations different, but successful examples of this type of research tend to follow a ‘hard’ research methodology.

TM games research typically ask the question: “Can we do X?”

1.3.2 tech minor

In contrast to Tech Major games, tech minor (tm) games focus on the social construct of a game rather than its technical construct. In a tech minor game, emphasis

is placed on researching long-term player interactions, over-arching theory of context ambiguity, heterogeneous interfaces, social implications, and current social readiness of technology. Technologies used in these studies/ projects are typically less cutting edge since interest is primarily in the adoption of a system where the hardware has already become accepted and pervades into player lives. Montola and other researchers often write about pervasive games where little to no technology is used. Invisibility of technology, in this case, is not as literally interpreted and instead refers to a tool's ability to be less visible than the task. Researchers and designers of tech minor games typically take on approaches that resemble ethnography and anthropological studies.

In tech minor research the question becomes: "Should we do X?"

Even within the field of Information Technology, it is important to explore pervasive games from a research perspective that integrates both the impact of technical game designs with reality-based social contexts. As Heidegger suggests [43], a new tool, like a hammer, starts out as "present-to-hand", a thing that we must theorize about and has no implicit value until we consider the "thing-ness" of it. It's only when a person uses the new tool, experiments with it, sees another use, that it becomes "ready-to-hand", a system, rather than the sum of its parts. It is, therefore, important that Tech Major research continue to explore the usefulness or thing-ness of technologically complex systems. Tech minor research, however, is critical to Weiser's vision of the ubiquitous computing experience [107]. In one of Weiser's first papers on the subject, he mentions the idea that writing or "literary technology" has become pervasive in our society, present on stop signs, billboards, and even graffiti [107]. I argue that this switch is not only due to the tool but the sudden focus on the application of

the tool. For example, the experiences we have with computers are now a “constant background presence.” Tech minor research on pervasive games asks the question: “Should this tool/game pervade?” while investigating the impact of system elements on society and people. This type of research on the social impact of elements such as system heterogeneity, seamless designs, and asynchronous play, however, can only be fully explored when technological novelty is restricted. This dissertation has a tech minor research focus on understanding the impacts of game elements on acceptance, adoption, and adaptability of pervasive games. A pervasive game should be considered socially integrated when the system (1) has a low barrier of acceptance* among both players and non-players, (2) has high adoption* , where the game gains enough of a foothold in the community so that people can play as intended by the designer, and (3) has high adaptability, where the game supports varying levels of engagement for an expanded magic circle of play.

1.4 Problem Statement

The boundaries of play are particularly confounding constructs for designers of tech minor pervasive games. The magic circle of play, a concept of much discussion in the domain of play theory really only describes the simple boundaries of a traditional, ludic game system. Through my dissertation, I explore the taxonomy of current pervasive games research in order to fully understand how social integration can be addressed in pervasive games research projects. As a result of my review of pervasive games, game theory, and research, I have developed a novel approach for representing boundaries in a pervasive game: Powell’s Pervasive Play Lens or 3PL.

Through research on my Table Tilt and Snag'em games, I seek to better understand 1) what kinds of research methods would be appropriate for detection of meaningful play and social integration and 2) to what degree adaptability, adoption, and acceptance influence a game's impact. In addition, Table Tilt and Snag'em were made with the intent of transforming game play into an acceptable social networking strategy. The methodologies used in this research center on measuring the value of the system as a social tool and identifying when transformative play⁴ occurs. This research seeks to further knowledge in the field of social computing by providing a framework for understanding when and how a person and a community might adopt a new pervasive game. My research addresses several questions within this problem space, as listed in the Research Questions section below.

1.5 Research Questions

- Pervasive games are so new that design intuition is hard to develop. Can I develop a framework that assists designers in predicting how players might play potential socially pervasive games?
- Can I model the requirements and guidelines of socially pervasive games such that designs result in higher adaptability and adoption among players and acceptance among non-players?
- To what extent can game designers orchestrate play and cause transformative play in their players?

⁴Salen [82] defines transformative play as play that overflows and overwhelms the more rigid structure in which it is taking place. It happens when experimental play occurs within a game structure or when players think differently as a result of game exposure.

CHAPTER 2: RELATED WORK

In the area of software engineering, research in pervasive games seeks to create new and exciting interaction techniques, streamline the production of games utilizing those techniques, and demonstrate usability of novel hardware in the context of gaming. Examples include FRAP, Feeding Yoshi, Bill, and Can You See Me Now? *FRAP* is a framework for pervasive games and a software architecture for building games that include a “capture the’ flag” metaphor [102]. *Feeding Yoshi* is a context-aware* game where players plant and collect fruit in physical locations and feed them to their “Yoshis” to earn points [5]. *Bill* is a pervasive game played on PDAs where players collect money and try not to have it stolen [15], particularly notable because it leverages the “seams*” of wireless Internet access (where the technology shows, and doesn’t necessarily always work) as part of the game. *Can You See Me Now?* engages online players in a mixed-reality game that includes performers who run the streets [24]. Problem areas persist across these examples (discussed in Section 2.3), where technical novelty usually results in buggy and incomplete designs, and users are drawn into the task of trouble-shooting. These technology and novelty-centric issues prevent researchers from gathering design guidelines for pervasive games, since users in these cases often disregard gameplay and instead provide feedback on each game’s technical novelty.

In contrast, there are other areas of pervasive games research where the use of technology is barely explored at all. In Montola’s research, several non-technical pervasive games were constructed to observe pervasive game play in a community. It is within this research context that we can examine the social implications of pervasive games. In the game *Beast*: an immersive game made for the movie *AI* by Microsoft and other collaborators, researchers explored the psychological implications of immersive gameplay*, observing “hive minds”, e-tribalism, and overall characteristics of collaborative multiplayer gaming [61] [64]. In pervasive Live-Action Role-Playing game (LARP) research, we can explore how role-playing games can be extended to fit into real life. Pervasive LARPS are useful indicators of what aspects of narrative need to be blended into ordinary life and uncover novel ways of game mastering by using technology [48]. In my own game, *Snag’em*, we start to see how the implicit sociality of games does not always result in a positive social outcome, and that certain design considerations should be made when making a game to bring about social change [78].

While reading about different types of pervasive games, it has been easier to understand the relationships between them by recording the designer’s intent. Using my Tech Major/ tech minor dichotomy, I have classified pervasive games research into two major problem spaces: social play theory and system usability. Understanding both of these spaces was vital to the design and analysis of *Snag’em* (Chapter 3). In the next section, I will discuss my Tech Major / tech minor literature review within pervasive games research and how it has shaped the design and analysis of my own social games.

2.1 The Tech Major(TM)/ tech minor(tm) Dichotomy

The TM/tm dichotomy has evolved from my extensive literature review of pervasive games and early feedback on my own game called Snag'em (discussed in detail in Chapter 3). In the beginning, some researchers questioned whether Snag'em was a pervasive game, since the game was not context-aware* and did not rely on embedded sensors, ambient hardware, or leverage pervasive computing technologies. Instead, my Snag'em research focuses on social pervasiveness, which falls into tech minor research. In reconciling the goal of being socially pervasive with other goals of pervasive games research, a continuum emerged. To illustrate the need for unifying definitions of pervasive games, I present two definitions here.

2.1.1 Definition One: The Pervasive Computer Game

According to Milano, pervasive games are a new and exciting field where the user experience benefits from the blending of real and virtual elements [66]. This genre of pervasive games spans from augmented tabletop games to Location Aware Gaming [35]. Sensors capture information about a player's current context, like location, and context is used to deliver a gaming experience that changes according to where players are, what they are doing, and even how they are feeling [6]. Myers defines pervasive computer games as those that use new technologies available on mobile computers like GPS-positioning or "always on" connectivity to enrich the game play of traditional computer games [68]. Waern asserts that a prominent goal for the pervasive computer game is delivering a *calm computing* experience, where human computer interaction is as immediate and intuitive as physical interactions [105]. The following quote from

a 2007 iPerg paper sums up these definitions of a pervasive computer game nicely:

An important distinction between pervasive games and pervasive computing applications is that pervasive games stress that the local context (e.g. other players, bystanders, game artifacts, and measurable environmental states) affects the gameplay through game rules. This is to distinguish, on a functional level, between games designed to be affected by their contexts and those simply designed to be more context-dependent than traditional games [76].

Pervasive games can also be represented as mixed-reality games, where the game makes use of virtual environments and real environments, and the real environment serves as a resource in the game [24]. Jane McGonigal explains pervasive games as “the dream of the virtual to be real [61].” This can be done in a weak sense, e.g. using GPS, sensors, and gestures, or by using more potent and staged mobile technical solutions to create the 360-degree illusion: a virtual environment that is perceived as authentic [105]. These types of games typically strive to achieve technological invisibility and immersion through acting.

2.1.2 Definition Two: Games That Extend The Magic Circle

Montola defines pervasive games as ones “that have one or more salient features that expand the contractual magic circle of play socially, spatially or temporally [105][64].” The salient features that make a game pervasive *may or may not* be computer based; advanced technology is not a requirement. Pervasive games, as they are defined here, have existed long before computers became mainstream. A common example of a

pervasive game that has existed since the 60's is *Killer*, illustrated in Figure 4, a very popular game played by first-year students on college and university campuses. A peculiarity of Montola's book, *Theory and Design of Pervasive Games*, was that it started out with making no references to technological pervasiveness of these game systems, even though Montola has written many computer science papers on the subject of pervasive games[48] [63]. Wearn later states in the book that "a game does not need to use pervasive technology to be pervasive." In Montola's review of pervasive games, he classifies games that focus on the technological aspect of the system as *technology-sustained* games and those that make clever use of technology as *technology-supported*. Montola's writings were among the first writings I found that discussed pervasive game design from a true game design standpoint, rather than as an outlet for novel *technologically occult* [64] game solutions.

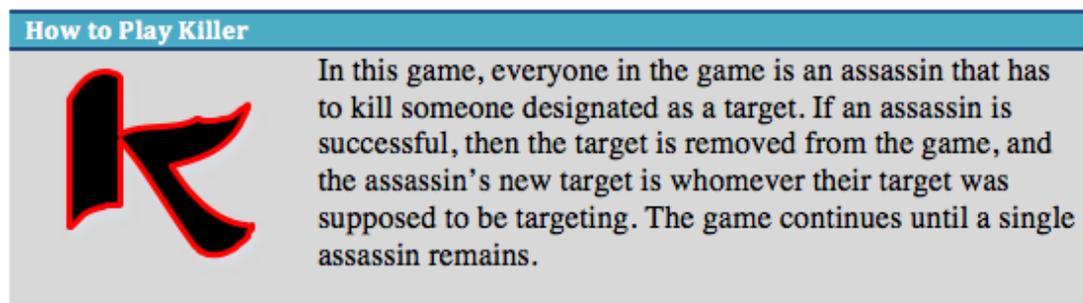


Figure 4: My paraphrasing of the play rules of *Killer*, a pervasive game commonly played at universities among undergraduates.

2.2 The Schism

These diverging schools of thought in pervasive games are not uncommon in electronic game history. Popular game designer Hideo Kojima, of the *Metal Gear Solid* series, once made a comparison between the perceived game design techniques of the

East versus those of the West. In a 2009 Game Developers Conference talk, he elaborated on the subject with various cultural and situational differences between eastern and western game designs:

...In Japan, players are often placed in a room with one door at the beginning of a game, which opens up into a room with two doors, and so on. The game has to open up gradually, piece by piece. But in the West, gamers can be placed in a jungle early on, and they often value that freedom, enjoying the exploration offered to them...[51]

The most interesting of perceived differences, however, was how the East and West tackle technological limitations of gaming platforms. When striving to create the Hideo's Ultimate Stealth Game Experience ⁵, Hideo noted that eastern designers attempt to overcome hardware limitations with game design, usually seeking to create a game experience that surpasses the capabilities of the hardware targeted, as opposed to the West, where game mechanics are used to showcase the capabilities of the platform being used. In short, he claims that the East uses game design to overcome the system (implying game design flexibility) whereas the West uses game design to showcase the strength of the system (implying platform flexibility). While this is, of course, an over-generalization of East and West game industries, he does bring up a valid point. There are many opinions on how closely the game designer should be connected to the lead programmer and platform developer. For those with different game design mindsets, different issues arise. Game realization is often pre-mature for

⁵game designers often refer to an experience being ultimate when it is deeply immersive, realistic, and engaging

“eastern” designs, who may release a game that would be better suited for a more capable system. Alternately, “western” designs can be somewhat like tech-demos; more focused on showing off new techniques in game development, and less based on game design theories of what makes a game fun and engaging. What first appeared to be a schism within the field of pervasive game systems in computer science, turned out to be unequal representation between those with different mindsets. Both claimed to be making game designs and coming up with design techniques, but Montola’s definition, at the time, was greatly under-represented when compared to pervasive computer game definition (definition 1). The problem with this fact is that over the years, several *nifty*⁶ ideas have come from the pervasive games genre, but few of them are sticking long enough to become socially pervasive solutions. This is not due to lack of interest; analysts suggest that Pervasive Gaming will gain a big market share in the game industry [35]. If one were to measure the success of a pervasive game by its social adoption, social acceptance, or commercial availability, then most of today’s games fall short. In the following section, I will review the most notable pervasive games that explore those different game design mindsets, and reflect on lessons learned from both Eastern and Western designs.

2.3 Technology Driven Games

In this section I will discuss the “Tech Major” designs, where technology is stressed and game design is used to showcase technological advancement and middleware

⁶Several educational research papers refer to nifty ideas as solutions that have an excessively small context in which it is useful[75]. Almstrum et al. further elaborate that nifty ideas “are no more than fashion” and that “not everything that is ‘intuitive’ or ‘sexy’ is appropriate within teaching environments[2].

development. Though many of these games use socially adopted technologies, I've noted a commonality among designers to throw technology into their system that isn't mainstream. The research done with these systems pushes the boundaries of computing and typically answers the question "Can we do something fun or engaging with this technology?"

2.3.1 MUPE, FRAP and other Pervasive Games Middleware

MUPE, TinyLIME, and FRAP are pervasive game middleware* solutions. In this section, I explain the current state of pervasive games research in the field of software engineering and middleware development.

2.3.1.1 MUPE

Multi-User Publishing Environment (MUPE) is an open-source middleware project of the Nokia Research Center developed in 2003. The developers of MUPE recognized the difficulties of developing context-aware software systems for mobile devices. Once a developer learns how to properly access raw contextual information from a device, designing for versatility of contextual information becomes another problem. To combat these issues, Suomela and Koskinen added context-awareness to the MUPE system, thereby opening up the Nokia platform to more pervasive game solutions while allowing for system heterogeneity*[92]. They did this by adding context-aware handlers into the software that would interpret any type of context, regardless of whether the hardware originally had access to that context.

To test for system usefulness, the MUPE researchers held a 24 hour mobile development camp [92]. Eighteen Computer Science (CS) graduate students were broken

into teams. Each team was encouraged to develop, within 24 hours, a context-aware game using MUPE. The resultant games were deployed on PDA devices and played at the event. This development camp helped researchers find system design flaws and bugs. The camp also demonstrated that MUPE made it possible for students to design and implement context-aware game ideas within 24 hours; something that would have been infeasible otherwise.

Several years later, MUPE developers [53] tried to measure player enjoyment. They made a mobile game: Sandman, and tested it in both a college game development class and an after-school children's program. The mechanic was very simple: players had to dispense virtual sand among their peers in an attempt to put everyone else to sleep. Playtesting revealed that the game was not appealing to adults. This could have been due to the environment in which the game was played, but the authors also surmise that adults tend to like sports better than "play". For the children, the rules and game mechanic did not matter and they found the system overall enjoyable as an interface to play a sort of "tag" game.

Neither of these system evaluations were formal [92][53] and it's difficult to know which of the games that were made were good games. Varying testing environments, social demographics, and devices for the system led to very different experiences for playtesters, making it hard to discern system design flaws from game design flaws. Technically, however, MUPE touched on several new system development ideas; including how to design a middleware for varying contextual input and the platform was widely used and cited by game researchers. The project was archived in 2009 [72].

2.3.1.2 TinyLIME

In Wireless Sensor Networks research, developers used TinyLIME middleware to create a Save the Princess game. TinyLIME is a pervasive system middleware that makes use of wireless sensor devices (a.k.a motes), atypically used in a game context. For system communication, packets including tuple information are passed from player netbooks to motes. Players pick up and drop things at wireless mote locations, making location-awareness a salient feature in the system design. An advantage to using motes is that motes are so tiny that they are easily hidden in the environment, making parts of the system literally invisible. The implementation of a Save the Princess game was a novel application of their pre-existing TinyLIME technology. The system supported a quick implementation of a game that required system location-awareness [66]. The middleware serves as a seemingly universal data repository in which all heterogeneous devices seem to interface with relevant data in the exact same way. Overall, using TinyLIME in development of this game resulted in a reduction in development time and lines of code.

With TinyLIME, Mottola, et. al, presented a way of reducing development time for game designers that are making games using heterogeneous systems [66]. They also show how system middleware, originally not designed for game development, can be extended to allow for context-aware game solutions. The authors did not discuss, however, the issues of player engagement or enjoyment. Though there was a claim that merging the game into the environment in this way would lead to increased immersion, the authors failed to measure or observe an increase in these factors. User

frustration, something that can easily result from a new interaction paradigm, was also not evaluated. The Save the Princess game ended up telling a lot about the rapid development of a simple game idea that used a novel interaction, but failed to explore the usability implications, or the question of whether or not they made a successful game.

2.3.1.3 FRAP

Tutzschke indicates that the high variety and short life span of mobile platforms make it difficult to develop pervasive games for mobile devices. Middleware is a typical solution to this kind of problem, offering developers a way to abstract away details to enable designers to more quickly create software in new domains [35][100][66]. Tutzschke designed FRAmework for a Pervasive game (FRAP) to create a model for a pervasive game and implemented a framework for this model for use in rapidly developing mobile pervasive games [102]. FRAP models and represents services including synchronization, data transmission, game orchestration, User Interface (UI) interface design and positioning, like other typical mobile development middleware [100][7].

Where MUPE addressed context-aware mobile games as a separate module of a large mobile games solution, the entire FRAP framework focuses on the specific domain of location-tracking mobile games. This framework also expands on previous work to develop a framework to support a location-aware game called Mobile Chase. Unlike FRAP, the Mobile Chase publication was less descriptive of the framework design and was therefore harder to replicate [35].

Researchers built FRAP to include a location-aware mobile distributed system and

used this to build a basic GPS-based game called King of Location. FRAP included a novel GameRuleValidation component, which can also be thought of as a rule engine. This idea is very unique to pervasive framework solutions, as games weren't previously thought to lend themselves to abstraction to catch-all rule engines in the past, with rules applicable to every location-based game. The GameRuleValidation discussion shed light on the authors' beliefs about how snap-together a location-aware game could and should be to reduce the technical challenge of developing such systems. The Game Protocol component showed how to build a log of actions and scoring of the game, while the GameManagement component demonstrated how a framework could allow the game designer to create UI functionality to let people enter and leave the game. This capability is one that is critical for pervasive games which tend to be 'always on'.

In King of Location, players compete to "conquer" the most of a number of pre-defined real-world locations, (like becoming mayor in FourSquare). Testing FRAP was done by in-house developers, but nevertheless revealed playability issues including the game being slow, incomplete, and buggy. Although it was built to aid in rapid development, FRAP did not include any framework to make it easier to test the pervasive capabilities of the system, so King of Location's multiple developers had to continually make changes and then go outside to test the system.

To evaluate the effectiveness of a pervasive game development framework like FRAP, it is important to have *other developers* make games using their system. The purpose of developing frameworks like MUPE, TinyLIME, and FRAP, as shown in Figure 5, is to anticipate services needed by pervasive game designers, to enable the

rapid development of sophisticated mobile games [100]. FRAP and TinyLIME, however, were not tested with their intended audience. By testing with actual game designers and not middleware developers, they can better identify what game design features need to be supported more and decide where they can make the system even faster. In the case of MUPE, there was more support that the system was useful and efficient for game designers, but there were few indicators that the games that were created were engaging or fun.

Frameworks	MUPE	TinyLIME	FRAP
Moral	It's hard to tell what these systems need when the context keeps changing.	Non-game middlewares are relevant too, but modifications may be necessary.	By telling developers what they will make, we can reduce development costs even further.
Contribution	An open-source middleware that works on common devices and handles the addition of new contexts.	A non game-related middleware to make a pervasive game.	The authors went one step further by making a pervasive game engine.
As a Development Platform	In a game-jam setting, games can be made quickly. Framework used by non-MUPE developers.	The TinyLIME system lends itself easily to pervasive game development when tested by TinyLIME developers.	FRAP leads to fewer lines of code and more snap together solutions, when tested by FRAP developers.
Game Play (Testing) Insights	The Sandman game performs well in different contexts, indicating success depends on the system and its environment and its users.	Testing for game playability was not discussed in this paper.	Reported difficulty in testing location dependent elements due to lack of devices and the requirement of leaving the lab.
Value of Context	Mix real and virtual world in new ways, leading to unique and new approaches to game play. Supported.	A more immersive experience. Not supported.	A more emotional relationship between players and the game by use of pervasive elements. Not supported.

Figure 5: Three pervasive middleware solutions compared: MUPE, TinyLIME, FRAP [102] [66] [92].

2.3.2 Mobile Augmented Reality Games

This section focuses on less accessible trends in pervasive and augmented reality mobile games. Often, in pervasive games research, it is assumed that the pervasive game designer is going to undertake construction of a game with “technologically occult” or use novel hardware solutions. These games, furthermore, will augment the player’s reality. Broll presents a taxonomy for AR games and explores the challenges faced when making pervasive games [7].

Within pervasive games, there is a sub-genre of mobile augmented reality (AR) games. Mobile AR games are distinctive location-aware pervasive games that use AR technology to modify the player’s real environment with virtual content. Games included in this sub-genre include: *The Alchemist*, an AR game that uses an Ultra-Mobile Personal Computer (UMPC)⁷ to reveal game elements involving alchemy and magic potions [7]; *TimeWarp*, a narrative Mobile AR game based on the legend of a particular city in Germany [58]; *Una Giornata di Gaio ad Egnathia*, a mobile-learning game designed for children studying an archaeological park of Egnathia, an ancient Roman city in the Apulia region in Southern Italy [91]; ARQuake, a version of the famous first person shooter Quake that places the player into the Quake environment with a head-mounted display and a backpack containing a laptop [6]; and REXplorer, a location-based game that uses smartphone screens to display paranormal activity on top of real world images [58][74][64].

As of 2007, very little research had been done on applications shared between

⁷UMPC was the 2007 word for smart phone or smart device

Mixed Reality and Ubiquitous Computing[71]. At that time, it was becoming clear that budgetary, technical and social barriers existed between the fields of Wearable Computing, Ubiquitous Systems, Graphics/Computer Vision and Mixed Reality that prevented collaboration between disciplines. Pervasive Games seems a very applicable field that might bridge that gap [18][65]. In his paper, Broll called for more developers to make pervasive AR games, stating how pervasive games make the real-world environment intrinsically part of the virtual environments of games and how they overcome the boundaries of traditional games.

There are two major directions of Mobile AR Games. There are simple AR games that use UMPC's and their built-in sensors. The second type of AR Game is more complex, event-based, large-scale games that are interwoven with their physical environments. Many mobile AR games make use of expensive and cumbersome AR devices such as head-mounted displays and/or backpacks full of technical goodies. These types of Tech Major games can test the application of new devices that may lead to much more immersive experiences.

Slightly outside of this genre are Computer-Augmented Table Tops, which are primarily stationary games that are typically based on board game extensions. These games typically use smart toys (e.g. cards with QR codes, bluetooth/NFC technology, etc) on top of some type of smart surface (e.g. Microsoft Surface). Again, these solutions are largely inaccessible and expensive when compared to other technology-sustained pervasive game solutions. The primary motivation for Computer-Augmented Table Tops research is the exploration and enhancement of strong social situations and interaction metaphors with future computing devices [56][6].

Pervasive games research can learn from research on mobile AR games, since they can have similar problems and yield similar playtesting results [65]. One such result is that there is a clear difference between engagement and presence [30]. Oftentimes, mobile AR games leave people feeling more engaged in the virtual elements but more present in the real world, going against the notion that pervasive games always promote a more immersive experience [7]. Furthermore, mobile AR games have high novelty value, with players becoming very excited by the prospect of using expensive and new technology [65]. Montola writes, “If you give people a novel device and let them toy with it for an hour, they are quite likely to enjoy the experience just because playing with new toys is fun.” On the other hand, most mobile AR games studies are done on prototype systems and the end result is usually clunky. Because they are not expected to be used outside of the testing environment, many pervasive games, particularly those leveraging mobile AR technologies, are dependent upon a specific physical environment and cannot be played outside of it. Also, because researchers study these systems in a controlled and serious laboratory setting, they often fail to observe their users playfully and socially engaged in a game solution [65][7]. Pervasive games demonstrate a need for cross-platform/ cross-media support, leading the genre to seek heterogeneous systems solutions [16][66][5]. Integration is also a big problem amongst mobile AR/pervasive games. AR games fail to give you a truly mixed-environment experience, with game objects being specifically real or virtual. Considering that these games typically try to use small UMPC screens to display augmented reality, researchers are seeking other options for achieving mixed-reality experiences with potential for a higher sense of presence, such as using sound as

primary feedback or using AR glasses to overlay the virtual on reality [63][30].

Mobile AR research suggests that while technology can provide new and interesting ways of augmenting the physical environment with game elements, research in this area often requires the construction of a game context rather than testing within a pre-existing context. Researchers of Mobile AR games often have to provide the hardware (limiting accessibility) and plant contextual artifacts within the environment, leading to solutions that are *nifty*; with too narrow of a context to generalize to other application.

Furthermore, early exposure to technology more often than not leads towards feedback on technical novelty rather than feedback on overall user experience. While this feedback is important to understand the *player-on-interface* experience, it comes at a cost of reducing *player-on-player* or *player-on-environment* experience. What a researcher hopes to learn should guide their use of novel technology and staged environments.

2.3.3 Heterogeneous and Seamful Games

A narrow design focus on one technology is less desirable in Ubiquitous Computing (UbiComp) and Pervasive Games research, since we can not count on all potential players having access to the same, or even the same type of, technologies. Additionally, it is not reasonable to assume that players will have or even want to use the same technology in every possible situation, even if they want to interact with a particular game. Hence, many researchers focus on heterogeneous systems as solutions for pervasive games, and include design considerations that can take advantage of lack

of network coverage or hardware access, referred to as *seams*.

Heterogeneous systems are used in a variety of different ways in pervasive games. In some situations, heterogeneous systems promote novel ways of game mastering [48][24]. Other games mix invisible sensors with mobile smart devices in order to make the connection between the physical environment and the technology as seamless as possible [66][67]. The more popular examples use cross media to serve different play states in the game [54][38]. In Snag'em, we use SMS technology, QR codes, web, and mobile web systems in order to create a highly accessible social networking game [78][36].

Heterogeneous systems are where we start to see a crossover between technology-driven games and design theory-driven games. Figure 6 describes the game “Can you See me Now?” created by Montola. The game’s cross-mediality was needed for different interactions between “runners” and players, for the orchestration requirements for mobile players, and to support the high performance value of the game [64][65]. In *Prosopopeia*, the end goal was to create a Pervasive LARP (live action Role-Playing Game), a genre that typically does not use technology assistance at all. In this case, the use of technology was purely circumstantial, used for “behind the scenes” game orchestration and special effects[48].

When put in the forefront of design, heterogeneous and cross-media systems can lead to interesting results. As a result of heterogeneity of systems, context often becomes socially constructed. Instead of context-awareness being constructed through the use of one dedicated sensor, multiple channels of system dialog can in many cases create a much more collaborative environment and result in a more verbose context

Evie Game Review: Can You See Me Now?



Control room orchestration limits the troubleshooting abilities of decentralized players, leaving them at the mercy of the information received by central command as well as the latency between information retrieval methods.

In *Can You See Me Now?*, we see a decentralized method of game orchestration. CYSMN is a game where Runners (expert performers) are trying to catch a virtual entity (online player). The runners must use technology to work together, collaborating for the end goal of trapping the online virtual player. During the game, however, runners often experience several technological failures including WiFi dark spots, GPS satellite failure, hand held device failure, etc.

In an ethnographical observation paper (Crabtree2004), authors reveal some of the technological failures experienced by the runners and discuss ways of overcoming those problems without the use of a control room or orchestration station. Every example given (2004) resulted in runners walking around blindly until the situation resolved itself, and always resulted in a halt in game activity.

Regardless of the fact that the decentralized solutions weren't very much fun, they did hit on some interesting ideas involving sharing more debugging knowledge with disconnected users. Making a living map of GPS connectivity information would be very useful in reducing the time it takes for a player to reorient herself into a live area.

I'd like to see what happens with a mobile control room (SWAT van) structure. A quasi-centralized orchestration allows runners to solve their own problems but also ask for helper from other player "Bosleys" allowing them to continue the feeling of being involved in something real.

Figure 6: An individual literature review of the pervasive game project *Can You See Me Now?* [24]. Image is from *Pervasive Games: Theory and Design* [64].

within and around the game environment. In these types of games, players typically provide feedback praising the system's support for social interactions without an emphasis on the system's technical novelty [54][38].

"Seamful design," a concept proposed by Mark Weiser, is the idea of making a

game where a technological limit (i.e. network coverage) is exploited as a feature and even a mechanic in a pervasive game [107][16]. *Bill* is a seamfully designed game that takes advantage of the times where the game does not know where you are, or can not connect to you[16]. In [16], reports indicated that the game was highly enjoyable. Embracing system unreliability allowed the designers to create a game that was deeply engaging, most likely due to the fact that user frustration remained low despite technical “problems”. In [16] this seamful design seemed dangerously engaging because they provided figures of players deeply engaged with the system as they cross the street. The original game, however, failed to engage players socially, with most players reporting a single player experience. In later iterations of *Bill*, designers decided to require players to work together to form a network coverage map. They also took emphasis off of individual player point collection. In this version, players engaged in activity with other players and had an even better, social experience. Designing the game in this manner forced the designers to consider how the technology *should* be used in the game, how players should consider their environment and their technology and ultimately led to a more educated, *intentional* design.

2.3.4 Discussion of Technology-driven pervasive games

Based on this literature review, we have found that:

- Often, in technology-driven research, real world social impact is overlooked in order to address research questions regarding novel application of a technical system.
- In many cases, developers find it difficult to test technology-driven research so-

cially because of context or environment changes outside of a laboratory setting.

- In order to have more applicable commercial solutions, game designers need to be provided with pervasive games middleware. Middleware systems make it possible for game designers to spend less time on implementation of a pervasive system and more time on fine-tuning the social and environmental game interactions. As it is, pervasive games are too hard to realize technically for the average game designer.
- Pervasive game theory rarely gets addressed in technology driven solutions. Enjoyability and engagement results can be confusing. Just because something is engaging does not mean it is immersive. Technically pervasive game solutions also do not imply increased presence. These factors appear to be independent of each other.

Interestingly, though many pervasive games claim to address Weiser’s vision of pervasive computing, these technology-driven games tend to make players focus on the technology while they are playing[64]. In many cases, designers focus on using a single GPS or AR glasses solution or some type of sensor to make a system that blends into real life. It happens often in “weird” technology research that developers end up making a system that uses small mobile devices to achieve system invisibility but it turns out that while they may be literally less visible, they are still very *thing* like, and the *thing-ness* (novelty) is still very apparent in day to day and more importantly social interactions. This brings up a very pivotal point in my dissertation and important point in pervasive game design. In order to evaluate a truly pervasive

user experience, players must be “more engaged” in the task of playing than they are in the tool/technology itself.

In the following section I will review several game design driven pervasive games.

2.4 Design Driven Games

In this section I will discuss “tech minor” designs, where game design-theory is stressed. Many of these games still use technology in their designs, but the technology is used as a way of enhancing or expanding a game’s influence. In this section, I hope to illuminate the differences in research questions in this space, and how technology fits into tech minor games in a very different, less explicit way.

2.4.1 Socially Adaptable and Asynchronous Games

A common challenge in Pervasive Games is creating a system that does not require 100 percent of a player’s attention for the duration of the game. When a game persists alongside real-world activity, then players must find times to participate in play, and those times will only rarely correspond to times when other players of interest are available. Pervasive games may extend over long periods of time, but players need to be able to play at different levels of attention - perhaps simply monitoring how the game is going at some times, ignoring it sometimes, but becoming fully engaged at other times. When thinking about how to facilitate player’s ability to enter and exit games at any time, tech minor game designers must also think about how this affects player performance or score. Asynchronous games systems are necessary when the game does not end, but players must still walk away from the system because the game session is excessively long.

The game *Mythical: The Mobile Awakening* demonstrates a successful asynchronous game play design, where intermittent play is not punished and is promoted by the game design. *Mythical* is a context-aware game in which wizards (players) gain access to a magical land through their mobile phones. In this game, the salient pervasive feature was its slow game updates, suitable for asynchronous play* by a large population of players. *Mythical* [41] designers reported on 300+ players involved in game play over 4 months. In order to accommodate such play sessions, players needed to be able to “phase out” of the game sometimes without being punished for game inactivity. To do this, the authors introduced interval-based play. In between interval updates, players reported their actions for upcoming intervals, making it unnecessary for the player to be present during the update. For example: during a player on player battle, there was a large span of time for players to submit attack or defend actions before game updates where the actions would then be applied.

Asynchronous game play was a new experience for a large portion of the users. After getting used to the concept, 73% said they liked that style of game play, but found that some interval settings were unreasonable. Most players said that they liked short intervals (30 seconds) or very long intervals (>10 minutes). This preference had to do with the play intensity level, in which players that were actively engaged preferred short intervals, and players that had other real-life tasks to do preferring longer intervals. The *Mythical* study showed that players accepted this style of play and could grow comfortable with it over time, but often players were not satisfied with interval update times, indicating a need for more system adaptability.

Day of Figurines also tackled asynchronous play in the context of a large group of

people. Day of Figurines is a large scale SMS-based game that was played by over 1000 people in Berlin, Singapore [37]. In this game, players control a character to explore a virtual space. They use SMS to receive missions, schedule events, and communicate with other players. Like Mythical, Day of Figurines is deliberately slow-paced to allow players to come into and out of the game at different times without much penalty. For this game, the designers were curious about how people slowly learn how to adapt pervasive experiences into their everyday lives. Here, the authors recognized that in order to make a game that pervades, designers have to evaluate how certain social environments tolerate and adapt to already pervading systems. Day of Figurines addresses adaptability* by viewing every in-game interruption as a potential interrupt of real world activity. The authors hypothesize that a player's level of engagement predicts whether an in-game interruption will be welcome or not. By making a system that could determine each individual player's level of engagement, the authors could potentially reduce the amount of unwanted interruption in the lives of the players. The authors sought to find data points in player activity that could indicate when players were engaged in play or not. The authors used an Experience Sampling Method (ESM) to monitor player experience. It is an "in situ" approach to measuring the quality of the experience by prompting participants to fill out questionnaires during their current experience with a signaling device ("beeper"). The study empirically confirmed the hypothesis that player engagement could be derived from elapsed player response time by comparing ESM self reports of engagement and elapsed response time data. In Day of Figurines, players' elapsed times and response times could be used to predict levels of engagement, enabling non-intrusive monitoring and avoiding

the need to ask the users directly about their level of engagement [37].

Designers of *Songs of North* attempted to socially adapt their game in a different way. Theorizing that players would be more capable and willing to spend their time in a middle ground (middle concentration) if they did not have to visually engage, the designers made a game that utilizes sounds as the primary source of game feedback in a persistent alternate game world [30]. Ekman et al. believed that mobile devices could offer novel game design opportunities, and that using non-speech sound for making user interfaces would make the system easier to navigate. The game was designed so that the player would have to wear headphones or place their mobile device on speaker phone for the duration of the game, and the game would provide audio cues about what was happening in the game session. Players were expected to carry on with their ordinary daily activities while playing this game. The purpose of this research was to identify elements of sound design that can be used to support different aspects of playability in a location-aware game for a mobile phone; and to collect insights on how sighted players respond to and make use of informative sound.

Songs of North had very different play test results, with mostly negative user feedback. This system ultimately failed at functioning in changing social environments. The audio aspect of the game was harmful to the social playability of the game, as it caused discomfort and embarrassment. Many people did not understand the relevance of sound in their play experience and this broke their immersion in the game. On the other hand, people liked *the idea* of sounds to signify ‘nearby’ events. *Songs of North* presented a valuable lesson on informing the players of new paradigms with systems, especially when attempting new uses for ‘normal’ technologies [30]. The key

takeaway from the Songs of North game was that the sounds emitted from the mobile phone did not necessarily serve to immerse players. In this case, the game world was very much separate from the real world, despite the designer's efforts to keep players present in both worlds. Sounds brought forth the presence of the game at the expense of immersion - or in other words, the sounds put the game world in the mobile phone, instead of putting the game world in the real world. The game didn't allow players to be in the mixed world all the time; instead it startled people out of the real world and directed their attention to their noisy devices (even during times that they did not want to be pulled in)[30].

Insectopia was a game developed by the researchers of the iPerg project as a socially adaptable game[76]. This game is a Bluetooth Harvesting game that takes advantage of the fact that during a day, players constantly move in and out of range of other people's Bluetooth devices. *Insectopia* is a bug collecting game in which you collect bugs by moving into range of others that have a similar device (mobile device or cell phone). Every phone produces one particular type of bug, and bugs die after 8 days. Players are encouraged to try and figure out who has what type of bug so that they can maintain their collection. The game also allows paired play so that organizing and playing with a friend is rewarded. The objective is to maintain a high score by collecting lots of bugs and keeping them alive [76].

Peitz, et al. evaluated the game by testing the game with a different team of 11 pervasive game developers in another country. Participants were given a mobile device and told to play the game whenever they felt like playing, and later took a questionnaire about their experience. In addition, the game was made publicly

available and 20-30 non-developer accounts were made in the course of 4 months [76].

As of 2006, feedback indicated that players found the game visually appealing but complained that there were not enough meaningful things to do [76]. This was expected, as the designers had ideas in mind for more complex interactions in the game that had not been implemented. Since the number of logins and the number of searches in the game were very similar, the researchers determined that people often logged into the system when they had a minute, searched for nearby bugs, and put the device away; indicating that the game promoted the intended interactions. Analyzing the game logs led to an important finding: players that live in technical, busy, social environments played the game longer and more actively. Since the game only looked for unique Bluetooth devices in the area, players were able to collect bugs from anyone with no social interaction required. Here, playability was not based on number of players in the area, but rather, number of devices.

As Eriksson et al. point out, pervasive games will not be possible until they can co-exist in complex and changing social environments [32]. As pervasive games become more popular, the *acceptability* of the game might also be influenced by a gradual change in the population's gaming and/or social habits. For now though, it is clear that games must switch to background activity when the game play becomes socially unacceptable or undesirable. We've learned from socially adaptable games that players typically prefer fleeting interactions, that either support small bursts of interactions over the course of a long time, or long interactions that occur over short play sessions [76][74]. Constant interaction in the examples provided were typically not ideal, most likely due to the fact that despite what was designed, the ordinary

world has many more distractions than just your game. When players are not feeling playful, or in other words, are in a serious ‘telic mindset’, they prefer to focus without interruption. Pervasive games should therefore support focus for the player in the ordinary world, and not punish too harshly players that must temporarily step outside of the game’s magic circle. This is not to say that the game should not attempt to pull players back into the game, but it should do so while taking into account players’ varying mindsets.

Like technology as a whole, pervasive games can often be disruptive in non-play environments, and designers should attempt to ensure social adaptability* so that disruption of both environment-on-game and game-on-environment can be reduced[32]. Eriksson et al. provide several guidelines to help designers with this task. Erikson et al recognized that asynchronous play is only one of several considerations that a pervasive game designer needs to make to ensure that a game is *socially adaptable*. In the list below, we see that along with interrupt-ability, a designer should consider understanding a game’s social context if the game is to truly adapt into that context.

- As all of the above examples indicated, pervasive games should support *interruptability*: often handled through asynchronous play for multiplayer games, or making the game completely single-player driven (e.g. Insectopia).
- Ambiguity (or inversely lack of precision) has a potential for making a game more accessible. Insectopia’s bluetooth harvesting technique [76] and more popular examples of reducing the precision of GPS information (like commercially successful FourSquare) are examples of how using ambiguous context makes the

game more playable and more accessible in non-play situations.

- Analyzing from several perspectives allows designers to create a more precise design for ever-changing player needs.

Eriksson et al. propose that more observation should be done on the interactions of players and non-players based on social roles. In pervasive games, many different types of people can represent players and non-player observers who are in proximity to players or the game's environment. The demographics represented in a game setting may be dependent on the social context. Furthermore, social acceptance of a game may be dependent on how the game adapts to social roles. Once a high level of granularity on the discussion of social adaptability can be established, designers can start making more informed game design decisions that lead to more socially adaptable games. For these reasons, I continue this literature review on immersive games. For immersive games, authors start to look at the social implications of deeply immersive, socially pervasive gameplay, primarily through ethnographic observation from multiple perspectives.

2.4.2 Immersive Games and Pervasive LARPs

Immersive games are games that engage participants in the idea that their pursuit of the game's objectives are 'real' and 'not a game.' Pervasive Live-Action Role Playing games (LARPs) engage players in role-playing within the context of everyday life. This section illustrates how ethnographic research on immersive games and pervasive LARPs can give game designers insights into the potential implications of socially pervasive games.

In 2001, Spielberg released a film called *A.I.: Artificial Intelligence*. During its release, Microsoft/Dreamworks produced an immersive game called *The Beast*, made as part of an advertising campaign, where players had to solve puzzles of increasing difficulty to reveal a pretend conspiracy. Some puzzles made by the developers were intended to take from a few days to a few weeks or months to complete. However, many of the more cleverly constructed challenges were solved in a matter of hours by the largest forum of *The Beast* players on the web: the Cloudmakers. Cloudmakers solve problems by integrating themselves as part of a collective mind, or hive-mind. This ultra-collaborative play activity is atypical in traditional games, where even the most massively multiplayer games are played in a single-player fashion by deeply engaged players[29]. *The Beast* became one of the more heavily-observed immersive games in pervasive research because of the implications of such social phenomena [64][61].

In one ethnographic research paper on *The Beast*, they found that collective, hive-mind type of play can be fun, but also very dangerous[61]. The paper starts with the Cloudmaker guild trying to solve very real, and very serious cases using their same collaborative efforts. One effect that *The Beast* had was acting as an enabler, allowing participants to believe in their collective powers enough to take on a serious task such as trying to determine who was behind the 2001 attacks on the World Trade Center on 9/11. Their efforts were disbanded after a few discouraged forum members chastised the guild for playing with a serious event. Another social effect found by *The Beast* play was that it caused people to seriously neglect real life. Sometimes players neglected and even lost their marriages, jobs, and health as a result of player

engagement [61].

Pervasive LARPs, often overlooked in pervasive game research due to rarity and non-computing motivations, are similar to immersive games since they often also encourage players to see the game as ‘real.’ Observing LARPS can be useful for understanding how computer-based role-playing games (RPGs) can be extended or enhanced to fit into real life, giving very useful indicators of what aspects of narrative need to be blended into ordinary life. Jonsson et al look at one pervasive LARP, *Prosopopeia*, in an attempt to understand more about how players perform when asked to consider a game as real, and blend their game interactions into their ordinary lives [48]. *Prosopopeia* was designed to allow its players to role play while still participating in ordinary life. In this game, 10 or more players are characters in a staged ghost story. Players are asked to play the game as if it were real, those being the only instructions they receive. The game was staged with physical game artifacts, with certain key locations appropriately set up with props. The game design was mostly centered on an in-depth story line; unlike traditional LARPS, however, they abandoned costumes, contact with staged NPC characters, and character preparation⁸.

During the game, players were observed through video surveillance. One character, during a game session, was asked to take notes on his experience, creating an ‘ethnographic report’ from a player perspective. Questionnaires and wrap up sessions were also used.

In *Prosopopeia*, the magic circle was expanded in all three ways: spatially, tempo-

⁸prepping players for their in-game roles

rally, and socially. Spatially, players played in unforeseen areas. The designers were able to balance propped areas with naturally occurring areas. Players expressed positive response to the reality aesthetics, claiming that it was hard to tell if a person or experience was created with intent or not. Players tended to agree that in order for a game to be successful, developers should strive for “maximal consistency between the game narrative and the complete experience with the player.” Socially, any person might be playing or not, and this added an element of mystery that added to the fun of the LARP [48].

Prosopopeia expands the magic circle temporally in two ways - blurring the boundaries of play purposely at the game start, but also by allowing players to choose when and how to play. When the players were debriefed on the rules of the game, they entered a state of dormancy, constantly on the lookout for an in-game clue that indicated that the game had started. Later, as part of the game, players would play as themselves being “possessed” by ghost characters. However, players could choose when this occurred, and move in and out of gameplay through this model as needed. In other words, while acting out a possession, players could terminate the possession for a phone ring or other urgent real-world event. As a result of this novel possession model, players were much more willing to stay in a play state because it allowed players to go about their daily lives without having to explicitly step out of the game.

Although many elements of Prosopopeia were successful, players felt that the designers could use technology to enhance the experience [48]. The game included very basic technology that ranged from cell-phones taped to things, or a reel-to-reel tape recorder as a way to talk to ghosts. Explicit design decisions should be made to ensure

that technology helps the game experience overall but also proves to be a diegetic* , or natural, addition to game interface [33]. In the context of a pervasive LARP, any technological augmentation of the game could be an opportunity to provide data and narrative immersion to the players, much like the use of a traditional game heads-up display (HUD).

Immersive games can bring about the idea of “hive minds”, e-tribalism, and extreme collaborative multi-player activity [61]. Many players in immersive games and pervasive LARPs can have an underlying dread to return to “real life” and the need for constant affirmation that the play they are engaged in is “not a game”, which goes against many conclusions one may infer from Huizinga’s magic circle theory. This implies that there is room for a blur of these boundaries as long as players sign off on the social contract put forth by the game, no matter how intense. In both *The Beast* and *Prosopopeia*, players are presented with game rules that explicitly state “THIS IS NOT A GAME” before the game starts[61].

“...the view of what is socially acceptable is a highly subjective matter and this implies that gameplay design of pervasive games needs to critically consider the norms for social interaction of the intended target audience [76].”

2.4.3 Prototyping and Game Modeling

When considering the potential social implications of a new tech minor pervasive game, designers may consider using prototyping techniques and models. Pervasive game prototyping techniques can help by reducing the reliance on new technology

when testing ideas. Prototypes can also help game designers quickly and more effectively make more knowledgeable and insightful designs before software development begins. In a 2008 publication, Ollila identifies the challenges of pervasive game prototyping and discusses guidelines for pervasive game prototype construction. He frames the problem of pervasive game design around the current emergent nature of pervasive games. Because context-aware games are so new, and social context so unpredictable, games often mix with the environment in unforeseen ways. Agile software development, ready-made software components, and paper prototypes (i.e. game sketching) are handy tools for the prototyping process; the trick is choosing the right methods [74].

Ollila et al. evaluated several game designs with rapidly-prototyped game implementations and presented the results of each. Many of the games presented in the paper were location or context-aware and were developed in less than 24 hours. A physical prototype is one that does not use software, but can include paper, actors, or anything else more easily generated. These can help a lot, but are not very good at identifying environment and movement issues. Hot potato, a game where Bluetooth devices pass a potato to other devices, was a good example of finding playability issues with a physical prototype. The potato could leave the game, and only the person with potato was engaged. Mythical: The Mobile Awakening was tested with a ready-made web forum and a physical prototype. The feedback gathered from the prototype cued the designers to create the game's slow interval updates (see Section 2.4.1)[74][41]. Game sketching and rapid development with a pervasive middleware (see Figure 7) are two other prototyping techniques to be used by pervasive game

designers. Of particular importance for socially pervasive games is *paratyping*, where social acceptability is measured by reflecting on the system requirements, but doing so without the use of a functional prototype [74]

Ollila urges designers to take care to choose the correct prototyping method. In a nutshell, if the desired result is to probe attitudes, opinions, and culture, use real players as test subjects and complete the idea enough for the players to understand what is supposed to be happening. Alternatively, if you want to generate ideas, test with experts and make the prototype low grade and sketchy. Lastly, if you want to test an already-constructed idea, use experts and make the prototype comprehensive. Playtesting in groups of six are enough for detecting playability and usability issues [74].

Ollila's paper, while very helpful for those interested in making and testing ideas quickly, lacks general guidelines for making a pervasive game engaging and enjoyable. For traditional games, designers use game models that provide simple deconstructions of what makes a game engaging, enjoyable, and ultimately allows players to achieve flow*. However, pervasive games have several considerations not present in traditional games. In pervasive games, players can not really be immersed in a virtual world if they are also expected to function in real life; ordinary social connections are not separated from play connections so social acceptance is dependent on both other players and non-players; and traditional games tend to have a much clearer focus on a game's virtual environment, while in a pervasive game, integration and lack of clarity is often preferred [47].

Jegers [47] proposed to create the Pervasive Game Flow model of user enjoyment for

Prototyping Methods for Pervasive Game Development



Wizard of Oz is a prototyping technique where the user interacts with a hidden actor, known as the wizard, who simulates the system output (Maudsley1993). Users are led to believe that they are interacting with a fully developed system, allowing developers to understand user expectations and requirements early in development. This technique is often employed

when content and behavior of the system is still undecided (Dow2005).

Good for observing: User Expectations, Interactions, Requirements

Paratyping is useful for gathering feedback on in-game experiences. Paratyping has designers act out conversations involved in potential situations of the game with real potential users (Abowd2005). This prototyping method does not involve a functional prototype, but is very effective at probing the attitudes and opinions of potential players of pervasive games (Ollila2008). Paratyping is an effective method of exploring social acceptability in a ubiquitous or pervasive application (Abowd2005).

Good for observing: Social/Behavioral Novelty, Interactions

Software Prototypes solutions vary from rapid software development: where developers implement software in short iterations; to software components: where developers implement only pieces of the complete design in order to test the parts that require software testing. Software prototypes can also include the use of ready-made software (i.e. web forums, Facebook, game engines) to get testable elements of the prototype system functioning quickly.

Good for observing: Context-Awareness, Continuous Time Updates, Complex Interaction Between Game Platforms, Technical Novelty

Physical Prototype solutions are constructed with (non-software) physical materials for testing game ideas. Physical prototypes are often tested with other developers rather than potential players, in order to test core game mechanics and game fun and engagement. More rapid physical prototyping, in which game ideas are often and rapidly thrown out and replaced, is called *game sketching*. By sketching, developers can test and refine several game ideas before starting to implement the software solution (Ollila2008).

Good for observing: Discrete-time Updates, Game Updates

Figure 7: Paraphrased list of prototyping methods for pervasive games as described by Ollila [74], Abowd [1], Dow [28], and Maulsby [57].

pervasive games by building on the accepted model proposed by Sweetser and Wyeth [94] using observations made of existing pervasive games and contrasting them with traditional games. For each section, they start a mini conversation of how pervasive games should have special consideration and propose a revision to the existing model. The paper presents a new game model for pervasive games based on the accepted differences between pervasive system games and traditional games. Jegers' model identified several guidelines that pervasive game designers should consider, including: concentration, challenge, player skills, control, and feedback(Figure 8).

Considerations	Guidelines
Concentration	Support pervasive game players with a process for switch levels of concentration in the game.
Challenge	Support and encourage players in creating new scenarios and set some of their own pacing, in a limited way.
Player Skills	Be flexible and enable skills to be developed at a pace set by the player.
Control	Allow players to easily pickup game play in a constantly ongoing game and quickly get a picture of the current status.
Clear Goals	Support communication of the player's own intermediate goals
Feedback	Players should receive feedback. This is no different from any other game.

Figure 8: Short paraphrased list of guidelines set forth in Jeger's Pervasive Game Flow Model [47].

While these modifications should lead to more game enjoyment, the name and purpose of Jegers' "Pervasive Game Flow Model" is misleading. Flow, as used in this paper and in Csikszentmihalyi's definition [26], is a state where the user maintains a state of energized concentration, usually leading towards extended use, and exploration of the system. However, this approach is possibly limiting, since it is likely difficult to maintain flow in a system that allows for a constant breaking of concentration. This model, clearly intended to be most helpful to Ubicomp and Pervasive Systems researchers, provides them with a simple checklist for the design of easy

to use and enjoyable pervasive computer game experiences. It does not necessarily provide guidelines to promote *pervasive play* experiences.

In conclusion, it is clear that when tech minor designers construct and observe game designs, the end goals are different than those of Tech Major designers, usually asking the question “Should we make the game do X?” rather than “Can we make the game do X?”. While Tech Major games tell us about how a user will interact with a technological system and accept the system as a tool, tech minor research is more suited to tell us about the social adaptability and acceptance of the game system as a social utility. The problem, however, is that results from tech minor research games are difficult to generalize in a social context because culture and social structures are not trans-historical [12]. As culture and social structures change over time, it may not be possible to transfer lessons from one time and place to other times or places. The non-transhistorical social delimita, in addition to the large technical challenge of pervasive games (discussed in the previous section), causes pervasive game designers to have to rely heavily on “tinkering to perfection” techniques through use of extreme rapid prototyping, and only partially intentional game designs through use of models derived from traditional games.

In the next section I discuss my own Pervasive Play Lens model of the play space for socially pervasive games, where I use the abstract magic circle of play as the foundation for understanding the social context of Snag'em at various academic conferences and events. This extensive literature review as well as experiences during the design and development of Snag'em, have driven the construction of the Pervasive Play Lens. Through out this dissertation, mixed evaluation methods are used to break down de-

sign questions to the spaces represented in my model, and I describe what factors are effected within each subsection of my pervasive play lens. Here, I describe the model as a way of organizing the spaces and design considerations pervasive game designers will undoubtedly encounter in the construction of tech minor pervasive games.

2.5 Related Work Conclusions

A main contribution of this literature review has been the identification of the Tech Major / tech minor dichotomy within pervasive games research. A better understanding of this dichotomy can lead to improved results for pervasive games research. For Tech Major games, evaluating engagement often leads to feedback on a game's technical novelty and system bugginess [65]. The Tech Major mote sensor games research presented in this dissertation currently results in present-at-hand technology and unconvincing game experiences. These challenges for Tech Major systems make it impossible to generalize engagement and adoption results for mote sensors in pervasive games [66][67]. Middleware researchers provide platform access to more game designers, but do not have time and resources for out-of house testing due to the short shelf life of middleware systems. These systems suffer from the same Tech Major issues arising from technical novelty, and there is a lack of informed game models to guide developers in supporting appropriate features for pervasive games [66][102]. It is only after several iterations (and often several years) of middleware and framework development that strong design implications are revealed [53][15]. Even in seamful games, a category that seems to have much crossover between tech minor game design and a Tech Major technical focus, most research addresses only one of the design

questions “Can I?” and “Should I?” in the same paper or even version of the project. “Can You See Me Now?” started out as a tech minor design, with the seamful novel game mechanic being the primary focus, however, when the game showed signs of technical bugginess (a lack of support for game seams) the focus immediately shifted to a Tech Major question, “How can one support loss of connectivity in a pervasive game?”.

Conversely, tech minor projects are best executed when technical novelty is restricted and system utility is already established. In the Beast, there was large impact on the lifestyles and social interactions of the Cloudmaker guild, in part because the software and hardware interfaces to the game were all pre-existing [61]. Wearn et. al refer to the use of pre-existing, or natural, interfacing in pervasive LARPS as “infinite affordances”, as a way of constructing *authentic activity*: a desirable aesthetic in pervasive games [105]. In Prosopopeia, existing, proven technologies were used to create an authentic experience. However, when technology was haphazardly added to support game orchestration, the result was negative feedback from play testers. To achieve the immersive “this is not a game” experience, the use of technology has to support a transparent “non-game” interface. Prototypes allow developers to quickly test aesthetics and mechanics of play without reliance on a complete technical solution [74], but overall, the addition of Tech Major contributions halt feedback on tech minor contributions until Tech Major designs become polished and commonplace.

The Tech Major/ tech minor dichotomy identifies the differences in research and design focus and highlight the contribution potentials of each. Pervasive games researchers often seek to make novel contributions both in technical advances and in

design considerations, but our discovery of the Tech Major / tech minor dichotomy in pervasive games research suggests that it may not be possible to do both well in a single project. By using a primarily tech minor approach, using only highly accessible and currently pervading technologies while focusing on game and play mechanics, I have developed a pervasive game model for socially pervasive games. The model, unlike Jegers' Pervasive Game Flow model, uses the magic circle as its theoretical framework. The tenets of flow, though useful and desirable in traditional computing environments, do not translate well into a system in which concentration should be regularly broken, seams are expected, and the outside world is expected to participate. These characteristics are typical in pervasive games. In order to connect the worlds of play and the ordinary, a designer's understanding of the magic circle of play is very important [21]. I propose that, in order to be most useful, pervasive game models should focus on how they affect the magic circle of play, so that pervasive game designers can construct more intentional designs through a more defined view of play space amidst the ordinary.

2.5.1 Game Modeling with The Magic Circle

Huizinga describes the magic circle of play as a simple but abstract concept. It's a boundary that separates the ordinary from a play space [45][82]. This boundary can be tangible or intangible [34]: like the difference between a game of tag (with a tangible boundary) and a board game (intangible). Boundaries can be porous or impermeable, which can expose the entire concept of the magic circle to paradox and misinterpretation [21]. Despite these complications, however, there are three things I

find particularly interesting about the magic circle of play:

1) It is very easy to create a magic circle. Game designers do it with rules, drawings, social contracts, and simple explanations.

2) Play cannot exist without this circle. Once the rules are in place, they must not be broken. In a cultural context, people do not want to play in the ordinary world. The ordinary world isn't fair and it's too complicated. Consider the first time you played a game with someone and they broke the rules. Maybe you were having a race, and when you said, "Ready?, Set, Go!" that person shoved you to the ground and trotted towards victory, without even trying to run hard. Immediately, the magic circle was removed and you were no longer in the playful mindset.

3) When the circle does exist, people take play seriously. It is because of this, that the magic circle of play is truly magical. Once people find themselves in a magic circle, they devote hours of activity, lose track of time, plan very specific, involved strategies, and believe in the value of things that only have value within the boundaries of the game. People do all of these things without ever losing awareness that the activity that we are engaged in is separate from the ordinary.

Upon first consideration, the concept of the magic circle goes against the idea that any game could or should become an ambient or pervasive experience, indistinguishable from reality. Games have continued to demonstrate, however, their ability to shape and change cultures and societies. In some cases, games and play have been known to take over key area of societies⁹ forming what are known as ludic societies.

⁹examples of ludic societies in Homo Ludens include feudal Japan with the Samurai code and ancient Greece with the philosophic schools and the Olympics

Stenros [90] explains how this concept relates to western society as a whole:

Recently the western world has been moving into the direction of becoming a culture of gamers. Digital games have played a considerable part in this shift: the generations that have been brought up with digital games do not “grow up” and stop playing. This means that each passing year the average age of gamers goes up and a culture of players is emerging.

Pervasive games, like FourSquare, in our current gamer culture demonstrate that there are structures within the magic circle and social contexts outside of the circle that allow a game to, on occasion, push the boundaries of a typical magic circle. I propose a simple camera analogy to help designers understand the boundaries between games and the ordinary.

2.5.2 The Powell Pervasive Play Lens

Socially pervasive games are hard to explicitly design. Game designers are trained to look at games as closed systems, where the outside world has only non-game related effects on the game. Unfortunately, ignoring the interactions between game and non-game is just not useful in the pervasive games space - otherwise, pervasive games will suffer from emergent interactions and will therefore need many unnecessary iterations in the prototyping and game design process. Should the game be playable in multiple settings, then the number of design iterations increases for each context for which the game is designed.

The Powell Pervasive Play Lens attempts to explain the play space of a meaningful pervasive social play system by relating it metaphorically to a photographer’s camera.

By staging a scene with the appropriate props and providing good light, a photographer can take a picture that many can enjoy, using just a simple camera. Applying the same camera techniques, however, to environmentally varying shots can lead to blurry and unprofessional pictures. These situations require different preparation and equipment. A game designer is in a very similar situation when taking the leap from traditional to socially pervasive games.

In the Powell Pervasive Play Lens, the well-accepted definition of the magic circle of play is the simple camera, that creates just one clearly defined boundary between play and the ordinary. I argue that there is no simple model when it comes to making a truly pervasive game - since the game must push the traditional boundaries of the magic circle either temporally, spatially, or socially. If one were to try and design a pervasive game with this simplistic magic circle as a model of the game's boundaries, she would not have enough understanding about the relationship between the ordinary and the play space to be able to make knowledgeable decisions about extending the boundaries to create the desired pervasive play experience. In order to understand how the magic circle looks different in a pervasive context, designers need to have a new and richer way to discuss and delineate the boundaries between play and the ordinary. The contributions of the Powell pervasive play lens (3PL) are that it provides a language for the discussion of pervasive play boundaries, and it promotes a better understanding of relationships between constructs of pervasive games and play space.

The 3PL model illuminates specific regions of the magic circle, some often overlooked by today's pervasive game design researchers. In hard-bounded games, an

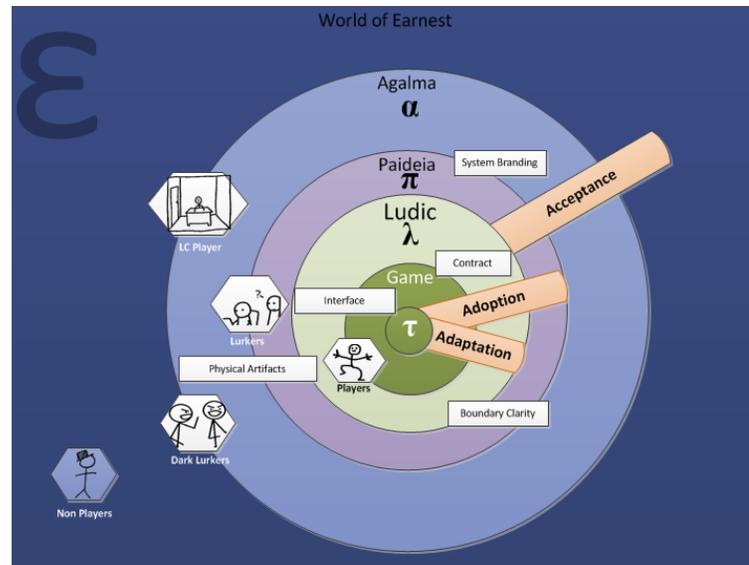


Figure 9: Current iteration of the Powell Pervasive Play Lens, aka, 3PL lens. The 3PL model breaks the elements of a pervasive game environment down by its intent or type so that the complex game ecology composed changing personalities, behaviors, and social contexts can be more readily interpreted by a pervasive game designer.

understanding of the game boundaries in relation to the ordinary world is not as important because boundaries in these games are explicitly designed to separate the game from the ordinary. Often, in the case of traditional games, the magic circle naturally occurs, and any pervasive artifacts of the game are coincidental, and are often due to advertising and high adoption rates. When designing a game where pervasive meaningful play is the main goal, however, the designer must become more involved in defining these regions outside of the game mechanic / rules space and orchestrating an experience that promotes ambient, always-on, play. As designers move towards increasingly pervasive game designs, the designer will need to take control of constructing game boundaries, and this is where 3PL comes in.

The primary contribution of 3PL, shown in 9 is the breakdown of pervasive game space into concentric zones. This model, reminiscent of the Burgess model used to

describe the construction of urban zones in a city [10], shows how the game mechanic is always the focal point of a pervasive game, but many factors important to the pervasive game experience are formed outside of the pure space defined by game mechanics. Like the much more simplistic concentric model by Salen [82], ludic activities and game mechanics are seen as subsets of playful activity. The model includes the World of Earnest (WOE), *agalma*, *paideia*, *ludus*, and games, ranging from the serious to the playful, to the rule-based mechanics of games. Below, each of these subsets are defined. The designer will use these zones to consider the impact of a pervasive game's design across all the boundaries between the game and the ordinary.

2.5.2.1 World Of Earnest

In *Homo Ludens*, Huizinga tries to define an antithesis to play: the earnest*. Later game theorists called 'ordinary' the antithesis to play [82], but in his book Huizinga thought that 'earnest' was a better suited word to describe the opposite of play. Today's definitions of the words serious and earnest are synonyms, but in 1955 in Germany, instead of meaning "with serious intent or conviction", earnest may have expressed something of a more severe or grave nature. In other words, Huizinga most likely chose the word earnest to represent things having to do with survival, such as food and shelter.

In 3PL, things fit into this area of utilitarian space when they are better left serious in nature, due to severe consequences or social norms. In the World of Earnest (WOE)*, people are motivated by the telic* mindset, which is a psychological state

where a person is motivated by achievement and future goals. To allow for this focus on a serious mindset within a pervasive context, Salen’s space of the “ordinary” must be divided into two concentric parts: the World of Earnest and *Agalma*. Based on my 3PL model, the “Agalma” space is a subset of the World of Earnest that is not playful, but includes elements of art and beauty rather than just function and utility.

2.5.2.2 Agalma

Agalma is a greek word that means “a pleasing gift to the gods.” Over time this word came to mean things that are iconic, beautiful, and things to be treasured [50]. In Huizinga’s discussion on the play-forms of art and literature, agalma was introduced as an argument that there is a lack of play-form in plastic arts, i.e. architecture, sculptures, etc. In this sense, Agalma represents an intermediate zone: something decidedly not serious and not playful. It occurred to me that this word, if considered in the space of pervasive games, could be key in explaining the intermediate area of play in pervasive games because of its ability to affect both play and earnest spaces. Not only does Agalma sit in a play-neutral zone, it also results as an artifact of play. Poetry exists as a result of word play. Recipes exist as a result of food play. Agalma is a tricky space because things in this space have value, but not the same kind of value as food or shelter. The elements in this space typically have value for all, including both those engaged in play and those that are not.

2.5.2.3 Paideia

Paideia is the greek word for child’s play. The roots of the word Paideia can be traced back towards school and learning. Huizinga considered paideia as unstructured

play, having minimal impact on culture. Huizinga mentioned Paideia in his book but did not pay very much attention to it as a play behavior that affects culture, and was later criticized for the oversight by prolific play sociologist, Roger Callois. Other behaviorists and philosophers throughout history have heralded Child’s Play as something critical to society and social development [13][93]. In 3PL, I use Paideia to define the space where play is occurring without rules or goals. This includes play through exploration, narrative, and construction.

2.5.2.4 Ludus

Callois built on Huizinga’s theories of play by introducing a play continuum [13], on which the two defined end points are *ludus*, structured play, and *paidia*, unstructured and spontaneous play. In this area, play has a tendency of becoming serious and agonistic (the play theory term for competitive), and we find ourselves once again in systems of conflict. As Salen and Zimmerman point out in *Rules of Play*, ludus represents a wide spectrum of structured play: defined by Callois as the Agon, competitive play; Alea: play with random chance; Mimicry: play through acting; and Ilinx: exhilarative play [13][82]. Only a small subset of ludic play is represented in game space. Furthermore, in game space, a play-form can become so intense that it throws a player back into a telic mindset and involuntary interaction (you can involuntarily “play” a game).

2.5.2.5 Games

In this space, the artifacts and behaviors observed represent those that are directly formed through “game play”. In a game, there are designed rules and outcomes,

structure also found in ludic play. Players, furthermore, are attached to the outcome through the use of strategy¹⁰[39]. In the context of my Pervasive Play Lens, I also add the following criteria that a game is a single system that is designed as the primary influence for meaningful play. I make this distinction due to the fact that games designed without the intent of voluntary play would have little to gain from my Pervasive Play Lens.

2.5.3 Game Observation and Evaluation through 3PL

The 3PL model divides all human action into these concentric zones, depending on the purpose of that action and its societal context. By considering all zones in the 3PL model, a designer can better and more carefully define the magic circle for a pervasive game. Game designers typically design only within the boundaries of their game, leaving everything outside of those boundaries to emerge and refine through tinkering. This “tinkering to perfection”, however, makes it much harder to design a pervasive game purposefully and to develop design theories. In a socially pervasive game, the boundaries that a designer needs to consider are much more complicated than those found in traditional games with “hard” well-defined boundaries. Socially pervasive games require a design that addresses the needs of players, non-players, and social context, because these elements are all strongly linked to the success of a game as a meaningful play experience. In later chapters, I use the pervasive play lens to illustrate what elements in my game effect the outside social context, either through making the game more acceptable or making transformative social impact. Likewise,

¹⁰The relationship between outcome and strategy as seen in games is defined by Fullerton as *strategic interdependence*

I also indicate which elements of my game introduce negative social impact and social weight for players.

Pervasive games interact in complex open systems instead of the traditional closed systems designed for strongly bounded games. In consideration of this complexity, we learn from design-based education research methods in order to “inquire more broadly into the nature of learning in a complex system” [20]. In the learning sciences, this is referred to as a learning ecology, a “complex interacting system involving multiple elements of different types and levels [19].” People learn both in and out of school and there are complex interactions between learning in different environments.

In pervasive games, people play both in and out of what a simple magic circle of play would define as the game context. The 3PL model strives to encompass the play ecology, generating a bigger picture to illustrate the nature of a socially pervasive game in a complex environment. The purpose of 3PL is to reveal and understand the nature of the magic circle of play across all societal settings. In some ways 3PL may even be used to understand the nature of reality as it relates to socially pervasive games. However, the primary focus in the creation of 3PL is to provide specific guidance towards the design of next generation socially pervasive gaming environments.

In an open system, like that of a social networking environment, it would be impossible to control for every variable that creates the cultural context of the social situation. This lack of control makes it problematic to conduct purely “hard research” [44][20][19][83]. Christopher Hoadley, researcher in computer support for cooperative learning, explains that because we cannot precisely engineer cultural context, we may

not be able to replicate exactly the conditions that were encountered [44]. This makes it very difficult to identify the factors that are most relevant to a particular situation. For this reason, a design-based research approach is employed, through which the researcher is concerned with complex interactions that cannot be foreseen with prior research or controlled lab environments [8].

Hoadley illustrates the necessity for design-based research in the following quote:

...as is true with most educational research, the simple studies and simple answers (“Which is best, A or B?”) can be misleading. ...interventions may take on widely varying forms depending on the teacher, the learning context, and even the particular geographic location. In technology research in particular, many researchers ask questions that bely the role of context. “Is tool A better than tool B?” is a foolish question if one doesn’t ever examine what is done with tools A and B. It’s as if one tried to answer the question, “Are books better than pencil and paper in classrooms?” by running a carefully controlled study in which half the classrooms used each without regard to purpose [44].

Design-based research is a type of research methodology, primarily used in Learning Sciences, that combines software design with education research through *in situ* research components [83]. Design-based research often aims to conceptualize interventions through theory, looking for “patterns that hold true across time and space” as well as identifying constructs that change due to social context. In design-based research, researchers test ecological validity of concepts/theories about the social

context while simultaneously developing a framework for the system design. Design based research often involves a complex system of strategically anticipating user needs, clarifying context through ethnographic observation, and generating new theories and system designs based on the successes and failures of previous iterations. The common problem with this approach, however, is that good design research does not often lead to good data or good results. The methodology employed here is just the beginning to understanding socially expanded play environments and the implementation of socially pervasive game designs.

As we learn from education research, while it may be clear from empirical evaluation that an educational solution can cause learning, it may not be clear in which contexts it may be effective. Consider randomized controlled trial evaluations. This is a dangerous way of testing a solution when issues of context are not resolved. “The use of randomized trials may hinder innovation studies by prematurely judging the efficacy of an intervention. Additionally, randomized trials may systematically fail to account for phenomena that are contextually dependent or those that result from the interactions of dozens, if not hundreds of factors [20]. Design research allows the researcher to understand more about the complex environment surrounding the solution, specifically, which elements may have some causal relationships to the effects that are being measured.

In the next chapter, I will further explain the construction of 3PL through a design narrative of *Snag'em*, a game that I designed for play in serious academic environments. I will highlight areas of the magic circle that proved important through several iterations. In my approach, I use several system design iterations and observations

to inform the construction of a *game ecology* rather than a *learning ecology*, often discussed in education research. The game evaluation evolved along with the development of Snag'em and the pervasive play lens. In each iteration of the game, data were considered according to the (then-current) understanding of the pervasive play space. As latent variables became apparent through evaluation of in-game data and ethnographic observation, they were organized within three key factors of Snag'em's success: adoption¹¹, acceptance*¹², and adaptability*¹³.

¹¹increasing population or players and player engagement

¹²tolerance of the system's presence in the environment, especially among non-players

¹³The ability of a game to adjust to individual players' levels of engagement and play preferences (emphasized) and changes in the social environment (not as emphasized in Snag'em)

CHAPTER 3: INTRODUCING SNAG'EM

3.1 Purpose of Project

Communities are defined as a result of interaction and deliberation by people brought together by similar interests and common goals [108]. These interactions, though, do not always create a community that is representative of all members. Individual factors such as level of extroversion, position within the community, and even native language can cause social inequality among members of the group, influencing the growth of the community [59]. In a conference setting, this can impact the way individuals interact with one another and could be detrimental to overall conference success as well as each individual's feeling of belonging.

A sense of community is paramount in an academic setting. A student's feeling of belonging within their college, or even specific department, has a strong positive correlation to that person's academic success within their major. This effect is particularly important in math and the sciences, where minority students suffer without a strong student support group [99]. This feeling of community can be nurtured with small group activities that augment the individual's role within a group and help students foster connections [97]. Creating an educational community that actively involves students with other members of the institution, particularly their peers, strongly correlates to both student success and the institutions retention rates

[96][97]. This emphasis on collaborative learning is vital, with Wegerif once noting that “without a feeling of community, people are on their own, likely to be anxious, defensive, and unwilling to take the risks involved in learning [106].”

Student social interaction is difficult to integrate into the academic agenda. There are a few possible reasons for this: professors who do try to encourage social interaction, are unsure of the proper way to approach the problem [9][27]. Furthermore, encouragement of student socialization is not universal; some professors believe that building student soft skills is not their responsibility, or that there is not enough time to cover material while designing an environment that facilitates group interaction between students. Snag'em is a proposed solution for social networking at academic conferences that supports community building through simple play mechanics and a play-themed networking support system. Snag'em allows professors and other community leaders to address the issue of social integration without dedicating excessive time and resources to the initiative.

Unfortunately, social interaction among students does not just happen (even in fun settings); rather, it must be intentionally designed in order to produce the intended results [97]. A few academic institutions have created technological ways to promote community through ubiquitous, proactive peripheral displays [22][59], RFID tags [23], and wearable computers and devices [104], though little work has been done to systematically evaluate these techniques or explore the effects of facilitated interaction on participants' sense of community. In these cases, systems often create *social weight*: unintentional negative social effects as a result of the system's presence. Snag'em is no different, and many iterations of the game's play mechanics and feature sets were

required to refine the game so it promotes high engagement and continued use while minimizing social weight.

Social gaming is quickly becoming a major category of applications on smart phones and social sites [70] [85], but there are few of these applications for in-person social networking. This chapter presents the evolution of Snag'em, an in-person pervasive game to foster and facilitate social networking in academic conferences and events. Snag'em has been iteratively refined and specially designed to improve its social adoption and effectiveness at increasing sense of community at a conference. As revealed in the narrative, the game's effectiveness at increasing sense of community was also dependant on other factors, including the game's acceptance among non-players, and the game's ability to adapt to how and when people wanted to play, and the game's overall adoption by a significant portion of the community .

3.2 Background and Related Work

Snag'em was initially created to provide networking opportunities for college students who attend the annual STARS Celebration conference, an NSF-funded computing diversity and retention initiative. While the conference was effective in promoting a sense of community, computing students and faculty needed a way to make stronger, longer lasting connections with other STARS members. Conference ice-breakers got the process started, but since most conference attendees were students who'd never attended a conference before, they needed to be educated on how to make new connections, track contact information, and think of ways to remember the people they met. Snag'em was created to solve this problem.

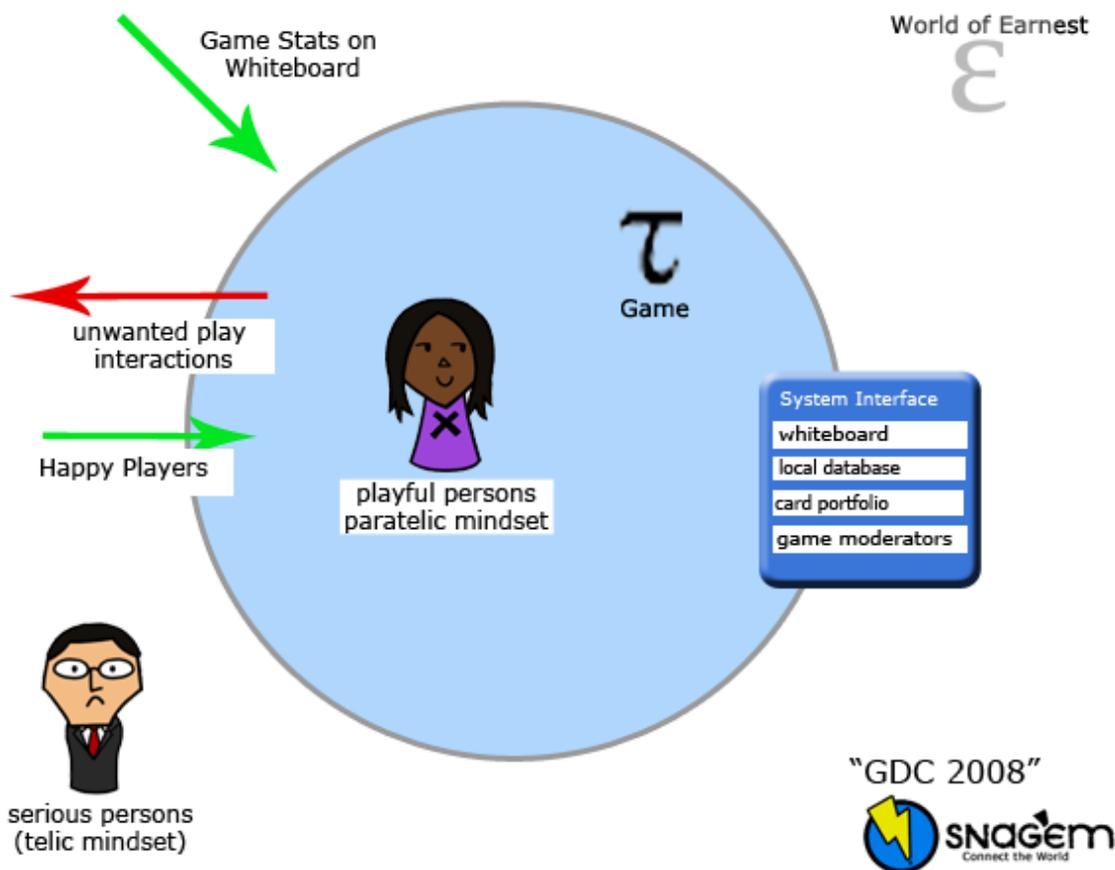


Figure 10: In this original lens, the organize the mindsets of players engaged in a socially pervasive game as opposed to players not engaged with the system. The lens is made of one circle, as the other boundaries have yet to be established.

Snag'em was modeled after Game Lab's "Destroy All Developers" game [62], a business card trading game created for the 2008 Game Developers Conference, where players joined teams and earned points by finding business cards that met certain criteria. The game moderators recorded game interactions in a local database at the game registration site, and posted game statistics on a whiteboard every hour. The game encouraged many new conference attendees to interact with each other to hone their networking abilities. This game had a unique ability to create a lusory* attitude in players, or in other words, encouraged the mindset of doing something inconvenient

or unwanted for the sake of game rules and game play. Destroy All Developers put the uncomfortable task of “cold” networking, i.e. approaching someone and introducing oneself without prompting, in the context of a game, making the task instantly playful and less stressful. For first time Game Developers Conference (GDC) attendees (such as myself), the originally telic* (serious/ non-playful) task of approaching and networking with hundreds of important business professionals can cause considerable unease and anxiety. However, when it was approached as a playful, or paratelic* task as part of a game, meeting new people became part of a mutual endeavor that was fun and exciting. It was this fundamental insight on what happens within as opposed to outside of a magic circle that generated the original play lens theory (as seen in Figure 10), that play can motivate networking if a shift in mindset is established. Snag'em expanded on this game by moving it to a technological interface, improving mission tracking and increasing mobility and accessibility. This move also allowed for the addition of player-created tags and other collectible items like badges, while still providing players with a paperless way to track contacts.

It was clear from participating in the Destroy All Developers game that a switch from serious networking to playful networking could cause more people to engage in networking activity. Beyond that, it was unclear what other effects a networking game would have on a considerably more serious environment. Game Developers Conference is a playful environment in comparison to other professional or academic conferences; after all, it is the attendees' professional business to pursue and create fun experiences. But even in the playful GDC environment, I still observed that non-players could become irritated by the interactions that the game inspired.

3.2.1 Networking Facilitation at Academic Conferences

Within the last decade, there have been several attempts to augment academic conferences with software and hardware solutions that can suggest friends based on your activities [95], locate specific conference members [88][60], store information about these conference members [25][77], detail information about people in a user's general vicinity [59], and store information about meaningful conference connections [14]. SpotMe, an industry-developed social networking system, provides members with a portable device that tracks other SpotMe members [88]. The SpotMe system also tracks users' interests, and notifies an individual when someone with similar interests is within a close distance. While SpotMe can help a conference member locate a person of interest, CharmBadge can help them log that person's information. CharmBadge, a product created by Charmed Technology, Inc., includes attendee's business card information in their system [46]. When two conference members interact, their individual e-information is added to each other's personal contact database. At any time, conference attendees can log in to their personal CharmBadge webpage and view the contact information of all of the participants they have interacted with. The Poken project also provides users with a "cute" RFID device that trades business card information when players touch the devices together (a Poken handshake) [77]; this technology was embraced by students attending the Grace Hopper Celebration of Women in Computing Conference in 2010.

CONNECT (Creating Open Networks and Expanding Connections with Technology) supports conference attendees' personal networking goals and tracks connections

made [14]. To start playing, CONNECT participants register and answer a few questions about the type of people they would like meet while at the conference (e.g. researchers, industry professionals, peers etc.). At the conference, CONNECT participants who wish to “connect” with one another both have their conference badges scanned with a dedicated CONNECT RFID scanner. At the end of each day CONNECT users receive an email showing them their progress on networking goals and suggested connections for the next day. At the end of the conference, CONNECT emails users their contacts [14]. Instead of leaving a conference with a pile of business cards, this system collects virtual business cards in a single place, and was well received as the networking solution at Grace Hopper 2009.

All of these systems use strategies to ensure quick dissemination of relevant information to their clients. These systems place an emphasis on allowing users to organize and exchange contact information as well as quickly identifying persons of interest. It is clear that in order for players to recognize the system as a social networking tool, the system should employ virtual business card functionality by sending out a summary of connections at the end of the conference, reporting why a connection was made, reminding players how that connection was meaningful, and whenever possible, connecting players based on whatever contextual information the system has access to.

Unfortunately, while these systems show degrees of varying success and are financially successful projects, most of these projects remain unpublished. “Neighborhood Window” (NW) and “Ticket2Talk” (T2T) projects are academically published social network systems that use Proactive Displays and RFID based to encourage confer-

ence attendees to initiate conversations with each other based on similar interests. Neighborhood Window uses tags as in Snag'em, where users tag themselves with personal interests, and later when near a NW display, the display will show a network of surrounding players' tags and how they relate to the user's personal tags [60]. Similarly, Ticket2Talk users select conversation topics for themselves, and then when Ticket2Talk players are near a display, the T2T display will show show a topic that two nearby users would like to talk about. T2T and NW displays are situated in food and beverage areas, show relevant data about other conference attendees located within the area, and help people leverage time they already spend in these locations to meet others[60]. Attendee data included what talks a person was doing at the conference, and self-reported interest tags. The evaluation of Proactive Displays (NW and T2T) was centered on qualitative data through observation and open-ended surveys.

The authors implemented T2T and NW using new, unfamiliar technology and like many Tech Major papers, feedback suggested that the system was, in some ways, too novel to be pervasive. The qualitative data collected indicated that, often, the users who engaged with these displays watched them like TVs instead of approaching each other [60]. There was also large concern among attendees about privacy that caused apprehension for system adoption. Ironically, the wide options of privacy settings made the system hard to use and caused user frustration.

Overall, however, the authors of the system determined that the system did meet its goal of enhancing the feeling of community among the conference attendees. After categorizing the open-ended feedback collected for the two systems as primarily positive or negative, it was clear that most responses were positive feedback responses.

For them, enhancing community can be about “increasing opportunities for interaction, number of interactions, and quality of interactions [60]”. Open-ended responses suggested that these systems did all of these things while maintaining “plausible ignore-ability”, meaning the system did not force or make people feel uncomfortable about not interacting with other users.

Snag'em integrates many of the features of these successful networking applications developed for conferences. For example, Snag'em users can view their social network, see the names and avatars of attendees, store contact information of other players, find players with similar interests, or learn about and advertise relevant events to the community. The evaluation of Snag'em is designed to investigate what game systems and mechanics are conducive to positive networking interactions. Our goal is to help future designers create meaningful play experiences where the *game experience succeeds at increasing one's sense of social integration in a socially acceptable manner*.

3.3 What is Snag'em?

Snag'em is a large, socially pervasive, group networking game that is essentially a human scavenger hunt. Snag'em is played online, via browser, but can also be played on smartphones and via SMS. The game was developed in PHP, providing a web-based front-end which allows players to create on-line profiles, shown in Figure 11. Players create a list of facts (known as *tags*) about themselves (as seen in Figure 12), such as school, favorite games, and hobbies. The game uses these tags to create missions for individual players. Missions are presented in the format, “Snag someone who works in the Games and Learning Lab,” and can only be completed by interacting

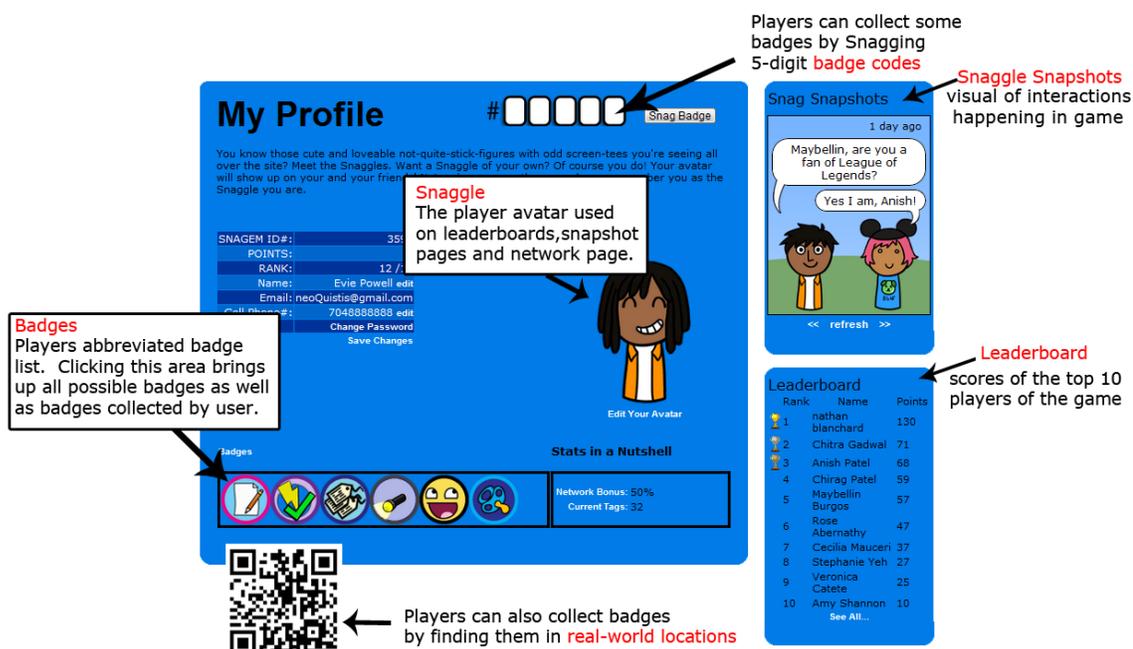


Figure 11: Screenshot of the Snag'em profile page. Players play via most any web browser or via SMS texting. Players can edit their profiles and view their badges on this page.



Figure 12: Close up of the Snaggle Snapshot section of the website. When a mission is achieved, such as “Snag someone who is a card player,” this interaction between two players is visualized on the Snag'em website.

with a Snag'em user who has tagged themselves with this qualification. Recent snags are visualized on the snagemgame.com website, as illustrated in Figure 12. Players are randomly assigned to teams, where player individual scores contribute towards team scores. Players can recruit new players to their team as well. The team and the players with the most points at the end of the event win the game.

After the event ends, Snag'em sends each player an email with fun game statistics

and the contact information and tags for all the people met through game play. Contact information also includes contextual data including when and for what reason they snagged each player. Any notes or messages they've received from a player will be sent in the email.

3.3.1 Game Play and Mechanics

At a conference, the Snag'em game starts at a recruitment table. Often situated near the conference registration table, the recruitment table is usually outfitted with five to ten laptops preloaded with the Snag'em registration page. One or more moderators sit at the table with several Snag'em promotional posters and fliers, as shown in Figure 13. The moderator explains the game to passers-by, and helps those interested in playing the game with getting registered. If time permits, the moderator will also help the player complete their first mission (described below). At the end of registration, the new player is given a *Snag'em sticker* to place on their conference badge. The Snag'em sticker indicates to others that the conference attendee is participating in the game, thus making the player more approachable to other players, and helping avoid confusing or off-putting interactions with non-players.

To create a Snag'em profile, players add character tags, and can also design a *Snag-gle*, or virtual avatar. At all times, the game procedurally generates five missions for each player, with examples shown in Figure 14. On occasion, the game also generates a Golden Mission that suggests connections based on shared research interests and shared home institutions (university or work place). Players can choose to pursue a mission that best fits the type of person they want to meet, and can choose to

“forfeit” missions they are not interested in for a small point penalty. To complete a mission, players must meet a player present at the conference that meets the mission criteria, and ask them for their 4-digit Snag ID. As shown in Figure 15, players have three ways to *snag* their target: by entering the target’s Snag ID into the Snag’em website, mobile app, or sending it to the game via text message. Players are discouraged from guessing random Snag IDs through a penalty for incorrect snags. The pool of customizable tags encourages more meaningful conversations with an individual, as the tags are generated in part by the players, ensuring that the missions support *mutual revelation* [59]; allowing attendees to learn more about subjects other players want to converse about. Snag penalties also motivate the player to make sure the



Figure 13: A few of various posters used for promoting Snag’em at events. The lightning bolt is the official Snag’em logo. Posters also include event-specific QR codes that take people to the game website, or unlock special badges.

person does, in fact, have the trait they need to locate through conversation.

In Snag'em, mission difficulty is defined by the probability that a person in the community has a given tag. More points are awarded for more difficult missions, and players are able to view the percentage of players with the tag requested in a mission before attempting to complete the mission. To ensure that missions are neither too easy nor too tedious, missions are only generated when 10% - 90% of players fit the given qualification. When the player has achieved a mission, their score is updated and they can continue snagging, since the game keeps their other four missions and generates a new one to replace the achieved mission.

Badges are a system of collectible virtual tokens that decorate a player's name on the game leader board. A side quest of the main game (added after STARS 2010) is to collect the available badges in a game. Badges can be collected by completing badge quests, which vary from "Log in five times" to "Recruit ten new people into the game" to "Suggest a tag to a player". Players can also collect badges at physical locations that are marked with badge codes. The badge system enables developers and game moderators to direct game play towards conference-specific goals.

In addition to individual badge achievements, teammates are encouraged to work together to complete team achievement missions. Upon registration, players are randomly assigned to one of three teams, and are given the tag for this team as well. The team names can be chosen by the conference organizer; by default, they are: pirates, ninjas, and zombies. Breaking the conference into three teams is partially inspired by another GDC game, where players were split into 4 teams and played a territory-winning game on displays scattered throughout the conference. This game

	Find Tiffany Barnes
Golden Mission	Tiffany is most likely a future collaborator on research endeavors. Make sure to meet this person!
	Connect Evie Powell and Drew Berrymore
Ultimate Networker	Connect people in your network that have not yet met each other for the ultimate networker bonus!
	Find Veronica Catete
Sting Operation	Upon completion of this mission, Veronica will be stunned and unable to score points for FIVE minutes.
	Find someone who plays Minecraft
Hobbyist Mission	Find someone who shares your hobbies and interests. 14% of Snag'em players share this tag.
	Find someone who collects stamps
Random Mission	Randomly generated hard mission. 11% of Snag'em players share this tag.
	Find someone who is playing Snag'em for the first time.
Random Mission	Randomly generated easy mission. 72% of Snag'em players share this tag.

Figure 14: The various types of missions that are generated in Snag'em. Golden Missions are only generated when the game finds meaningful connections between its players.

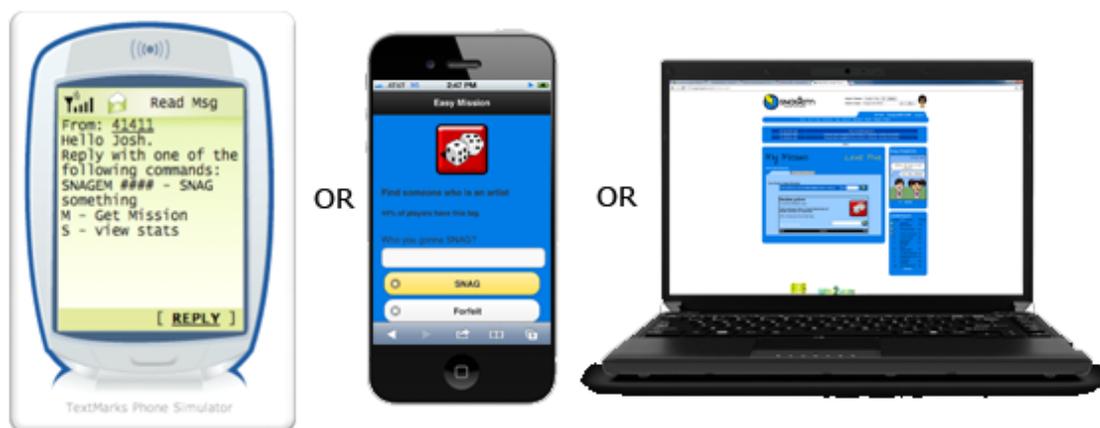


Figure 15: Examples of Snag'em mission page on a feature cellphone, a smart phone, and a laptop. Snag'em system is available on many different platforms to maximize accessibility.

encouraged people to bond with strangers on their teams over the team performance and gave people a social reason to engage in the game.

Team quests are designed to be too large for a single player to complete alone and require the collaboration of several team members to complete. These quests were added in 2012, after the FDG conference. By completing team achievement missions, players upgrade their Snaggle Castles, adding new features like a moat, a dragon, or a fancier castle. When logged into the website, players can see their Snaggles going in and out of their team castles, as shown in Figure 16. Castle size is dependent on team score, so teams with higher scores have visibly bigger castles. Team scores are computed as the sum of player scores.

In addition, players can also complete *event* missions. This feature was added after STARS 2011 and used at later conferences. Community events are particular conference sessions and events that moderators can add via the Snag'em website. Once added, they appear as event missions, and players can 'snag' events by attending

The screenshot displays a game interface with a dark blue header bar at the top containing team scores: **Ninjas: 382**, **Pirates: 330**, and **Zombies: 284**. Below the header is a 3D-rendered landscape with three castles on a green hill. The left castle is grey with blue flags, the middle is grey with red flags and a skull-and-crossbones, and the right is grey with green flags. A small avatar labeled 'amyra' is visible near the right castle. Below the landscape, the text 'Team Achievements' is written in a large, white, handwritten font. Underneath, a message reads: 'You are a **Pirate!** Work with your team to complete these missions:'. Three mission bars are listed below, each with a checkbox on the left and the mission name in white text on a dark blue background. The first bar has a green checkmark and the text 'Week 1: All In' followed by 'Mission Complete!' on the right. The second bar has an empty checkbox and the text 'Week 2: 150+ Tags'. The third bar has an empty checkbox and the text 'Week 3: Inter Mingle'.

Figure 16: Team Achievements are shown on the main page after a player logs into the website. Team Scores are displayed along the top of the castle visual.

the event and snagging a secret code given by a presenter or moderator (this was initially created for workshops or seminar sessions). Players add multipliers to their scores by snagging other community event attendees. Players are discouraged from interrupting the event by snagging people during the event by ensuring that event organizers give the event code at the end of the event. Snag'em event duration is longer than the event's duration so that players can wait until after the event speaker is presenting to make snags. An even bigger bonus is given when one player snags another player that has already checked in to an event.

3.3.2 Network Connectivity

Snag'em encourages players to build large networks that promote strong ties by offering connectivity bonuses that boost how many points are earned for a particular snag. Strong ties in networks have been linked to increases in trusting relationships and increased sharing of important information[101]. These interactions are promoted within game mechanics so that stronger ties between players can be established. When two people mutually snag each other, the connection is considered a strong connection. When snags are not mutual, a weak connection is created between the two players. Figure 17 shows two examples of networks to illustrate the difference between a 'weak' or 'strong' social network. The bonuses for strong connections in Snag'em were designed to encourage desirable social behavior by making it advantageous to participate in reciprocal snags and to engage in pleasant interactions with other players so that they will want to play again later. Researchers in Social network analysis accept the idea that ties between two entities are stronger when reciprocal and repeated interactions occur[42].

By awarding more points for more complete networks, Snag'em also encourages players to help their already-snagged friends to complete missions in order to form stronger in-game networks. Players can find out about the connectivity of their networks on the player's personal network page, that shows a visualization of players' social networks. This visualization gives players one more way to think about how they are relating to others at the conference, encouraging them to make reciprocal snags and introduce people they've met to one another. Although mutual snags

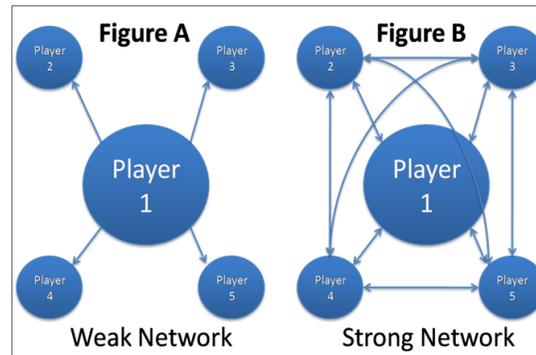


Figure 17: The difference between weak and strong social networks. In a game that promotes weak networks, Player 1 is more likely participating in unwanted sociability like badgering players for their IDS or hiding his badge from other players so they can't get points.

result in bonuses, repeatedly snagging the same player results in a Snag penalty. This system encourages players to continue adding new people to the network, while also promoting regularity in these interactions to build strong connections. Figure 18 shows the personal network visualization on the right, and the conference-wide Snag'em network visualization on the left. On the Snag'em website and at the main Snag'em table at the conference, one display is usually showing the conference network overall - allowing people to see when new players join, and when new connections are made. The global networking visualization further illustrates meaningful play in our system, showing how short fun missions bring people together and help foster community-building interactions.

3.3.3 Development Details

Players connect to Snag'em via browser or SMS text messaging. Players can access their missions and snag other players via text message. Snag'em uses the TextMarks SMS API to accept text messages sent to a specific number. The Snag'em website was developed for both standard and mobile web browsers using PHP, Javascript,

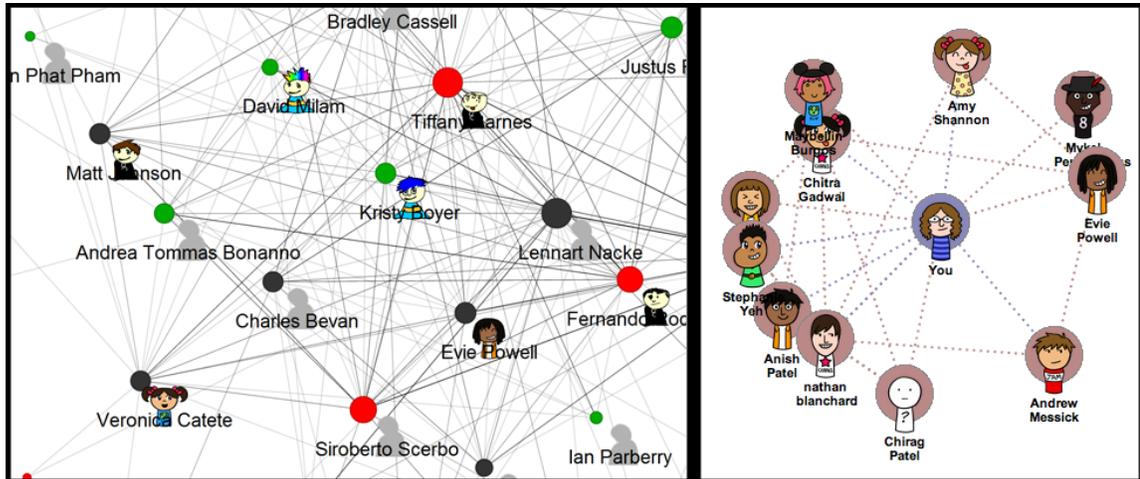


Figure 18: The Snag'em network visualizations. The global network shows everyone's connections, using line thickness to represent strength of connections, this visualization is often displayed at the Snag'em recruitment table of conferences. The personalized network shows connections of the logged in player and their friends' connections.

Ajax, MySQL and HTML5 canvas. The network visualizations are built using jsviz and Protovis. Snag'em uses MySQL relational databases, with one master database to track all the people registered for game events and deployed versions of the game. Most of the game's interactions are enabled by the flexible MySQL database design, which allows new types of tags and missions to be integrated into the game easily. Each conference implementation uses a separate database and web address, referred to as a game session, so the game feels tailored to each conference, with its own unique game tags and badges. This architecture allows players to play at several events using the same game account. Each session records time-stamped logs of each game interaction. This allows for error tracking without removing evidence of an event occurrence.

3.4 The Prototype: A Game for the Masses

The primary game mechanic in Snag'em is social networking through talking to people. In order to succeed in the game, players must develop ways of networking with new people. Over time, the game has been refined based on successes and failures of previous sessions as well as guidelines to achieve the desired game effect.

The first version of Snag'em was a simple expansion of Destroy all Developers, based on the assumption that making the system more integrated with technology would make the game more accessible, reducing time and spatial commitments. This belief was based on the fact that Destroy all Developers at GDC was a time and space commitment, particularly for committed players like myself. Since I had traded business cards with so many people, I had to purchase a business card portfolio in order to better organize my interactions. If an interaction was meaningful outside of the game (most of them were not) then I had to take notes about the person and tuck that note away with the business card in order to remember why that particular interaction was important. Because the database associated with the game was not online, I had to wait in line to have my score hand-verified and updated, causing me to skip several sessions and workshops. While the game was enjoyable and encouraged me to approach more conference participants, it wasn't easy to play the game competitively, and I had to sacrifice time that might have been better used at the conference to play it.

Based on this experience, the fundamental flaw of Destroy all Developers seemed to be its lack of technology. Therefore, Snag'em was built to implement a very simple

initial set of rules, but allow play online and via text messaging. A player registered by providing their name, email, and school. Players then received procedurally generated missions to Snag other players based on first name, last name, and school. Every mission was worth $n+1$ points, n being the number of missions completed (ex: a player's fifth mission was worth six points). Players could lose points by snagging the wrong person for a mission; this would prevent players from gaming the system by collecting player IDs and systematically guessing. The game could be played via any web browser and SMS messaging, to ensure that players could connect to the game quickly, and between conference sessions. The original skin for the Snag'em website was a dark assassin theme, as in a shooter or hunting game. Players were allowed to collect a sticker upon registration, and again after completing every 10 missions. First, second, and third place prizes were offered for players with the highest number of points to stimulate interest in the game.

3.4.1 STARS 2009: Methods

I performed a pilot study on Snag'em at the STARS Celebration 2009, which was held in Tallahassee, Florida, and hosted at FAMU and FSU campuses. The study was informal, and participants were asked to volunteer to play the game and provide feedback through an online survey after playing. The game was fully integrated with the STARS Celebration conference. This means the conference organizers integrated Snag'em into the conference experience, providing Snag'em with a list of attendees, and providing Snag'em with a "booth" set up near the registration desk for the duration of the conference. The booth was always staffed by at least one moderator,

who explained the game and its purpose¹⁴, and provided two Snag'em laptops for people to register to play. At this initial pilot, Snag'em points were awarded to players who also played the pilot Table Tilt team building game (discussed in Chapter 4). On the last day of the conference, sixteen Snag'em players completed surveys to provide feedback on their game play experience. The survey can be found in Appendix A. Note that, at this point, the evaluation was focused on adoption, or level of engagement by individual players.

Table 1: General demographics of STARS 2009. Active and passive playership is reported differently here than in other studies. Here, active players scored 2 or more missions, interested scored one mission.

# of participants	Snag'em Participants	Conference attendees
Overall	N = 80	N = 280
Gender		
Females	50.0%(N = 40)	60.0%(N = 168)
Players		
Active	100.0%(N = 80)	28.6%(N=80)
Interested	35.0%(N = 28)	10.0% (N=28)
	50.0%(N = 40)	14.3%(N= 40)

3.4.2 STARS 2009: Prototype Evaluation

At STARS 2009, 28% of the conference attendees played Snag'em over the course of three days. Table 1 shows statistics and data for Snag'em and the conference.

In 2009, “players” were identified as anyone that registered for the game. “Active

¹⁴The purpose of Snag'em, as explained by moderators, is to provide a social networking solution at the conference, to help encourage attendees to meet one and remember the people they've met.

players” scored two or more snags in the game. Interested players were players that scored one or more missions in the game, including “active” players¹⁵. Moderators informally recorded observing nine players (11%) using the text-messaging version of the game. Player activity was consistent throughout the conference, with players playing at all hours of the day from as early as 8:30 am to as late as 10:00 p.m., even though conference sessions usually ended at 6:30 p.m. Even though the game suffered from two external server shutdowns, and several hacking attempts, with players giving themselves points and attempting to destroy parts of the database with SQL injections, players resumed play as soon as the game came back online. Despite the game’s vulnerabilities, Snag’em received positive feedback, and the game moderators observed that several players were among the most gregarious attendees at the conference. Based on the game’s popularity, faculty from Spelman College asked to use the game during a weeklong ‘Geek Week’ event the following semester.

The survey responses collected at the end of the conference were largely positive, with people indicating that the game was easy to understand, the graphics were fun and appealing, and people overall appreciated having the option to play Snag’em via text messaging. Most players indicated that their favorite affordance was meeting new people. When asked what they would like to see added to the game, a few players indicated that they would like to receive points for being snagged. They also indicated that it was often difficult to tell who was playing, asking for better physical ways to identify players. Many players indicated that the game changed their conference experience for the good. One survey participant had this to say

¹⁵A discussion on the breakup between active and interested players can be found in Appendix B

when asked what their favorite feature/experience was in the game:

“I liked meeting so many new people. I probably wouldn’t have introduced myself to some of the interesting people that I did, had there not been some icebreaker type reasoning behind it such as, ‘Are you playing Snag’em?’ Now, I’m friends with cool people who I otherwise wouldn’t have known.”

3.4.3 Reflection

This initial prototype brought some success and some surprises. Though the surveys indicated that active players were fine with the look and feel of the game, less enthusiastic players told moderators the game was too ‘dark’. Some people were discouraged by some avid players’ undesirable social behaviors, like hiding their Snag ID number, or badgering others into providing their Snag IDs without trying to get to know the other player. There were also many interesting game strategies. One set of players looked up people on the STARS conference roster on Facebook. Using the pictures they found there, they would track down the newly visually identifiable players, and wrote down their Snag ID numbers along with any school or other information they could gather without talking to a person.

These discoveries implied that Snag’em needed a friendlier look and feel, and the game mechanic needed tweaking so that people being snagged didn’t feel as if the person snagging them was benefiting but they were not. This second observation revealed that social networking is not and should not be a zero sum game - there should be no winner or loser in a single face-to-face interaction; it should be mutually beneficial. The leader board itself reflected a divide among players, with only 10

people playing competitively and a larger number of players who gave up early on, after deciding they could not win without devoting the majority of their conference experience to the game. King-making behavior, i.e. trying to help another person win because it's impossible to win yourself, made these score disparities even greater.

3.4.4 Revising Game (τ) and adding Earnest (ε): Game mechanics for non-gamers

The prototype feedback indicated that the play demographic consisted of the youngest, most competitive of the community. In the play lens, these players are represented as being fully encased in the Game (τ) space. Attendees that decided not to engage with the system often thought the game was too dark and that the game mechanic introduced inappropriate behavior into the conference experience. This is illustrated in Figure 19 as a red arrow labeled with “non-appealing graphics” leading away from the game’s magic circle and towards Earnest (ε); a negative effect of the game’s graphics. This effect inspired reconstructing the game appearance to appeal to the people who made up the majority of the conference where Snag’em was staged (not just young gamers).

In addition to repelling more serious players through appearance, game rules led adoptive players to prefer short and shallow interactions (weak connections) over longer and repeated interactions (strong connections). Many players failed to employ socially acceptable networking techniques while playing, and moderators observed faculty and other students avoiding the game and its players. It was necessary to look at ways to make the game more approachable in a conference context, and a more useful tool for those that did actively play the game. These observations led

to a refinement of the space outside the game's boundaries. Figure 19 demonstrates the boundaries between the Snag'em game τ , the playful space of paideia (π), and the earnest (ε). After observing the characteristics of players and non-players, we attempted to place members of the community in the play circles, and marked different features and affordances in the game that inhibit (red) or encourage (green) people to move between these spaces. We observed that though we had many people score points, there were few players that were trying to win, other players (often friends of gamers) were content with helping a friend win (kingmaking), or just being snagged by competitive players. The arrows start and end in the spaces that are affected by the construct. For example, non-players that experienced a non-appealing game interaction were often repelled from entering the paideia play circle, instead staying in the World of Earnest, rejecting the game before they attempted to interact with the interface. New players and passive players (in the paideia play space) were prevented from entering the more engaged game circle when established players would hide their badges and make it difficult to score points.

3.5 Snag'em 1.0: Integrating with a community

After the Snag'em playtest at STARS 2009, several students who became interested in the game and how it changed the feel of the STARS conference joined the Snag'em development team. Since the game did not explicitly promote meaningful interactions, and good networking practices were completely dependent on individual players, the team created more concrete design requirements for the next iteration of Snag'em, as listed in 2.

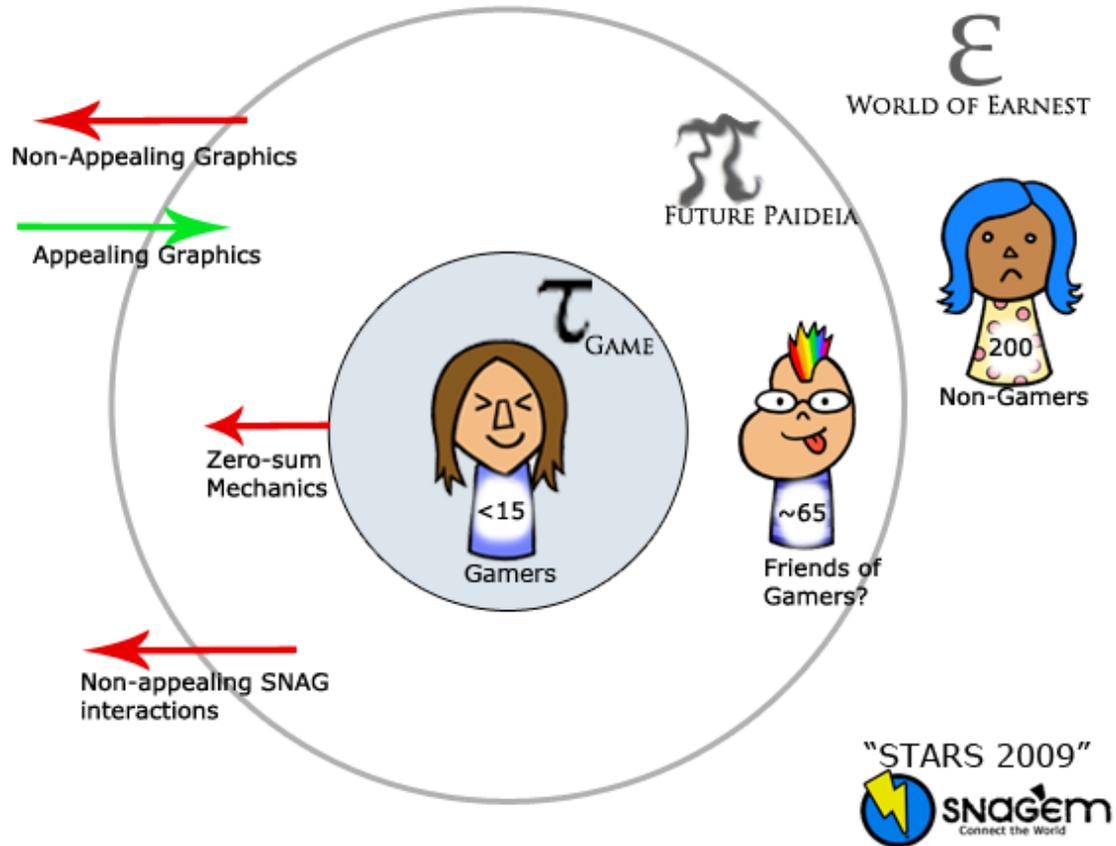


Figure 19: Visualization of the understanding of the game in relation to the conference as of 2009.

To meet these goals, the following additions were made to Snag'em. These additions are also summarized in Figure 20.

3.5.1 Addition 1 - Networking Game Mechanics

Snag'em was intended and designed to match ideal networking solutions in Snag'em to those found in real life. When networking professionally, it is advantageous to not only build strong relationships with others in your network, but to also be the person that connects people together. When these tips are translated to graph theory, with players as nodes in a network, and the snags between them as edges, an ideal player network would be large and dense, with repeated and reciprocal (directed)

Table 2: The design requirements for Snag'em 1.0.

Observations	Requirements	Features	Expected Outcomes
Players kept lists of people they snagged to limit interactions.	Players shall be motivated to maintain connections with others participating in the game.	Repeat Snags are a legal game move.	Game (τ) mechanic causes engaged players to interact more often.
<i>Mechanic Dilemma</i> <i>If repeat snags are possible, then what motivates players to talk to new people?</i>	Players shall be motivated to talk to people they do not know.	Game scoring limits payoff for repeat Snags by introducing a repeat snag penalties.	Game (τ) mechanic causes engaged players to reach out to other/new players.
Players hiding conference badges so that other players could not pull ahead in score.	Players shall be encouraged to help others in game and help make more connections in the game.	Network connectivity bonus Cupcake points	Game (τ) mechanic for engaged players makes being snagged and connecting others in your networking favorable.
Attendees reported frustration at non-meaningful missions. Missions did not inspire conversation. Players only had to look at conference badges.	Connections shall be made relevant for both persons participating in the Snag, regardless of if the person being snagged is a τ or ϵ attendee.	Interest missions through Tags Game Moderation	Serious persons (ϵ) will be more willing to participate in snags. Engaged players (τ) will be more likely to have meaningful conversations.
Attendees reported the games appearance as being too dark. This was also believed to affect the mood of the game.	The mood of the game shall be more appropriate for a serious setting.	Default game visuals were revised to be less dark. Visual themes were customizable.	Serious persons (ϵ) find game appearance appropriate. Playful persons (τ) can benefit from playful mindset.
Snag'em Team had to go through player scores and infer number of snags. Other player behaviors were not traceable via the Snag'em database.	Game shall track player activity more closely.	Database redesigned to log more interactions during game sessions.	Better understanding of player behavior in future events.

connections between the nodes, by the end of the conference. Snag'em STARS 2009 playtesting revealed that the existing design did not employ enough game rules to prevent directed and sparsely connected network graphs. As a result, a lot of the players made connections that were most likely shallow and unhelpful.

To remedy this problem, we added a booster to game score through network con-

nectivity bonus. In addition to getting a base score per mission, players also received an additional bonus percentage of that base score based on the connectedness of their network. For example, if a player had a network containing two other players besides herself, she would receive a network bonus of $2/6$ (33%) if she had only snagged those two players and they did not snag her back. If they snag her back, that would create a network bonus of $4/4$ (66%). She would receive a full 100% network bonus if those two player also bridged the connections with each other.

3.5.2 Addition 2- Introducing context with Interest Missions

To promote more meaningful conversations, I scaled back the points for Name Game missions and created Interest missions where players suggest tags for themselves that represent their interests and things they would enjoy talking about. The intention for interest missions was to prevent players from treating other players as faceless resources in a game, but to require more conversation, while still keeping the missions possible. As a result of having to ask someone about their interests, players should have more authentic conversations to know the value of an individual player for particular missions. Interest missions are given points based on their rarity. Rare interests are harder to come by so missions to find them are worth more than common missions.

3.5.3 Addition 3- Cupcake points

To prevent players from hiding their Snag IDs, I invented “cupcake points” to offer an incentive for being snagged by other players. This addition effectively shifted Snag'em from zero-sum gameplay, where one player's success means another player's

loss, to positive-sum gameplay where it is advantageous to help another player grow in the game. To promote stronger connections between people, new “connectivity bonuses” make interest missions worth more points if they result in your network becoming stronger (more highly connected). Networks can become stronger through reciprocal snags or by creating a connection between two other players in your network. In this way, it is advantageous for players to keep talking to people they’ve met before. In the previous version of Snag’em, it was not possible to snag a person you’ve snagged in the past. This was to prevent players only playing with a small group of friends, but in the game it resulted in players avoiding repeat interactions. To limit abuse of the connectivity bonus, I also introduced a repeat Snag Penalty. The Snag Penalty allows players to snag the same person multiple times, but reduces the points per mission for snagging someone you’ve snagged repeatedly. By introducing the Snag Penalty and Connectivity Bonuses, I hoped to encourage people to revisit players they’ve connected to previously without allowing them to keep playing in their already pre-established group of friends.

3.5.4 Addition 4- Game Moderation

To allow players to tag themselves with their own interests, I added customizable tags. However, anything customizable in a game needs to be moderated, since it doesn’t take long for players to create inappropriate tags. The new Administration page made it easier for moderators to see what players are submitting to the tag tree, confirm that they are committing them to the correct part of the tree, and to ensure that players are always receiving missions that are possible to complete. The

Administration page also allows moderators to broadcast messages to players easily.

3.5.5 Addition 5- Increasing Engagement through Visuals

Based on player feedback that the dark original Snag'em website theme promoted competition and 'survival', I added a selection of game 'skins' to allow players to customize their game experience. The skins were in several different colors, made to appeal to different genders and age groups. I also added an avatar builder and a personal network page to help players visualize themselves and their connections in the game ¹⁶. On the Network page, players see the names and avatars of everyone in their networks to help them visualize their progress in building strong networks, or to remember the name of that interesting person they met.

3.5.6 Addition 6 - Data Logging

To observe player behaviors and track activity during the conference, I added a relational database to log key interactions including: login times, snags (who snagged who), Missions (who had/completed what mission), and Tags (who added what tags). The resulting system provides considerable insight into player behaviors.

3.6 Snag'em at STARS Celebration 2010

STARS Celebration 2010 was held in Champion's Gate, Florida at a conference hotel. Based on Tinto's Theory of University Departure, increased interaction with other students, faculty, staff and community supporters can increase the retention rate and sense of community within secondary and post-secondary academic com-

¹⁶Picture uploads were not added since we did not feel we had enough moderators to prevent abuse of this feature.

Additions	Descriptions
Network Mechanics and Visualization 	Added networking game mechanics that promote being snagged by other players and promotes connecting players in your network with each other. In addition, visualization was added to the new "Network" page, which allows players to see what their network looks like and how it is growing.
Contextual Missions 	By adding interest tags into the games, the game could pull mission criteria from its database of user tags. Name game missions remained as an easy ice-breaker mission to get players started. In addition, missions could now be generated based on social context and topics that players choose to talk about.
Cupcake Points 	In addition to promoting network connectivity, players are also rewarded a small amount of points for being snagged. This mechanic was added as a means of changing the game from zero-sum to positive-sum, meaning that helping others complete their goals also helped that player complete her own goals.
Game Moderation 	Since players can now tag themselves with their own interests, this allows players to introduce inappropriate content into the game website. To moderate this activity, an administration page was added.
Appealing Visuals 	Added multiple color schemes for system appearance so that the game could be appealing to diverse players. The assassin theme was put in the list of possible themes players could choose from, but the default theme was changed to a more professional look. The avatar builder was added as a playful way of representing players in our system (on network and leaderboard pages).
Data Logging 010010101 010010010	The system tracks as much data as is relevant so that on top of observational and survey data, developers can reflect on system performance via system logs.

Figure 20: Summary of the game additions after Snag'em at STARS 2009

munities [97]. There were two hypotheses for STARS 2010 Snag'em: 1) The game would be more engaging, as measured by the number and percentage of conference attendees who actively played Snag'em in 2010, and the number of game interactions they engaged in, as compared to the same numbers in 2009, and 2) STARS 2010 conference attendees who actively played Snag'em would feel a greater sense of community than those who did not. The study was a post-test only design to measure sense of community and game play among conference attendees.

Prior to this event (during playtesting within the UNCC College of Computing and

Informatics and at the CHI 2010 conference), we had attempted a pre- and post- test design for our Sense of Community study, but that effort was unsuccessful. Incorporating pre-tests into the registration process often took more time than a participant could dedicate to registering and learning how to play the game. Therefore, the pre-test was not integrated with registration for this event.

3.6.1 STARS 2010: Methods

There were 252 attendees at STARS Celebration 2010. At this conference we used a post-test only design. During the conference, all conference attendees could elect to play Snag'em, which logged all game interactions. After the conference, attendees received a link to the post-survey, which includes open-ended and Likert-scale questions on the design and perception of Snag'em, and a list of items from the validated Chavis, et al. Sense of Community Index 2 (SCI) survey [17]. The survey includes 24, 4-point rating scale, questions on sense of community, with every set of 6 questions relating to a sense of community factor: Reinforcement of Needs, Membership, Influence, and Shared Emotional Connection. The survey was changed minimally to fit the community of computing at a conference. The modified SCI instrument can be found in Appendix A.

The Snag'em system also time-stamped all important interactions that occurred into a logging database. These interactions included snags, logins, messages, tags added, mission completed, mission failed, snag through text messaging, registered, avatar creation/update. Since snags were the best indicator of pro-active networking in our system, we primarily tracked snags in our system evaluation. Because of my,

Table 3: A table showing the use stats of Snag'em as collected via the Snag'em game database.

Location	Players	Women	Snags	Recruits	Logins	Tags
<i>STARS Conferences</i>						
STARS 2009	80 / 280	40	~200	-	-	-
STARS 2010	66 / 252	28	309	54	532	487

as yet, limited understanding of the game's impact beyond the game boundaries at the time, passive interactions were not considered in the game's evaluation. Survey instruments, found in Appendix A, focused again primarily on adoption and it was assumed that part of the appeal of the game was its adaptability.

3.6.2 STARS 2010: Evaluation and Results

As indicated by statistics in Table 3, the 2010 version of Snag'em was a more engaging game than the original. Slightly less of a percentage of the conference played the game at 66 of a potential 252 players (26%), but of the players there were more instances of repeated Snag interactions and 100% of participants scored points in the game either through active or passive play. I observed many players being snagged near the registration booth after they completed registration. With the current design, everyone was at least included in the game passively, with active players having motivation to find less active players and snag them for their own missions. Non-developers recruited thirty players (54%) and developers recruited 26 players, so most participants (85%) joined the game because of other players. Every one on the leader board (top 15 players) completed 5 or more missions. The top 9 players did 10 or more missions (10th ranked player did 8 missions). The top 3 players made

57, 33, and 32 Snags respectively. Feedback and increased number of interactions suggest that game acceptance and adoption was higher in 2010. Nonetheless, game play was severely impacted by a lack of Internet and cellular service connectivity at the conference that year.

There were 32 participants that took the STARS 2010 post survey (see Table 4 for demographics). Survey participants indicated that social networking at conferences should be facilitated and that they agreed that they and others would benefit from a social networking activity at the conference. Most people were neutral or in disagreement that they would have preferred a different social networking game than Snag'em. As Table 5 reveals, when asked about Snag'em, people thought that finding people for missions was fun ($M = 5.13$, $SD = 1.45$). Most people moderately agreed when asked if they would have played more if more people were playing (mean $M = 4.59$, $SD = 1.70$).

People responded to the network page and custom tags favorably. When asked if they thought that social networking games like Snag'em could increase community, 18 of the 21 responses were "yes". People seemed to answer the question as it directly related to Snag'em saying that the game promoted bonding, networking, conversation, and sense of belonging, all of which were important for establishing a sense of community. There was only one person that was wary of the idea of gamifying social networking with points and a leaderboard.

Table 7 shows player responses when they were asked what aspect of Snag'em they found most appealing. Overall, people responded most often with the networking that they needed to engage in to succeed. The Networking page visualization was

Table 4: Demographic data about STARS 2010 attendees.

# of participants	Survey	Snag'em Participants	Conference attendees
Overall	N = 32 12.7% of Attendees	N = 66 26.2% of Attendees	N = 252
Job Title			
Students	50.0%(N=16)	75.7%(N = 50)	69.4%(N=175)
Faculty/Staff	12.5%(N=4)	16.7%(N = 11)	21.0%(N = 53)
Industry/Other	37.5%(N=12*)	7.6% (N = 5)	9.5%(N=24)
Gender			
Females	>25.0%(N>8**)	42.4%(N = 28)	47.6%(N = 120)
Players			
Active	46.8%(N=15)	100.0%(N = 66)	26.2%(N=66)
Interested	15.6%(N=5)	24.2%(N = 16)	6.3% (N=16)
	46.8%(N=15)	83.3%(N = 55)	21.8%(N=55)

Note: (*) 12 survey participants did Snag IDs. They were placed in the "other" category.

** Again, 12 participants were unidentifiable as male or female. We assume that since they did not reply with Snag IDs, they were non players

also highly praised as well as the leader board and scoring system. These features are all shown with green arrows on the Pervasive Play Lens picture for STARS 2010 shown in Figure 21. In this year we saw that tags were great for making the game seem more relevant, causing more people to be drawn into playful activity. System insecurity and usability issues would often keep people from playing. Community leaders were the hardest to get into the game; undergraduates were the easiest. When asked what they liked least about the game people mentioned the lack of participation the most often. Accessibility was also mentioned repeatedly as a cause for low participation.

3.6.3 Revising τ : System usability and the magic circle

In 2010, Snag'em experienced an issue most common in Tech Major pervasive game designs, the idea that the technology (in this case: Internet connectivity) did

Table 5: Feedback on Snag'em mechanics and game adoption.

Please rate your answer in response to the following comments about Snag'em.		
Answer Options	mean (M)	standard deviation (SD)
I would have played Snag'em more if more people were playing.	4.59	1.70
I thought it was too difficult to find people to fill my missions.	3.66	1.31
I thought the idea of finding people to fill the missions was fun.	5.13	1.45
I didn't play Snag'em because I was embarrassed to go up and talk to people.	2.94	1.68
I put effort into trying to play Snag'em	3.53	1.90
I thought the Snag'em game mechanics were unappealing	2.97	1.45
I wanted to play, but it was too difficult to find other people who were playing.	3.75	1.54
Answer rated from 1 (strongly disagree) to 7 (strongly agree)		N = 32

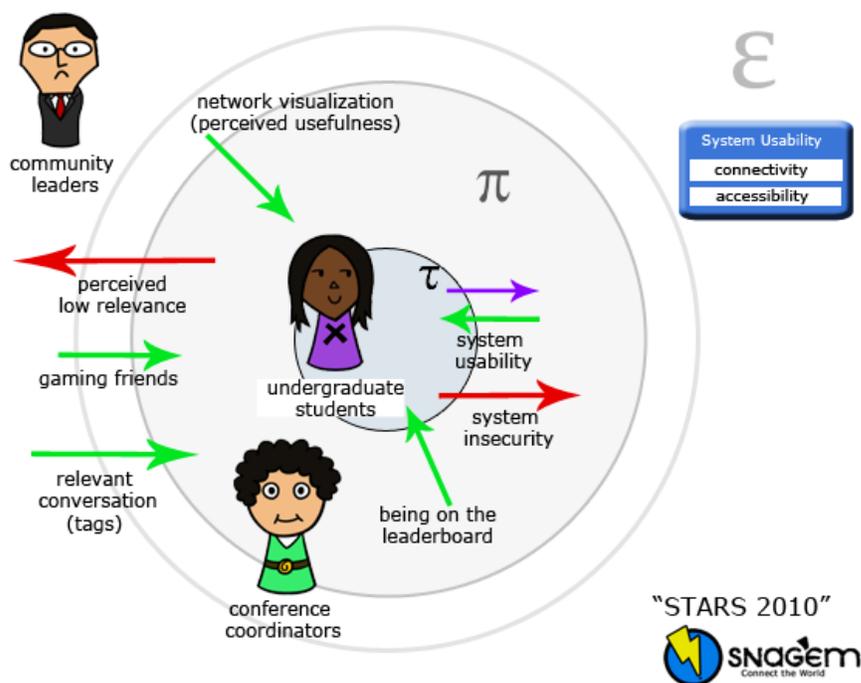


Figure 21: A play lens snapshot from STARS 2010.

Table 6: Quotes from players of STARS 2010 Snag'em. Left are things people found the most appealing about the game. The right side were some players feelings on Snag'em and sense of community

What was most appealing aspect of Snag'em?	Can social networking games (like Snag'em) increase sense of community?
<p>“I think it’s a great idea, making a game out of networking. It would have helped me meet a lot of people, had I been able to play.”</p> <p>“I enjoyed meeting new people and having to introduce myself out of the blue.”</p> <p>“finding out simple facts about people I already know”</p> <p>“encouraged networking and social interaction”</p> <p>“I liked the networking opportunities. Just to see where people were from and what they were working on at their respective universities.”</p>	<p>“yes. people that play together stay together”</p> <p>“Yes. Social networking involves people and computing. With this idea, the sense of community is easily established.”</p> <p>“yes, the Snag'em ‘party’ was interesting I met students I probably would not have talked to otherwise.”</p> <p>“Definitely. You get to know (or find out) a lot more about everyone - with Snag'em as the sole context! You find more people who are like you, and discover facts about people whom you’ve known for some time.”</p> <p>“I think there is an aspect of such games that could increase the feeling of community. If points become the objective instead of social interaction, then there might be negative results.”</p>

not pervade the event. It was a mistake to assume that Internet is a fully pervasive technology, and that everyone always has access to either a WiFi or a cellular connection. This led me to begin to define several context conditions that are necessary for Snag'em to be a success: firstly, to have Internet (at least at kiosks) and cellular connections or WiFi at or near the event for times when the kiosks are not open. Failure to ensure these conveniences will undoubtedly prevent players from entering the game circle. Furthermore, as emphasized with a purple line in Figure 21, system usability can *expel* already playing attendees from the circle.

Table 7: Categorized response count for most appealing game feature at STARS 2010.

What aspects of Snag'em did you find most appealing?		
Category	Response Count	Percentage
Networking	5	29.4
Missions	2	11.8
Leaderboard	2	11.8
Network Visualization	3	17.6
Motivation	2	11.8
Other	3	17.6
Total	17	100.0

3.6.4 Revising π : Roles and Perceptions

After STARS 2010, we realized that social roles and perceptions of the game have an important impact on who chooses to play Snag'em. Although the game was specifically designed to promote social and professional networking, this was not obvious to all attendees. If the game was perceived as having little relevance to conference networking, it was resisted (shown as a negative red arrow in Figure 21) .

In particular, non-player STARS faculty and staff, on the STARS 2010 post-survey, indicated that the game didn't do enough to incorporate personal networking goals. From this feedback, I realized that the community leaders¹⁷ did not perceive that the game's playful nature and randomly generated game missions could be enough to lead players to make meaningful professional connections. Community leaders are very influential, so a specific design focus to understand and guide their perceptions of the game should have considerable impact in the social adoption of the game. Community leaders, particularly at the STARS conference, have little time to devote to new activities or meeting a large number of conference attendees. It was important

¹⁷Community leaders are members of the community that are least likely to meet others above their peer level, and include people who help build the community and mentor others

that these leaders perceive that Snag'em could help them meet their own goals, but it was equally important for us to stay true to the game's nature. Therefore, it was important to design experiences within and around Snag'em that were still playful but allowed people to meet their own networking goals within the context of the game.

3.6.5 Design Revisions for Snag'em after STARS 2010

The new design revisions for Snag'em after STARS 2010 revolved around augmenting the game with features that would engage more players, allow players to manage and visualize more about their own connections in the game, improve perceptions by non-players and particularly community leaders, and give hardcore gamers incentives to play more and to engage more non-players in the game. These revisions are shown in brief in Figure 22 and described briefly below.

3.6.6 Addition 1: Game kiosks & Even faster registration

The connectivity issues at STARS 2010 led me to conclude that the only way to ensure everyone can play Snag'em is to provide Internet and laptops at the conference. Therefore, after STARS 2010, the Snag'em table is set up with several laptops, forming game kiosks where anyone at the conference can play, or just surf the Internet if desired, adding another benefit of the game being on site. For STARS 2010, the registration included the pre-survey, and I felt this burdensome data collection before play deterred people from engaging in the game. It was more important to get people to play, I felt, than to get a lot of pre-survey data but not get players involved, since the game needs a certain level of participation to be a success. To make it easier

Additions	Descriptions
Faster Registration 	To get new players into our system quickly and reduce pre-mature player frustration. Registration features bigger buttons, fewer tags, and an SMS quick-register option.
Recruiting Bonuses 	When players register for Snag'em they have a recruiter option to recognize a player that introduced them to Snag'em. This gives active players incentive to bring new players into the game.
Global Network Visualization 	The Global Network Visualization is an aid for showing players and non players the effectiveness of Snag'em as a tool for increasing the number of networking interactions at a conference.
Notes and Messages 	The Notes and Messages features enhance Snag'em as a possible better alternative to business cards. Through taking notes and leaving messages to players, players can use the system as a means of keeping track of important data about players.
Badges and Levels 	Game constructs to promote beneficial networking behaviors, including Hobbyist, Ultimate Networker, and Sting missions. Leveling systems help manage challenge within a game, increasing the game's difficulty and variety at higher levels.

Figure 22: Summary of the additions added after Snag'em 2010.

to start playing, I redesigned the registration page to make it shorter (30-60 seconds as opposed to several minutes), more attractive, and easier to use. Since missions inspire players to tag themselves later on in the game, I reduced the number of tags required to register. I added an SMS “speed registration” to register via SMS when no computer was available.

3.6.7 Addition 2: Recruitment bonuses to create a viral solution

Viral gaming is tricky; too much viral exposure frustrates players and non-players alike with unwanted advertisements and/or interactions, but with too little, the game fails to spread. New in-game recruiting bonuses encourage players to recruit their friends and also to encourage interactions with conference attendees that have not yet signed up for the game. When players register for the game, they have an option

of typing in someone else's Snag ID to give that player extra points.

3.6.8 Addition 3: The Global Network Visualization

For community leaders, most of their reasons for not playing could be attributed to a failure to demonstrate how playing Snag'em could benefit their community. Leaders already know a large number of the attendees, and their professional network needs are more targeted toward other leaders; only a small percentage of community members could directly help them advance. Therefore, the leaders needed a completely different motivation for playing: the growth and success of the community as a whole, rather than their own individual or personal growth. To help visualize the impact the game has on the community, I created a global network visualization (Figure 23) that stayed visible on the Snag'em website and at the Snag'em table during the conference. With it, passers-by could see in real time the connections forming as a result of playing Snag'em. I hoped that by showing them what was happening in the community, the leaders would feel more motivated (and even obligated) to play.

3.6.9 Addition 4: Notes and Messages

Notes and Messages allow players to take notes on their networking pages. In previous versions of Snag'em, the most engaged and competitive players usually had some way of taking notes for the game, writing down the names and Snag IDs for people they met. Players also sometimes had their friends and colleagues log in and add the tags that she thought the player should have, just so she could tag the player for a mission. Players would also send tag suggestions and in-game messages to players they had snagged.

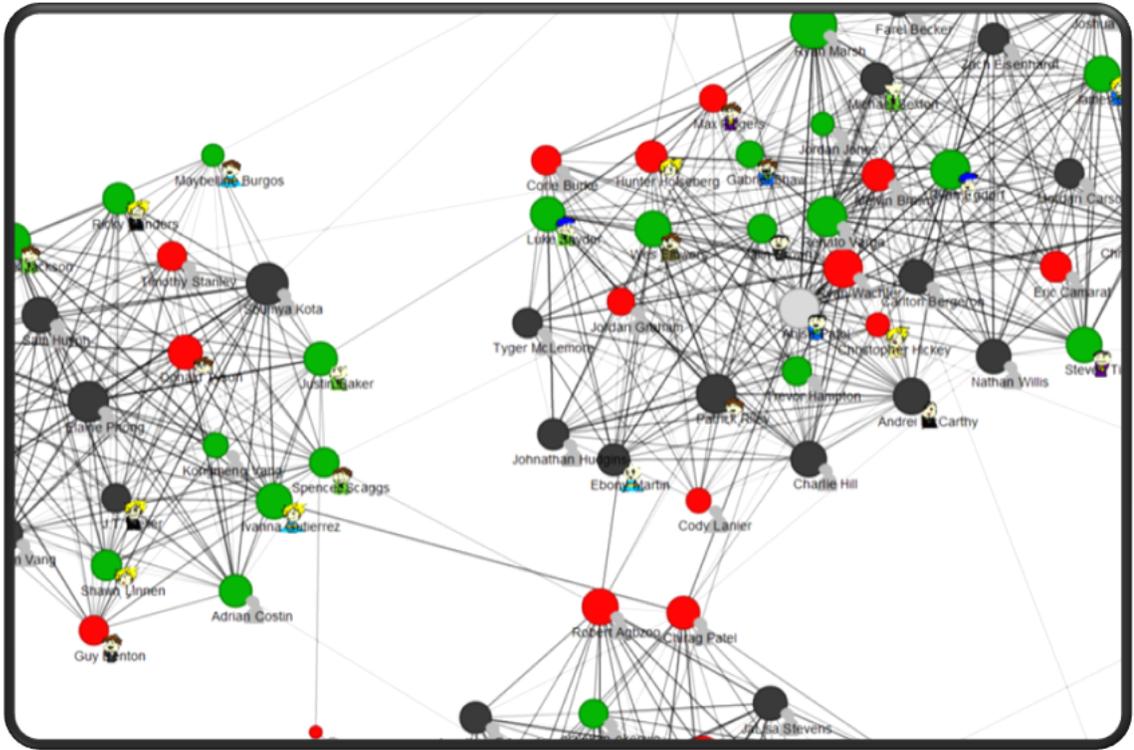


Figure 23: A zoomed-in screenshot of the global network page.

3.6.10 Addition 5: Badges, Levels, and Unlockable Missions

Badges give players optional goals to pursue within a game. In Snag'em, badges were added to encourage recruiting, taking the pre-survey, and making snags during social conference events. Badges are shown on the leader board next to the player's name. To help further motivate Snag'em players, I added new unlockable missions that can only be accessed once a player has performed certain tasks or reached certain levels. These new unlockable missions were built to be interesting, more challenging to promote player growth, and also beneficial to the game. Hobbyist missions, unlocked after a player adds a hobby tag that another player shares, are missions to find people with similar hobbies. The design intent of hobbyist missions is to inspire players to heavily tag themselves with interests and allow players to guide the game towards

connecting people with similar interests.

Ultimate Networker and Sting Operation missions were designed for hardcore players at level 4 (the highest level in the game). Ultimate Networker missions require the player to encourage in-game connections between people in their network, making them have to talk with two players and help them discover how they can connect to one another. Ultimate Networking missions are extremely challenging and require players to have to network in bigger, more inclusive circles. Sting Operation missions allow a high-performing player (level 4) to stun another high-performing player (level 3+) for a high point reward. High scoring, level 4, players are typically very much in a “play” mentality, so they will tend to become more excited about the game when new and more difficult challenges arise. This addition was a purely competitive agonistic element, but it has been carefully designed to impact only highly competitive players. Level 4 players who discover Sting Operations have new strategies to consider: Should they allow people to snag them? What if it’s a sting? How are they ever going to find just one person in a conference of 200 people? While the competitive nature of sting operations may be seen as unwanted interactions for non-players, I anticipated that this mission type would be more engaging for competitive level 3 and 4 players, while minimally impacting new and non-players.

3.7 Snag’em at STARS 2011: Methods

The next iteration of Snag’em was at the STARS 2011 conference, where I hypothesized that Snag’em players would experience a higher sense of community, as indicated by the Sense of Community Index (SCI) scores, than attendees who did

not play the game. There were 240 attendees at the STARS Celebration 2011. The study was a pre-post design, with participants registering to play Snag'em, optionally taking a pre-survey, playing Snag'em with logged game interactions, and taking a post-survey a few days after the conference was over. The survey instruments can be found in Appendix A. Note that the evaluation at STARS 2011 was expanded as the pervasive play lens evolved, to include more questions about the game's acceptance along with adoption and adaptability.

To encourage pre-test participation without affecting registration time, players were rewarded for taking the pre-survey with a "Good Citizen" badge in the game. The pre-survey consisted of demographic information and the SCI instrument as described in the STARS 2010 section. The post-survey repeated the SCI instrument and included open-ended and rating scale questions on participants' perceptions of the Snag'em game and their sense of community.

Several more moderators were deployed at this event than in years past, and there were two Snag'em kiosks at the conference at different locations. Moderators would explain the game to attendees and help them register for the game. Observational data was informally collected by two of the four moderators.

3.7.1 STARS 2011: Evaluation and Results

Table 8 shows the overall demographics and total number of game interactions for each STARS conference from 2009-2011. As shown in Table 8, players were much more active at STARS 2011 than years before. Eighty-eight percent of players scored points in the game, with players completing a total of 1124 missions (288 name games and

Table 8: Summary of play demographics for STARS conferences

Location	Players	Women	Snags	Recruits	Logins	Tags
<i>STARS Conferences</i>						
STARS 2009	80 / 280	40	~200	-	-	-
STARS 2010	66 / 252	28	309	54	532	487
STARS 2011	140 / 240	68	1044	83	2609	1859

836 interest missions) at STARS 2011, a huge jump over prior conferences. Players showed appreciation for badges, collecting 487 of them during the conference. Players also liked tags, identifying themselves with 1859 tags at the conference, when only 700 of these were needed to play (each player must have 5 to play). So, on average, players added 9 more tags to their profiles than the game required.

Text messaging was a popular way to play, with 50% players agreeing that they played (or would have played) via text messaging. This was also evident during *Museum Night*, where players were given a badge for playing at an outing that was hosted off-site. During this event, 19 players collected the Museum Night Badge. More players later indicated that they attempted to play that night, but were thwarted by an in-game bug. Since the event was held off-site and attendees had to walk around the exhibits, most attendees did not have access to laptops and played via text message and smart phones. This high accessibility proved to allow more people to play (and is shown with a positive effect in Figure 25).

Few registered attendees were inactive, and participatory¹⁸ player percentages are reported in the “Players” row of Table 10. At STARS 2011, everyone was pre-registered to play, but did have to complete some tags about themselves to play.

¹⁸participatory players are identified as players that interacted with the system in any way after completing the registration process

Table 9: Game activity among interested players (N=101).

Activity	Mean	Std. Deviation
NumSnags	10.34	16.085
NumSnagged	9.48	9.511
NumLogins	25.41	63.631
NumTags	13.94	7.707

Fifty-eight percent (58%) STARS attendees played the game. Developers playing the game recruited ten players (7%) and non-developers playing recruited seventy-three players (52%), meaning 59% joined because of existing players. Others joined independently or did not report their recruiter. Table 9 provides more details about game interactions for interested players. Interested players completed an average of 10 snags each. The leader board players completed over 20 missions each. Nineteen Ultimate Networker Missions were completed during the conference. This was surprising as this was the hardest unlockable mission in the game. In 2011 the top ten players unlocked Ultimate Networker missions. Forty players created snagglers, Snag'em avatars. Most of the avatar-building players were top players.

Table 10 shows a summary of the types of people who attended STARS 2011, and what percentage of each group played Snag'em and/or took the surveys. Active players for this conference are divided into two groups: those who make 5 or more snags and those who make 10 or more. For the within subjects t-test analysis described, however, we categorized them as 10 or more, due to the drastically different amount of game activity. More discussion on the formation of active and interested player groups is found in Appendix B.

There were 12 survey participants who completed both optional pre- and post

Table 10: Summary of play demographics for STARS 2011. For the first time during analysis, over 50 percent of the players were active, based on the previous criteria of 5 or more snags. After some consideration (see Appendix B) we moved the active criteria to 10 snags just for STARS 2011.

# of participants	Survey	Snag'em Participants	Conference attendees
Overall	N = 12 5% of Attendees	N = 140 58% of Attendees	N = 240
Job Title			
Students	83.3%(N=10)	70.0%(N = 98)	61.7%(N=148)
Partners and Guests	0%(N=0)	8.6%(N = 12)	11.7%(N=28)
Faculty/Staff	16.7%(N=2)	21.4%(N = 30)	26.7%(N = 64)
Gender			
Females	58.3%(N=7)	48.6%(N = 68)	60.0%(N = 144)
Players			
Active (10 snags)	100.0%(N=12)	88.6%(N = 124)	51.7%(N=124)
Active (5 snags)	58.3%(N=7)	26.6%(N = 33)	13.8% (N=33) of Conference
Interested	-	72.1% (N = 101)	26.7% (N=64) of Conference

surveys. Dividing these 12 participants into two groups according to whether they made at least 10 snags in the game resulted in 7 active players and 5 inactive players in the survey. I performed a within-subject t-test analysis on the player SCI scores. For the total sample (N=12) there was significant increase from pre- to post on SCI scores (pre- ($M = 1.806$, $SD = .5113$) and post ($M = 2.257$, $SD=.4980$), $p = .006$). I followed with a Repeated Measures ANOVA in which pre- and post-test scores were the repeated measures, player activity, and then testing the active player interaction. Though initial observation of means suggested that active players had higher pre- and post SCI scores(see Figure 24 A), significant differences between active players and

non-active players could not be found.

I expected to find that Snags were positively correlated with differences in SCI scores, but found no such correlation. Instead, within the sample, Number of Snags appears to be positively correlated with pre-survey ($p = .018$) scores. As Figure 24 sections B and C indicate, pre-test SCI scores were a type of predictor for those that were successful in the game. The correlation with pre-test scores was especially interesting because it implies that the players who already felt a strong sense of community “bought in” to the idea of the game. This is probably very important for engaging people to believe in and play the game. This result raises a question: if I implement Snag'em in a locale where no one yet feels a sense of community, will the game get enough of a foothold to make a difference? (Spoiler alert: The answer is “not necessarily”, as seen in Chapter 5). In order to answer this question, more data would need to be collected from non-players in order to compare sense of community in player and non-player populations.

3.7.2 Self-Reported Feedback

The majority of the 72 survey responses were of strong opinions, falling outside of the 3-5 range in a 7-point scale. When asked “Do you think social networking at conferences like STARS should be facilitated”, 54% of respondents answered with “Absolutely”! There was no strong rejection of facilitation of networking. Roughly 63% of 33 responses strongly agreed (6 or 7 rating) that not only would the community as a whole benefit from a social networking activity (62%), but also they themselves would benefit (64%) When asked, “Would you have been more willing to participate

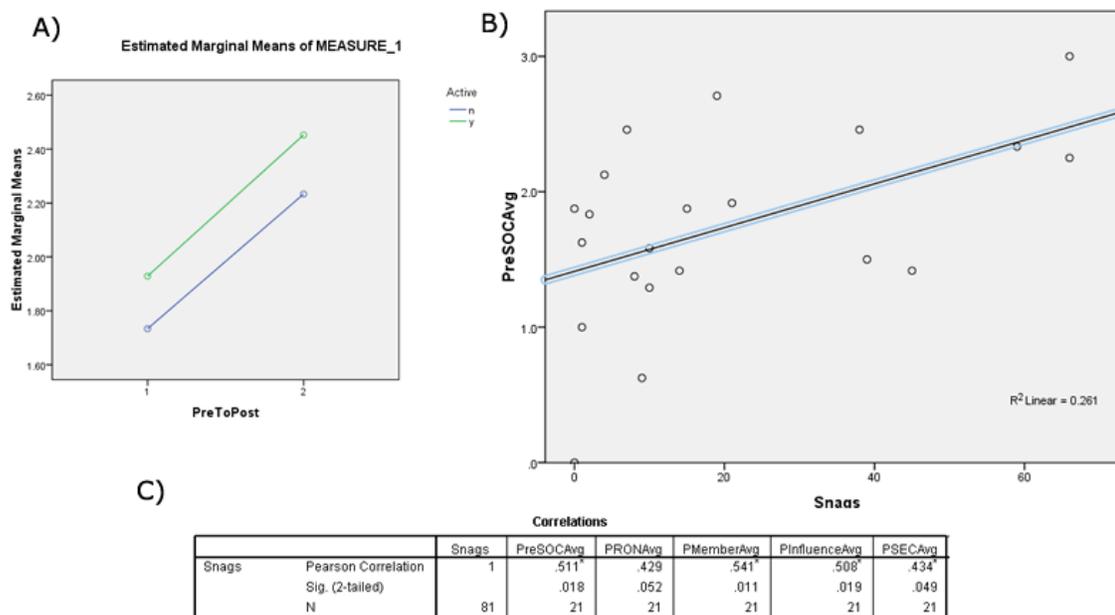


Figure 24: A) Repeated Measures ANOVA analysis, shows active players higher SCI scores from pre- to post-test. Test was not significant. B) Best Fit line of pre-test SCI scores as they relate to number of Snags. C) Significant correlation test establishes that there is a correlation between pre-test SOC and all sub-categories of SOC, minus Reinforcement of Needs. Categories are discussed in Appendix A.

in a social networking activity that had no gameplay elements?” most respondents disagreed (56%) or were neutral (31%). The attendees that did not show interest in the game (N=29, M=4.03, SD= 1.955) answered neutral, whereas the interested players (N=43, M=2.72, SD= 1.777) moderately disagreed. This general acceptance of the game’s existence was thought to be a large contributor to the ability of the game to cause overall adoption of playful attitude among attendees, as illustrated in the Pervasive Play Lens view of the interaction of game features with player attitudes given in Figure 25.

Players indicated that the system was successful at pulling players into positive networking experiences. Overall, people continued to adopt a playful attitude towards approaching others: 69% of players thought the idea of finding people to complete

missions was fun (Table 11). Sixty-three percent said that embarrassment did not deter them from playing. Fifty-three percent felt that Snag'em did not involve a lot of effort, consistent with the design goal that Snag'em could be played during down time in between sessions. Interested players were neutral about their amount of effort ($M=4.16$, $SD= 1.76$). while non-interested attendees disagreed that they spent effort to play ($M=2.82$, $SD= 1.72$).

Concerning our goal of getting more community leaders to adopt the game, we learned that the Notes and Messages system was barely used by anyone. Moderators observed, however, that after we explained the functionality of Snag'em as a note-taking tool, community leaders were typically less resistant to the game as they may have been originally. The same was true of the Global Networking page, as it allowed non-players to see how Snag'em was positively affecting the conference through increased interactions (see Figure 25).

3.7.3 STARS 2011: Discussion

Players found Snag'em easy to play, with no players reporting confusion on how to play. Sixty-one percent said that they liked the network visualizations. It was almost an even split on people that played / or would have played via text message or not. I interpreted this as a need to continue developing both versions of the game; it seems that some players either don't have smart phones, or simply prefer using text-messages to their mobile browser. The lack of a full mobile "app" version Snag'em for STARS 2011 may have also caused players to adopt the text messaging version of Snag'em.

Table 11: Post Survey data from STARS Celebration 2011 in the form of averaged responses. Players answered Likert-scale questions that had values from 1 to 7).

Please rate your answer in response to the following comments about Snag'em.		
Answer Options	mean (M)	standard deviation
I would have played Snag'em more if more people were playing.	3.79	1.93
I thought it was too difficult to find people to fill my missions.	3.44	1.74
I thought the idea of finding people to fill the missions was fun.	5.24	1.75
I didn't play Snag'em because I was embarrassed to go up and talk to people.	2.43	1.89
I put effort into trying to play Snag'em	3.55	1.84
I thought the Snag'em game mechanics were unappealing	2.91	1.79
I wanted to play, but it was too difficult to find other people who were playing.	2.82	1.71
Answer rated from 1 (strongly disagree) to 7 (strongly agree)		N = 68

Personalization of Snag'em was very much appreciated by Snag'em participants. Over half of respondents indicated that they liked adding tags about themselves. The exceptionally large amount of tags added compared to years prior are consistent with the self-reported results.

After this conference ended, we continued to see examples of increased community among players. Players posted on Facebook and attempted to stay connected through a Facebook group. One game adopter made a speech at the end of the conference saying how Snag'em changed an initially intimidating conference experience for the better. Conference community leaders and organizers were excited about the idea of deploying Snag'em at future conferences. Some faculty requested Snag'em's presence

at their own schools and events. We even had one Staff member request Snag'em for a family reunion she was planning. Lastly, even though the game was still dominated by students, we found that we didn't need total adoption, or even playfulness, in our community leaders to be successful. It did not matter if they played or not, so long as they could appreciate what was going on around them. It was this interesting stance they took just outside the circle that formed the *Agalma* space in Snag'em.

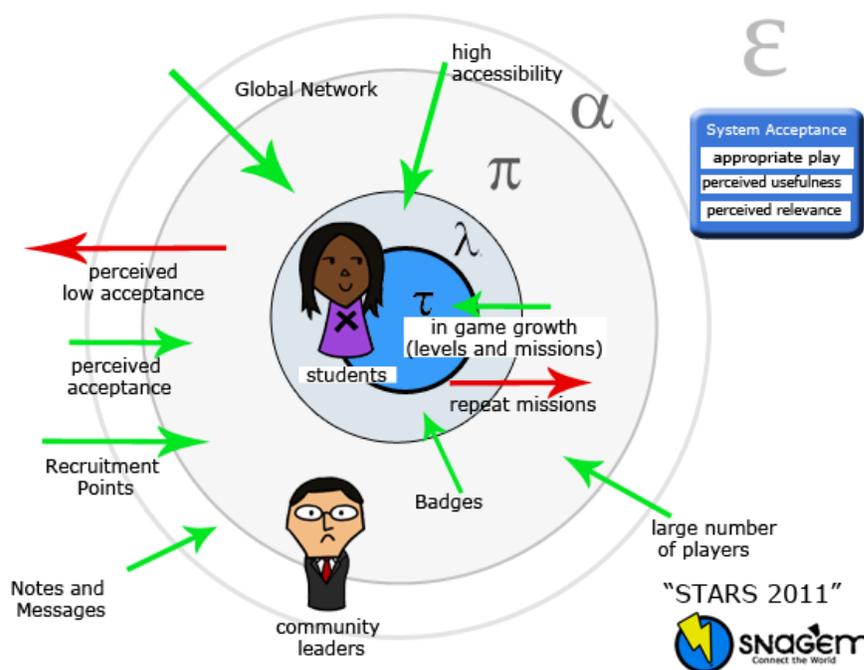


Figure 25: A play lens snapshot from STARS 2011. In this year we saw that overall, the more people that played, the more people wanted to play. Community Members were pulled into the game, but not how we anticipated, establishing a new *general appreciation* boundary of “play” circle. Recruitment points brought more people into playful interactions. Badges brought people into experimental and non-competitive but structured play (thus the birth of the *ludus* circle). The global network was especially effective at establishing system usefulness.

3.8 Leadership Seminar: Methods

In Fall 2011, a UNCC instructor was looking for a social networking solution for his “Leadership Seminar” course designed to develop leadership skills for the incoming

undergraduate freshman computer science majors. During the second week of class, I made an introductory presentation about the game, what it was for, and how to play during class, and answered any questions they might have about the game. The instructor required students to register for the game and do the 5-10 minute pre-survey for homework. The following week players were given one 90-minute lab period to play Snag'em competitively. At the end of that week players were emailed details on the final statistics for the game and a link to the post-survey. A total of 40 students consented to having their pre- and post-survey data used for the research study. The pre- and post-surveys were similar to those used for STARS 2011 (with only minor changes to adapt to the situation), and evaluation of the Leadership Seminar focused on sense of community.

Unlike previous versions of Snag'em, I was not physically present during the classroom play. The classroom TAs both participated as players and moderators. They also observed player behaviors and reported them back to me after play sessions ended. Meanwhile, I engaged in remote game moderation at my lab desk. I approved and rejected tags as players made custom tags during their play sessions. I also performed server maintenance during the play sessions. Having classrooms of players engaged competitively all in one short play session caused the system to slow down greatly. Bottlenecks were prevented by turning off features as they became over used, and optimizing the game before subsequent game sessions.

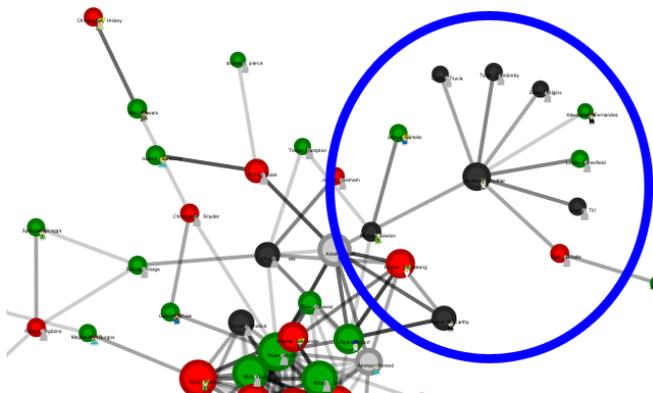


Figure 26: This pinwheel is an indicator of cheating in Snag'em as seen by the Global Network Visualization for the Fall 2011 Leadership Seminar.

3.8.1 Leadership Seminar: Snag'em Results

The seminar had 126 students registered. A pre-survey revealed that these students were mostly just out of high school with 84% indicating that they were between 18 - 21 years old. There also seemed to be no community aversion to games with 74% identifying as moderate to hardcore gamers. Despite their appreciation of games, however, 46% of pre-test responses indicated that they were primarily playing because they were told to sign up, and had no real interest in the game (N=82). The first week, students played casually: snagging their friends, tagging themselves, creating avatars, and collecting badges. The people playing made only a handful of snags that week. One person especially interested in the game created several fake people in the game so that he would have more points than his peers. He was easily detectable because of his peculiar appearance in the global network (Figure 26).

Most active players, those making 10 or more Snags, only participated for their 90-minute lab session. Collectively, the class completed 2663 missions, created 73 avatars and 4061 tags, completed 148 name game missions, and collected 940 badges.

The students gave themselves an average of 31 tags per person, compared to 12 per person for STARS 2011.¹⁹

Because of the semi-closed environment, I expected a lesser effect in sense of community (SCI) scores. I conducted most analysis on active versus inactive players due to the fact that it was more difficult to decipher between interested and non-interested play in this closed environment. While some play happened outside of class, most activity occurred within the confines of a classroom for a 90-minute session. I did a within-subject t-test analysis on the player score averages. For inactive players (N=8) there was not enough evidence to claim a difference in the pre ($M = 1.349$, $SD = .73427$) and post-test ($M = 1.248$, $SD = .581$) SCI scores ($p = .689$). There was also no significant change in means for active players (N=32) from pre-test ($M = 1.428$, $SD = .60302$) to post-test ($M = 1.494$, $SD = .6308$) with a p-value of .464. However, these trends were similar to those for STARS 2011, with slight increases in mean SCI score for active players and slight decreases for inactive players (see Figure 27). There were no significant differences in the means within factors for the SCI subsections for inactive or active players. Unlike STARS 2011, snags were not correlated with high pre- or post-survey scores, indicating that either this finding does not persist across contexts or there was a fundamental difference in the way Snag'em was played during Leadership Seminar. Game activity may have not predicted engagement because engagement was based on a class grade rather than game enjoyment.

The Leadership Seminar Study illustrates how important Snag'em's context is to

¹⁹During some of the game sessions, the game website experienced bandwidth and CPU throttling, causing slowness and even server failure for very short amounts of time. Snag data may have been lost during that time, so the data are minimum numbers; there may have been more interactions than reported here.

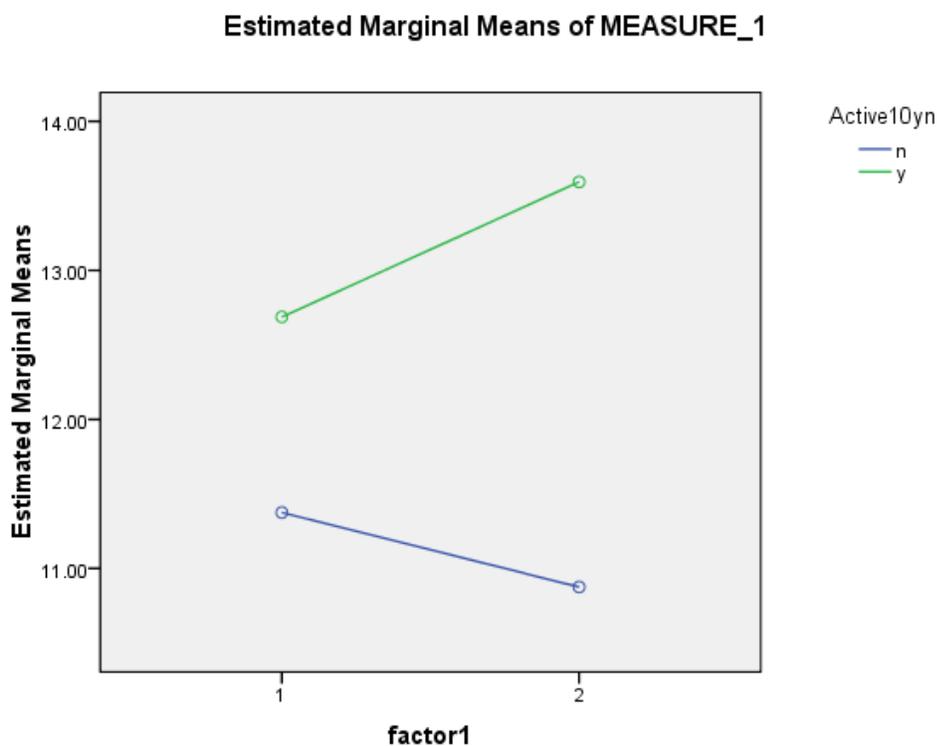


Figure 27: This graph indicates the relationship between sense of community “Membership” Scores and player activity. Players that were active were observed to have a slightly higher sense of community after playing. Inactive players had a lesser effect in the opposite direction.

the way the game is played and the type of behaviors that will evolve. Even though the seminar players interacted highly with the game, the game did not perform well. Players had little motivation to engage in conversation because the game only lasted an hour. Since everyone was completely within the game circle, there was no reason to introduce players to other players. In addition, players were also required to play during class time. This involuntary participation likely reduced the perceived enjoyability of the system. We felt that this environment made Snag'em into a data collection exercise, and provided a stress test for the system, but did not achieve its goals of building a sense of community. Based on this experiment, and our other

implementations (not reported here), we believe that the optimal length of play for the final version of Snag'em is about 3 days, to allow time for acceptance and adoption to occur. The longer the game, the more important adaptability becomes.

3.8.2 Discussion of the impacts of Snag'em

The results across several studies show Snag'em has some relationship with sense of community among players that adopt it as a networking tool, and only a few people believe that Snag'em is detrimental to the conference networking experience. When asked about the parts of Snag'em that appealed to players the most, players responded with features like “networking” or “meeting people”. These results suggest that when thinking of Snag'em, players thought about social networking rather than avatars or technology. This suggests that Snag'em is achieving its purpose of making networking fun and exciting for players. In the STARS annual report, Snag'em was indicated as being the favorite activity at the STARS Celebration along with “networking with peers (see Figure 28)”.

Out of the 240 Celebration participants in 2011, 148 were students and 64 were faculty. Survey response rates for students were 60% (n=89) and 72% (n=46) for faculty. Items were rated on a 5 point Likert scale; percentages below indicate strongly agree and agree responses combined.

Table 3. STARS Celebration 2011 Survey Feedback

Students felt connected	Faculty were inspired
89% felt that the Celebration builds community	88% expectations were met
91% agreed they connected with peers	92% satisfied overall
71% agreed they connected with faculty	87% satisfied with speakers
71% learned about graduate school opportunities	83% developed helpful professional collaborations
63% said it was very beneficial	91% inspired to become more involved in BPC
Favorite: Snag'em & networking with peers	Favorite: Networking with peers

Figure 28: Snag'em Feedback from the STARS 2011 Annual Report [89].

Correlation between snags and pre-survey SCI scores for STARS 2011 suggest that

Snag'em, in the right conditions, may be particularly attractive for people with a high sense of community. The correlation between snags and post-survey SCI scores indicates that people with high sense of community post-survey scores played the game actively. Correlation with changes in (or differences between) scores would have been the strongest indicator of causation but wasn't present in this sample of data. However, Snag'em was still helpful: T-test analysis indicated that people who played the game experienced a very large increase in sense of community when compared to people that didn't. Most players also indicated that they believed that Snag'em helped increase their sense of community.

The Fall 2011 classroom study of Snag'em proved to be very informative in how Snag'em works in a closed setting and in a short time. Game server slowness and playing for homework decreased enjoyment of the game. This is an interesting finding, suggesting that I have considerable voluntary play effects in a conference setting. It also became very apparent that, in this closed setting, the game was not as challenging, interesting, or useful. The play session did not contribute significantly to the game lens due to the fact that the game did not pervade an event or community. Play lacked meaning because students could not see a benefit to meeting other freshmen; at a conference, you can meet people at different levels of skill and advancement who can help you move up in the community. Students in the STARS conference had a stronger sense of community than those in the class, which may be an important factor in original willingness to play together. Involuntary engagement may have also been responsible for the poor reception of the game. There were different types of players all forced to behave as if they were within the game (*tau*) circle of play; play

was consequently not meaningful for most players. When participants are forced to conduct game interactions, their motivations are derived in the World of Earnest. Therefore, the lens will not be useful to design or understand such situations.

3.9 Snag'em Conclusions

Snag'em has been iteratively designed to be a widely adopted, socially pervasive, game for social networking. I hope that the lessons learned from the evolution of Snag'em can be used to support underrepresented minorities, particularly in STEM fields. There has been a foundation of research that states that a strong community can increase the retention rates of students, particularly minorities, in computer science, though there has been no work evaluating how games can or should be used to foster the growth of a strong network of people.

In this chapter, I discussed the design iterations in developing Snag'em: a social networking tool designed to foster social networking and effectively increase sense of community through luscious attitude and shifts in mindset. Ultimately, Snag'em was widely accepted as a networking solution at the STARS 2011 conference, where over half of the conference attendees played and found the game enjoyable. Snag'em significantly impacted sense of community with a large effect size for active players at STARS 2011. The current design may not allow for this finding to be replicated in classrooms, likely due to the different social and physical context. In future iterations of Snag'em (described in Chapter 5), we evaluated perceived usefulness and usability as factors for game adoption. It is likely that if perceived usefulness can be established in a classroom environment, players will be more interested in adopting the system.

The iterations of Snag'em presented in this chapter shaped the initial factors and data points observed in the Pervasive Play Lens Model. There were other Snag'em events, not discussed in this section, that further revealed the separation between player adoption, player acceptance, and the game's adaptability. The College of Computing and Informatics evaluation²⁰ was the first experience in which a changed social context affected system performance (the game did not adapt to different environment), and I could not replicate the results of my original STARS 2009 study. Conference on Computer Human Interaction(CHI)²¹ observations featured even less player adoption, despite the introduction of more interesting game mechanics. These findings helped to establish critical mass and perceived adoption as factors that affect system adoption and acceptance. It also helped us further establish the use of physically present system artifacts that lead towards higher visibility and increased perceived adoption. The Leadership Seminar was the first instance in which we realized that we could not replicate our findings based on perceived usability of our system, and the inability of the system to adapt to a closed physical environment.

The 3PL model is further refined in Chapter 5, where the interaction of system acceptance is observed as changing the overall ethos of the game experience within the circle. Detection of these interactions required that we not only empirically evaluate our game for social impact, but also employ design-based research methods for the construction of user stories and a deeper understanding of the overall gaming ecology.

²⁰during the Fall semester of 2010, we deployed snag'em for ten weeks for college wide play.

²¹We deployed Snag'em at CHI2010 conference, but it was not integrated into the conference experience. At CHI, conference support was minimal and the conference was much larger than any other conference at which Snag'em was deployed.

CHAPTER 4: TABLE TILT

4.1 Introduction

With Snag'em, the idea has always been to build systems that help foster positive and socially relevant interactions among conference attendees. One of our smaller scale projects that was built for this purpose was Table Tilt, a cooperative mobile game that utilizes “Pod Play” in order to promote close, comfortable interactions with people that you may not know. Here, we discuss our game Table Tilt, which is a fast-paced multiplayer icebreaker game that gets people working together in a fun environment, establishing rapport and possibly building stronger relationships.

Table Tilt was built in conjunction with Snag'em but is a bit different from Snag'em, in that it doesn't focus on monitoring and explicitly causing new connections. Instead, Table Tilt plays a more passive role in getting players to communicate and work (play) together. As a pair, Table Tilt and Snag'em work together to help people meet others and then build stronger connections through shared interests and game goals.

We are particularly interested in interactions between Table Tilt's designed game mechanics and *social play*. Table Tilt is built to leverage typical social game elements that appear even in single player games, such as playing for status, gaming capital, and performance [90]. Our goal with Table Tilt was to use features of game sociability to shape a meaningful and shareable play experience. The phenomena of sociability

of games is a complex one and one that is not often included in the formal approach to studying games [68]. In the case of games used for the sake of social networking, however, it is a critical element to meaningful play.

Table Tilt was an exercise at creating a non-traditional mobile experience with purpose. We kept the focus on our goal: to promote team-building and cooperation among players. We call this a “tech minor” approach, that focuses more on gameplay than on the new technology being leveraged. This focus allowed us to consider our game in a richer context and determine whether the game achieved its goal of promoting community and teamwork. We also broadened our view of Table Tilt as a more open system, rather than the usual view of games as closed systems [82]. Among other ideas, game play sessions are intended to be like performances that intrigue and draw in potential new players. People, as social beings, are willing to go out of their way to see what other small groups of people are doing, particularly if the group appears to be playing. Game play sessions are short, and rules are simple so non-players can quickly jump in to an existing game setup, or even start their own game play session elsewhere. Our goal was to take a tech minor approach that is aware of and promotes the more general social context, in order for Table Tilt players to build new social connections and strengthen existing ones.

We believe that Table Tilt represents an integrative approach to designing next generation mobile games that considers games as both performance and as social team-building interventions in a broad context. The effect of increased team mentality comes naturally in Table Tilt, as video games promote challenge and goal-oriented behavior, which are the key elements of any team building intervention. However,

games can also promote blame and/or competition, potentially leading to negative social interactions. We are particularly interested in researching how best to promote effective team-building techniques while also preventing or mitigating negative social interactions resulting from typical agonistic behavior associated with games.

The latest version of Table Tilt can be found in the iTunes App Store

<http://itunes.apple.com/us/app/table-tilt-2/id489238303?mt=8>



Figure 29: Puzzles require players to communicate ball and hole locations, as well as timing when to pass to one another.

4.2 About the Game

Table Tilt (2) is a simple puzzle game designed for iOS 5, where players try to maneuver balls into different holes on the screen. A player can host a 1-, 2-, or 4-person game. The gimmick here is that the balls on the screen can be tilted off of one screen (via accelerometer sensor tipping motions) and onto another players' screen.

In each level of Table Tilt, the goal is for players to get every ball into the appropriate hole. More balls are added in successive levels, and balls must be rolled into holes that match their color. If they fall into a hole of a different color or fall into cracks, the level will reset. As the levels progress, additional obstacles are added to the game. Cubes appear later; they do not cause damage or point losses, but they cause the ball to bounce back at an increased velocity. A level with lots of cracks, cubes, or multicolored holes can increase difficulty considerably.

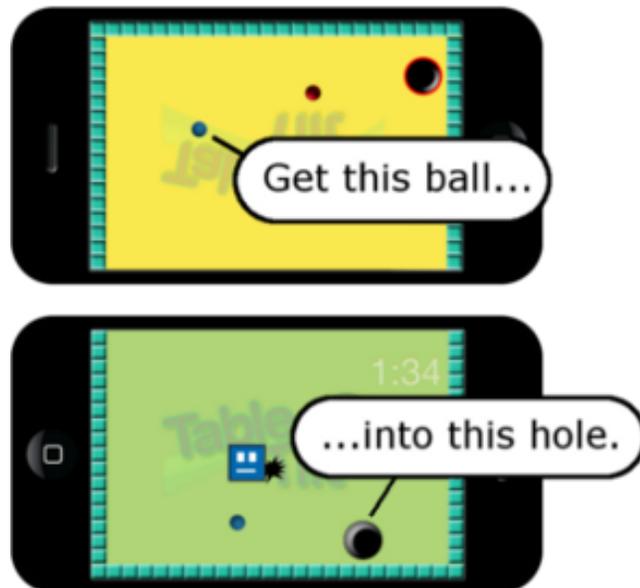


Figure 30: Puzzles require players to communicate ball and hole locations, as well as timing when to pass to one another.

Players win if they cooperatively complete all levels before the two-minute timer runs out. Players can enable Bluetooth to detect nearby multiplayer games. The game runs on any device that uses iOS 5 (iPhones, iPads, and iPod Touches), and can be purchased on the App Store for one dollar.

4.2.1 A team-building solution

Table Tilt introduces a new player experience in computer-aided gaming in that sociality or human-to-human interaction is not mediated by the computer screen. In a traditional computer game system, the player “reports” to the screen that acts as the mediator. Games may use one screen for many players, or may use one screen for each player, where the player sees the entire game or a split screen on their own device. In Table Tilt, we utilize multiple screens for multiple players. Unlike traditional multiplayer games, every player in Table Tilt is utilizing all of the screens, not just his own. To do this, she must communicate with the “team” consisting of all the game players. Table Tilt’s design intentionally and inherently promotes team building for the purposes of organizational development.

I call this particular method of interaction “Pod Play”, because players form pods while playing. These pods act as very closely knit play circles, which I believe causes a much more relaxed environment than a typical mobile game system. The close knit circle of play you would find in “Pod Play” games is something you would similarly see in a traditional table-top games. In Snag’em and other socially pervasive games, “designers have found that taking play out of its culturally established place causes tension, which players try to mitigate by establishing their own ad-hoc zones

of play. A quickly established, but visibly playful circle, would theoretically be a more comfortable and accessible play space when attempting to cause play in a primarily non-play environment. TableTilt, while not a pervasive game, does not cause the discomfort people typically experience while playing a game outside of culturally established place. This effect is more prominent in systems like Snag'em where players do obvious gesturing and act in a ridiculous manner.[65] Goffmans' theory explains the phenomenon that gestures cause awkwardness when they are clearly observable but also inexplicable for the spectator. We've alleviated these potential issues by using mobile devices in an atypical way, pulling players closer together instead of isolating them to their own individual screens.

We are interested in how our design, including our novel display arrangement, promotes team work and communication as implicit strategies. We also observe player enjoyment. In surveys, players have reported that the defining features of Table Tilt are the teamwork and communicating with other players.

4.2.2 Implementation

There are two versions of Table Tilt currently on the Apple App Store. In 2009, we created Table Tilt (1) to be playable on iOS 3.0 and older devices with WiFi supporting 2-, 4-, and 6-player games. Table Tilt 2 features better graphics, music, advanced ball-on-ball collision, Bluetooth, and iOS 4.0/5.0 support.

Table Tilt broadcasts game updates in a traditional chatroom format. The server is responsible for keeping track of the score, generating levels and sending them to the other players, and notifying the team when events of interest occur. As a valuable

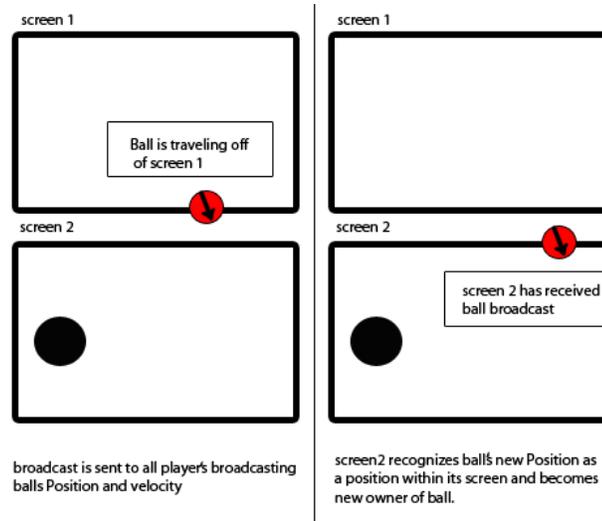


Figure 31: Broadcasting ball position from screen 1 to screen 2. Sending minimal network packages enables smooth, lag-free game play.

time-saver, our implementation “fakes” what appears to be constant broadcasts of the location of each ball. However, the only events broadcast in our game are when a ball rolls off of someone’s screen, someone makes a mistake, or the level is restarting. The server does not indicate which player will receive the ball. As shown in Figure 4, the ball is handled locally by Screen 1 until the ball crosses its boundary. Then, the server broadcasts the ball’s new position. The “receiving” screen identifies the ball’s position as within its bounds and assumes control of the ball until the ball rolls outside of its boundaries.

Table Tilt 2 was developed in the XCode IDE using the iPhone Software Development Kit, for iPhones or iPads running iOS 5 or later. Using storyboards (new to iOS 5), we constructed views of the game visually, and added new original sounds, music, and artwork to improve the game’s appeal. Table Tilt 1 was made by 3 developers in 4 weeks. In contrast, Table Tilt 2, including a new code base, new artwork, music, and sound composition, was completed by 1 developer in 2 weeks.

4.3 Play by Play

In this section, we outline a typical game session at the STARS Celebration 2009 conference. We offered players a small 50-point incentive in Snag'em for playtesting Table Tilt. We also provided six lab iPhones and iPods for playtesting. The game is set up to last for 2 minutes. The game starts with the players all huddled around the iPhone screens and completing their puzzles to ensure all the devices are in the proper position, forming one large table with moving parts for play. In level 1, a Mebol appears on one player's screen, and the hole on another. The players start offering information to one another, indicating who has the ball and where the hole is located. Each level gets successively harder, with colored Mebols and holes appearing first, then cracks to avoid, and later cubes that speed up the Mebols. Players shout when they win, and laugh when someone makes a mistake and the game restarts.

A few times during every 2-minute play session, a passerby stops, intrigued, and asks about the game. Often, one player explains the rules as she continues to play. At the same time, another player communicates her strategy to the player she is about to pass the ball towards. During more gameplay, two more passers-by peek over the players' shoulders. After several more peeks and questions, the initial game ends and a new group of players begins. The most communicative of the original players sticks around for another game, that is, until another interested player comes up to take her place²². Later, team members notice the leaderboard and bring groups back to try to move up.

²²Players would often hop in and out of play, both through a game restart, or switching players in the middle of a play session

During a typical game session such as this, players range from being quiet and docile while awaiting commands, to being talkative and animated. Players with game objects on their screen typically feel it necessary to list the objects they possess in case the other players aren't yet looking at his screen with statements like, "I have a red ball and a blue hole" or "Don't send it to me, I have nothing but cracks". Players will often look expectantly and hopefully at players when they pass the Mebol along as if they are placing trust in the individual to get the ball to its destination.

Competitive players typically tell their team mates what they intend to do with a Mebol before passing it to anyone. As we hoped they would, players laugh at the humorous message they get when mistakes are made. We noticed that more competitive players verbally reflect on the error made when they restart the level with statements like "Pass the ball slower this time," or "Be careful about what side you send the ball on". Games typically become more animated when players are competing to 'win' the game or achieve a higher rank on the leaderboard.

4.4 Evaluation

We performed a pilot study with our initial Table Tilt prototype during the STARS Celebration 2009 conference. The game was tested in conjunction with the Snag'em game and we had participants play Table Tilt while waiting to register for Snag'em, or after they registered for Snag'em. We found that while Table Tilt and Snag'em were initially pitched as a package, they were ultimately played by two different groups of participants with little overlap. During the conference we observed roughly 50 people playing the game, out of 280 attendees. Ten participants gave us feedback about

the game via our online survey. We asked several Likert scale questions about the Table Tilt game's functionality, stability, and overall design, on a 5-point scale with 1 being "Strongly Disagree" and 5 being "Strongly Agree". We also asked open-ended questions about players' favorite and least favorite game features.

Playtest feedback was positive, with 100% of survey participants saying the game was fun, and that they liked the art. Although most would not pay for the game (average response 2.9 of 5.0), most indicated that the things they did not like were when the game crashed or when procedural generation of levels left someone out of game play. 60% of participants said that the game crashed during game play "once or twice".

We conducted an informal pilot study of Table Tilt 2 in Fall 2011 with a small 20-person convenience sample of fellow students. During this study, teams of 2 or 4 would play quick two-minute game sessions where they would try to complete each level. Players took a quick survey about how they liked the game and how they perceived communication in the game. Several players mentioned the "fast-paced collaborative gameplay" as being one of their favorite things about Table Tilt. The main requests for improvement revolved around the random level generation and a longer view-time on lesson screens. As one player put it, "[I] liked the game, but there were some quirky issues with holes filling up and things being generated in unusual places." We fixed most of these bugs upon discovery.

4.5 Discussion

In the two versions of Table Tilt, play testing suggests that we were successful in creating a game that emphasizes teamwork without explicit game rules or game mechanics. Based on our feedback and survey results, and the characteristics of typical team-building interventions, when making a game for organizational development and communication, sociality is better suited for design in the implicit rules and strategy of a game, rather than in the explicit rules and outcomes. If these rules are imposed upon players by the game mechanics, they can be artificial. For team-building, we want people to organically create effective communication strategies to solve problems. By using implicit rules to create a collaborative experience, we created a game that was easily accepted by players.

We have developed a continuous scale to describe the extent to which a pervasive mobile game's design and evaluation focus on developing and testing new technologies (Tech Major), or focus more on social and/or pervasive elements (tech minor). Table Tilt has a tech minor game design. This means that when making what we believe is a next-generation mobile gaming experience, we forego technical novelty in hopes of learning more about the social implications of game adoption.

Even though the technology employed in Table Tilt is not new, we were able to come up with a peculiar game design, unlike traditional multiplayer games. In our game, every player in Table Tilt is utilizing every one of the players' screens, not just his own. Table Tilt's design inherently promotes team building, because in order for a player to truly utilize the other players' screens, he has to communicate with

them. This element affects players in many ways. In some players, there is a level of frustration about the need to be so close to the other players around them to get the most out of the experience. Many players have requested a built-in communication system to enable remote play. A number of players reported that they would be willing to purchase Table Tilt 2 on the App Store and could see using the game as a means for connecting with others.

We have made strides toward making a social game that succeeds in inspiring team-building and collaboration in players. In Table Tilt 2, players indicated that the game involved communication (4.25 of 5.0) and teamwork (4.5 of 5.0). The game currently does not cause explicit planning in most players (2.7 of 5.0). We believe this to be an indicator that the game causes a natural organizational development to occur. In some cases, planners take charge, with other players “following orders”. This is acceptable at a conference, where the purpose of the game is to meet and talk with others. In other team-building contexts, we may refine Table Tilt to prevent this type of organization.

4.6 Pervasive Game Conclusions

After a playtesting session of Table Tilt, a STARS Celebration participant wrote on the lead developer’s Facebook wall: “I WANT TO PLAY THAT GAME. TAKE ALL MY MONEY.” This was one of several requests we received to place our game on the iPhone App store. This game, more than any iteration of Snag’em thus far, succeeded at creating an easily adoptable experience that was comfortable for the players and acceptable for non-players / observers. This game, however, is in no way

Table 12: Table Tilt feedback at STARS Celebration 2009. All 8 responses indicated teamwork and communication as the most important elements of the game despite the fact that communication was not explicitly built into Table Tilt.

What is the most important element to this game that makes it fun?

Teamwork
Teamwork
The teamwork factor of the game makes it very fun. Also utilizing the tilt sensitivity of the iphone makes the game fun as well.
Working with several other players.
Competition to a high score
Yelling about who has what ball / hole color
teamwork; looking like a dork
The fact that you have to communicate and interact with your team members in order to play the game. It makes the game more interesting and intense

pervasive, aside from the pervading sociability of the game experience after players leave the game circle.

Table Tilt, was the first indicator received that game play does not have to be discreet in a serious environment in order to be effective. Instead, the game succeeds because the boundaries of play are clear. The tightly formed, physically visible social circle formed during Table Tilt play allows players to interact playfully with less fear of violating an outside social contract. In this chapter, we see how understanding the boundaries of play is beneficial for players. In the next chapter, we see that understanding the boundaries of play is also beneficial for designers. When orchestrating a system intended to blend into a non-gaming environment, inherent knowledge of what interactions are acceptable and when they are acceptable are less clear. Likewise, pulling people too deep into a game flow state could prove damaging to the community and the players' status within a community (see Snag'em at FDG).

CHAPTER 5: SNAG'EM ECOLOGY THROUGH 3PL

5.1 New Data Collection Techniques

In 2011 and 2012, several versions of Snag'em were deployed for different events and conferences. For each of these events, tags, team names, page themes, events, and badges were customized for the experience sought by the conference organizers. Though Snag'em's popularity was rising among conference organizers, each of the Snag'em play experiences were drastically different from the other. In one case, player activity was high but game enjoyment remained low (Snag'em in Leadership Seminar). In another case, fewer players played the game but those that were active reported positive and meaningful play experiences that allowed them to network with people without anxiety and unease (Snag'em at BigSURS described in 5.3). It was clear that the currently employed design research methods were not effective for understanding the interactions between the game, players, and the environment: the Snag'em ecology.

After every session of Snag'em, I sought to understand exactly where the measured factors were affecting my game within the boundaries of the play space. From past studies and literature, it was clear that adaptability was an important factor in deciding if players could function properly in game and out of game. Adaptability, the ability of the system to adapt to different concentration levels ²³, was important for

²³e.g. Mythical: Mobile Awakening - the game detected engagement and tuned interruptions for

players to remain players. Social influence is “the extent to which a person perceives that important others believe he or she should use a new information system [103].” Social acceptance, in this context is “the extent to which a system augments rather than detracts from, social situations and a person’s social ‘self’ [86].” These factors have all, in some previous iteration, revealed themselves to be key variables in constructing a pervading environment that is non-damaging, engaging, and meaningful (resulting in positive social impact). It is difficult, however, to determine the relationship between these factors and how they affect the environment. In this chapter, I use Powell’s Pervasive Play Lens (3PL) to understand the interactions between Snag’em mechanics, players, and gaming ecology at academic conferences in order to properly discuss the design implications of Snag’em within this context. In this chapter, I use mixed methods research to build comprehensive user stories of different user types, in varying degrees of game engagement. As seen in other related works (like *Mythical: The Mobile Awakening* [41]), engagement can be tracked through player interaction with the Snag’em system. Players that login often, tag themselves, and actively seek out Snags are thought to be highly engaged in the system. We also report this type of proactive behavior through ethnographic observation. This study is based on 3PL theory as well as three primary constructs that are known to impact technology use behavior [109]: acceptance, adoption, adaptability.

I use the 3PL theory to construct visual models of Snag’em iterations at two conferences at which Snag’em was deployed.

times of more engagement

5.2 Snag'em 2012 Edition

As seen in Table 13, Snag'em was deployed at several other conferences and events since STARS 2011 including: Big South Undergraduate Research Symposium (BigSURS 2012), Foundations of Digital Games (FDG), UNCC's Research Experience for Undergraduates (REU 2012), and Summer Students in Programming, Robotics and Computer Science (SPARCS 2012). Another sense of community study was conducted at FDG 2012 along with ethnographic observations. I attended each of these events as a moderator and observer. At FDG 2012 and BigSURS, two additional graduate student moderators from UNCC were also in attendance. At the end of each event, observations were pooled together and design conclusions were made about the current iteration of Snag'em. In this chapter, I discuss two of the four aforementioned events, as BigSURS and FDG involved the most structured quantitative and qualitative analyses.

5.3 Snag'em at BigSURS: Methods

BigSURS 2012 was an undergraduate research symposium held at Winthrop University for two days. This event was multidisciplinary, with undergraduates presenting their research from several different schools in the southern region, on many different subjects. In addition to research from different fields, there were also poetry readings and art galleries, and several attendees representing liberal arts studies. The conference had 310 registered attendees, of which 72 (23%) registered for Snag'em.

At this conference, Snag'em was a fully integrated social networking solution adopted by the conference coordinators. I was asked to attend several planning meetings for

the conference in order to modify the system to fit the needs of the event. Modifications included promotional and informative materials to distribute via conference bags; modifications of tags to suit a multidisciplinary conference, global network modification, setting up a mobile cascading style sheet (CSS) for smart-phone devices, etc.

Table 13: The breakdown of game activity in all major deployments of Snag'em. The (-) marks data points that have been lost due to server shutdowns and deleted tables. Partial database statistics remain from past writings and/or publications.

Location	Players	Women	Snags	Recruits	Logins	Tags
<i>STARS Conferences</i>						
STARS 2009	80 / 280	40 / 168	~200	-	-	-
STARS 2010	66 / 252	28 / 120	309	54	532	487
STARS 2011	140 / 240	68 / 144	1044	83	2609	1859
<i>Other Conferences</i>						
CHI 2010	50 / 2385	-	102	41	41	373
BigSURS 2012	71 / 310	45 / -	284	13	553	631
FDG 2012	62 / 152	17 / 42	441	15	871	833
<i>Events</i>						
Spelman 2009	43 / -	31 / -	60	0	~24	129
CCI 2010	91 / 1290	20 / -	324	5	171	558
REU 2010	18 / 18	9 / 9	209	4	-	-
Leadership Seminar 2011	137 / 137	26 / 26	2549	22	3770	3537
SPARCS	12 / 12	12 / 12	48	2	53	203
REU 2011	16 / 16	10 / 10	316	4	116	294
REU Extended	18 / 18	11 / 11	95	2	232	564
Total	804	314	5981	245	9217	9468

Note: Players Total does not accurately reflect the number of unique players that have played Snag'em. Several of these events involved repeat players. A (-) marks data points that were not tracked that year or have been lost.

Snag'em Kiosks served as free Internet access points courtesy of Snag'em. Promoting Kiosk play was thought to alleviate some of the accessibility issues seen in previous versions of Snag'em, where players without smart-phones were thought to be at a severe disadvantage.

Snag'em flyers were distributed in the conference bags and at the conference registration table. Snag'em was featured in the conference program and promotional materials were placed on the registration desk and the Snag'em recruit table. The conference organizers also offered prizes (gift cards, t-shirts, etc) for the top players of the game. The global network was displayed on several projectors in the poster session room. Everyone at the event was also pre-registered for Snag'em, meaning that most of their data was already in the Snag'em database, and they only had to tag themselves and create a password to start playing the game.

We collected data at this conference primarily through moderator observation and game data logs. Attempts to collect pre- and post-survey data were made before and after the conference, but attendees were largely unresponsive to study calls for participation. The pre- and post-surveys were the same as those used for STARS 2011, with only minor changes for BigSURS. The evaluation was focused on sense of community among Snag'em players. At the time, more focus on non-players was planned in order to better understand acceptance of the game, but IRB approval for that portion of the study was not obtained in time to implement it at BigSURS. In the following sections, we discuss the BigSURS results according to adoption, acceptance, and adaptability.

5.3.1 Adoption

The game was played in the background of conference activity. Mild engagement was observed among undergraduate attendees and high engagement among volunteers and organizers²⁴. Moderators received several compliments on the game's design and implementation, and players openly admitted that the game was fun and made them talk to people they would not have talked to otherwise.

Usability issues did slow down adoption rates somewhat, especially on day one of the conference. Unknown to the moderators for half of the day, the game contained a bug for pre-registered attendees, making many of them unable to show up on the leaderboard, despite successful completion of missions. This discouraged many non-volunteer players from continuing the game on day two, particularly after several student volunteers ended up (wrongly) winning prizes for being top players on the leaderboard. Volunteer players had extra time to ask a moderator to fix their problem, but regular players did not have the time to rectify their point discrepancy. The problem was fixed on-site after reported by an off-site moderator (a UNCC moderator saw peculiar game activity in the Winthrop game).

5.3.2 Adaptability

Several players also indicated that the game did not adapt well to players without mobile device access, discouraging them from attempting to play the game competitively. Either they were not familiar with the SMS version of Snag'em, or they believed that the SMS version of Snag'em still put them at a severe disadvantage (see

²⁴six of the 15 active players were student volunteers or organizers for the conference, one of the active players was a high-school aged son of a conference organizer

Table 14).

The majority of players that registered for the game (71%) demonstrated interest in the game by playing either actively, passively, or intermittently. Of the remaining 28% that did not demonstrate interest, 11 of those players were unable to play on day one (as they also did not have tags) and were therefore discouraged from play early on.

Table 14: Comments from BigSURS Attendees addressing beliefs / perceptions, adoption, acceptance, and usability.

Noteworthy Feedback from BigSURS	
Adoption - Perceived Usefulness <i>Do you think it is easier to talk to others after playing Snag'em?</i>	"Depends on how seriously people are taking the game. If they just want to score points than no, they often leave the moment they have your tag number"
Perception of Players <i>Do you think that Snag'em helps increase others' sense of community?</i>	Perhaps, there was also a mean competitive edge to some of the players approaches, almost a manipulative desire for information for the sake of being "the winner" as opposed to using the game for its intent of networking
Acceptance - Belief / Perception <i>What aspects of Snag'em did you find least appealing?</i>	"(Snag'em) Turned some people evil"
Adoption - Perceived Needs <i>Can social networking games (such as Snag'em) increase a feeling of community among academic communities? What aspects?</i>	Yes, I am of the opinion that people often need this sort of push to participate in social interaction, which is unfortunate but, alas
Adoption - Perceived Popularity <i>What aspects of Snag'em did you find most appealing?</i>	The network map and live feed of connections being made was really interesting to watch.
Usability - System Seams <i>What aspects of Snag'em did you find least appealing?</i>	That I had to either have a computer or smart phone with me or pay to receive text messages to play. Neither was really convenient.
Usability - System Seams <i>Do you think that Snag'em helped increase your sense of community?</i>	Not really, but that is because I didn't put enough effort into playing it. I had wrongfully assumed that it required a smart phone prior to the conference, which I did not have.

5.3.3 Acceptance

BigSURS social context was very different than the context established in Snag'em conferences/events passed. There was no pre-established community for the players, making it less likely that attendees felt a need to network with the other researchers around them. Most attendees were in a very serious mindset, oriented towards the goal of presenting their research and appearing professional (with most dressed in business attire). This is unlike STARS conferences, in which most students are there not to present but to improve their soft skills and collaborate with other students and faculty. Overall, conference goers seemed apprehensive about Snag'em.

Table 15: Attendees survey feedback on game engagement and adoption at BigSURS.

Please rate your answer in response to the following comments about Snag'em.		
Answer Options	mean (M)	standard deviation (SD)
I would have played Snag'em more if more people were playing.	6.17	1.17
I thought it was too difficult to find people to fill my missions.	4.83	1.33
I thought that finding people to fill the missions was fun.	5.33	0.82
I didn't play Snag'em because I was embarrassed to go up and talk to people.	3.00	2.00
I put effort into trying to play Snag'em	4.50	1.52
I thought the Snag'em game mechanics were unappealing	3.00	1.55
I wanted to play, but it was too difficult to find other people who were playing.	4.50	1.76
Answer rated from 1 (strongly disagree) to 7 (strongly agree) N= 6		

The Global Network seemed to mediate some, but not all, apprehension. The displays were very prominent in the poster session and updated in real-time. When a

player made a snag or someone new registered for the game, the network would update with an animation of someone being pulled into the Snag'em network, causing some attendees to ask questions. Interested attendees asked me about the system, and complimented Snag'em on its ability to show what kind of connections were being made at the conference. The system, most of all, seemed to increase the perceived acceptance of the system (Table 15). One attendee, while observing a poster, looked up when a snag was being reported on the display. He responded to the event by asking his friend "What was that? Are people really playing that game?" In a different event, a female witnessed a snag on the display and said to her friend "Oh! Amy just got someone, did you see that?" Overall, having the game fully supported by the conference promoted the perception of the system as being useful and players (mostly) interacted with the system as a playful tool rather than a competitive system. Distribution of prizes seemed to have a negative effect, however, as non-players became discouraged from entering play when high concentration players would win prizes by being annoying (one player referred to Snag'em players as evil in Table 14).

5.3.4 Discussion

When features and observations were placed into the 3PL Lens for BigSURS, it was clear that prizes may not be the best motivation for getting people to play our game competitively. After a few hours, the leaderboard displays very discouraging numbers to non-players looking to enter the circle of play. Many potential late-entry players expressed that they would not register on the last day because they had no chance of winning, preventing them from adopting the game even passively

(Perceived Disadvantage). It was starting to become clear that our current points system, while good at rewarding passive play, obfuscates how much work is necessary to gain access to the leaderboard. This is further obfuscated by them observing some players “working” at the game at every given opportunity.

Players with the most amount of “free” or non-conference session time were most successfully pulled into the game circle. In a few cases, however, their aggressive (“aka evil”) play styles had the potential of discouraging others from engaging in the game, even passively (entering the play circle). Team points were not enough to cause players to play the game collaboratively or provide extra motivation for play. Badges, however, were of interest to some players, causing players to register so that they could collect a QR code badge and in a few cases, they would try and seek out QR code badges. Early system failure caused game adoption to slow dramatically, and the game really didn’t reach critical mass of players until day two of the conference.

In future iterations of Snag’em, particularly for multi-disciplinary conferences, it would be necessary to provide extra in-game motivation for players to network in order to increase perceived usefulness of the system. Perhaps, if event Snags had been more integrated into this version of Snag’em, attendees would have seen the system as a tool for getting more conference goers to attend their sessions or visit their posters.

It would also be advantageous to remove perceived disadvantage from late entry play in order to increase the number of highly engaged players. Sniping Missions provided an interesting but agonistic form of reducing the disadvantage of late entry players, but it was only effective among people already in the game circle. Players

that had not yet entered the game circle did not believe they had any way to catch up, and many players did not want to play if they could not win. Prizes tended to reiterate this “play to win” mentality.

System failure, once again, proved to be crippling to the adoption of the system, and players expressed extreme discontent and frustration when the game was slow. Many players would threaten to stop playing the game when the server became slow or if system feedback was not immediate. It was very clear that not only does system failure repel potential players from entering the game circle; it also expels fully established players out of the circle, if the failure persists. Using the Pervasive Play Lens, these interactions can be visualized through a lens snapshot (see Figure 32), showing how the features provided so far effect the game experience.

5.4 Snag'em at FDG 2012: Methods

The Foundations of Digital Games conference (FDG) is a ACM conference on games. The conference lasted three full days and unlike BigSURS, was attended by primarily graduate students and faculty of research universities and institutions. Industry representation at FDG was also very high. FDG is opposite BigSURS also in the fact that the conference was highly specialized; having a pre-established need for community building among its attendees.

There was very little time between BigSURS and FDG 2012, so not very many updates were added to Snag'em after play-testing at BigSURS. The mobile version of Snag'em was updated to be an HTML 5 app, using the jQuery mobile Framework. The mobile app, however, was in its infantile stages so was only tested by a handful

of players (who were warned about system bugginess). The Global Network was not modified in any way, but was set up to be more interactive for passers-by. Interested parties were allowed to zoom and pan around the network to look for interesting data.

For this conference, another sense of community study was attempted, since this community had a decided interest in collaboration across schools and institutions. The pre- and post-surveys were minor adaptations of the STARS 2011 instruments. A pre-survey call for participation was sent via email to the conference two days before the conference started. During that time, players were encouraged to register for the game and become familiar with the game interface. A few days after the conference ended, we sent out a call for participation to all conference attendees to complete

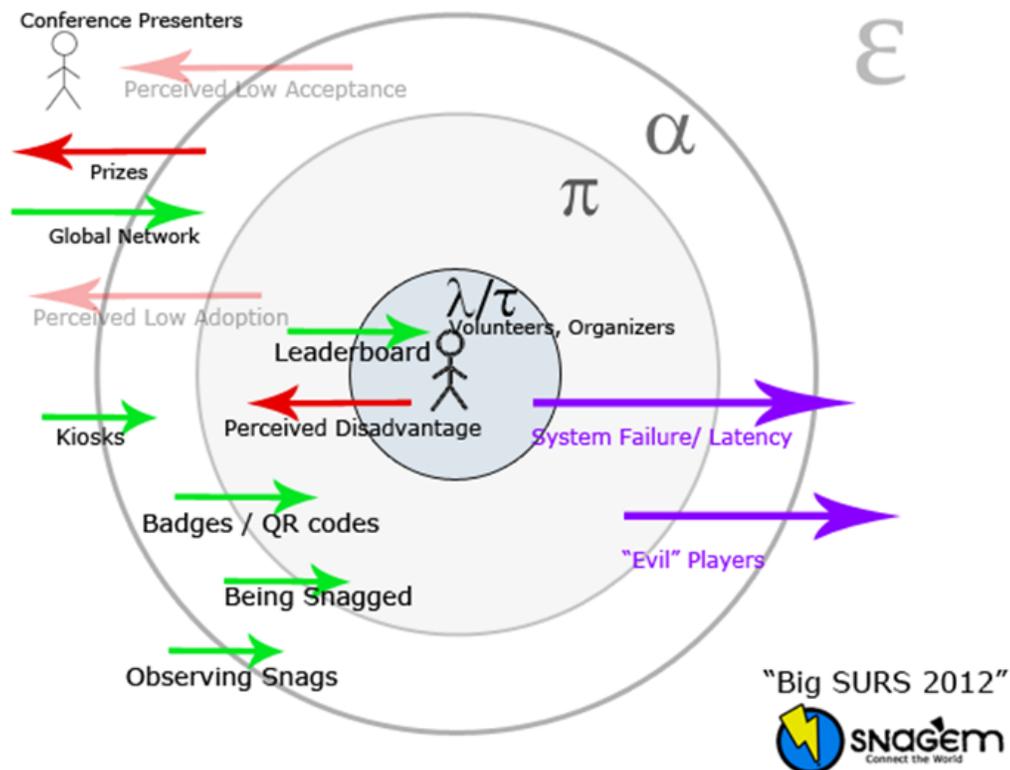


Figure 32: Game feature interactions with the game ecology at BigSURS 2012.

the post-survey. This was done to ensure to collect data from both players and non-players. In addition to the sense of community study, a newly developed ethnographic observation rubric and Non-Player Questionnaire (generated through exploration of game boundaries within the subsections of the Pervasive Play Lens) was used to make meaningful observations about system use, adoption, and acceptance.

At this conference, the evaluation was expanded to investigate passive play, including: number of logins, adding tags, and being snagged. This evaluation change was a result of increased development and understanding of the pervasive play lens. In past conferences (primarily STARS 2011) we had observed that participation among community leaders was meaningful, even though it was passive. Players that logged into the system often, and allowed themselves to be snagged, were indicated as positively impacting the game environment. For this reason, we tracked active and passive (interested) play behavior.

5.4.1 FDG Results

As shown in Table 16, only a small percentage of conference attendees were undergraduate students. The majority of attendees were graduate students or faculty. International representation was also high at this conference, with representation from several European and Asian countries. Of those that took the survey 68.2% percent of them identified as White/ non-Hispanic, 18.2% were Hispanic, 4.5% were Asian, and 9.5% were other. There were no African American participants in the study. Player age was also higher than previous conferences with 47.6% of survey participants between 22-29, 23.8% between 30-39, and 28.6% above age 40. The nature of

the conference and pre-survey responses indicated that these players largely enjoyed games, with 81.8% of survey participants identifying as moderate to hardcore gamers.

In the remainder of this section, we discuss the FDG results according to adoption, acceptance, and adaptability.

5.4.2 Adoption

If one were to base the success of Snag'em at FDG on adoption rate, they would find that Snag'em was very successful. In three days, 441 snags were made at this event. 41.4% of conference attendees registered for the game, half of which were fully registered for game play before the conference started (many players registered for the game preemptively). Of those that registered for the conference 17 players (28%)

Table 16: Demographic breakdown of Snag'em at FDG 2012. Like in previous breakdowns, the dark blue "players" row represents attendees that participated in play, doing something more than just registering for the game.

# of participants	Survey	Snag'em Participants	Conference attendees
Overall	N = 22 14.5% of Attendees	N = 61 40.1% of Attendees	N = 152
Job Title			
Undergraduate Students	4.5%(N=1)	8.2%(N = 5)	>5.3%(N>8)
Graduate Students	40.9%(N=9)	44.3%(N = 27)	>21.7%(N>33)
Faculty/Staff	40.9%(N=9)	39.3%(N = 24)	>23.7%(N > 36)
Industry/Other	13.6%(N=3)	8.2% (N = 5)	>5.3%(N>8)
Title Unspecified	0%(N = 0)	0% (N = 0)	44.1%(N = 67)
Gender			
Females	31.8%(N=7)	27.9%(N = 17)	27.6%(N = 42)
Players			
Active	50.0%(N=11)	79.4%(N = 50)	32.9%(N=50)
Interested	31.8%(N=7)	27.0%(N = 15)	11.2% (N=17)
Interested	18.2%(N=4)	52.4%(N = 33)	21.7%(N= 33)

were observed as being active players, 44 players (72%) demonstrated interested play, and 52 players (85%) participated in play in some way. The top player completed 73 snags and logged into the system 103 times over the course of 3 days. This player was an international student and played the game entirely via Kiosks provided by Snag'em. The second top player completed 55 snags recruited 5 players, and logged into the system 89 times. Interestingly enough, he was also an international student (though not initially connected in any way to the top player) and played entirely via Snag'em Kiosks.

Those interested in the game completed on average 10 snags and were snagged 9 times. Interested players also logged into the system on average 19 times during the conference. Interested players had an average of 18 tags per player (see Table 17).

Table 17: Play statistics collected through the Snag'em database at FDG (N=44).

Activity	Mean	Std. Deviation
NumSnags	9.95	16.168
NumSnagged	9.05	7.853
NumRecruits	0.34	0.963
Logins	19.18	23.801
Tags	17.98	10.934

At FDG, the conference suffered from a lack of Internet coverage at the hotel where the conference was hosted. The Snag'em team requested Internet before the event start date, having experienced a lack of coverage before at STARS 2010, and offered Internet coverage to the conference through the laptops provided at the event. This was not enough to encourage many to play, however, because the conference as a

whole still had no Internet access, making it really hard for players to quickly snag others in their free time. The Internet access provided at the Snag'em table was often slow, making it frustrating for some players to snag quickly. On top of this problem, the remote server on which Snag'em was hosted experienced a slowdown all of conference day one and a two-hour freeze in the middle of day two, once again causing players to become frustrated with the Snag'em system. System stability was recovered after reporting the problem and requesting that server maintenance restart the server.

Players that took the follow-up survey indicated that there was a need for more Snag'em participation, despite the high adoption rates. This was less of a concern, however, than was expressed at BigSURS (see Table 18). Players reported many instances of positive networking and, when asked directly, reported improved sense of community among themselves and others attendees. Attendees indicated that they saw Snag'em as a helpful networking solution ranging from a simple and effective ice-breaker, to a system that brought the whole community (both players and non-players) together. Players also reported, however, many instances of observed social weight, perceived non-acceptance, and overly competitive play. The amount of negative impacting feedback was like that reported in the initial STARS 2009 version of Snag'em.

5.4.3 Adaptability

Players found the system accessibility *seams* to be problematic during game play, which once again discouraged many players from playing the game competitively.

Table 18: Survey responses on player engagement and adoption at FDG 2012.

Please rate your answer in response to the following comments about Snag'em.		
Answer Options	mean (M)	standard deviation (SD)
I would have played Snag'em more if more people were playing.	4.60	1.70
I thought it was too difficult to find people to fill my missions.	4.00	1.83
I thought the idea of finding people to fill the missions was fun.	4.00	2.06
I didn't play Snag'em because I was embarrassed to go up and talk to people.	2.60	1.57
I put effort into trying to play Snag'em	2.72	1.87
I thought the Snag'em game mechanics were unappealing	3.84	2.03
I wanted to play, but it was too difficult to find other people who were playing.	2.95	1.70
Answer rated from 1 (strongly disagree) to 7 (strongly agree)		N = 20

There were many international attendees at this conference, making it difficult for them to play with their mobile devices. The SMS version of Snag'em was generally an unappealing play style, and people were bothered by the reduced functionality of the system. It was also revealed at this conference, that players did not fully understand the SMS system, with several players indicating that they did not realize that they could reject one of their five generated missions without penalty.²⁵ It also became apparent, through many reported issues, that the systems do not work well when the same player attempts to play with both the website and SMS messaging.

Active players once again showed through logged game interactions that they did not feel confident that they could win by playing passively. I only observed one player

²⁵On the website and mobile version of Snag'em, players can see all five of their missions at once, so forfeiting a mission results in a loss of five points. SMS version uses an Accept/Reject system for scrolling through the five possible missions. This system does not penalize forfeiting missions because players can see only one mission at a time.

mention that he could stay on the leaderboard by being snagged by many players. Adaptability of the system appeared to be low, and active players tended to either stay in high concentration at every given opportunity, or give up at game play.

5.4.4 Acceptance

The overall mechanic of game play was a mystery to some. One player believed that the global network visualization was the game. Most other non-players understood Snag'em as an ice-breaker game that provides players with extra motivation for approaching and meeting other people. The game was present enough for most people to know what the game was about when asked, and the game's outermost appearance led players to believe that the game was at best, an effective community building network solution and at worst, an uneventful social networking experiment. Of the 15 players that took the Non-Player Survey, no one indicated that the game was inappropriate for the conference.

Attendee comments and survey responses indicated that beliefs and perceptions about Snag'em were mixed, not consistent among attendees. Fifteen non-engaged attendees were asked about their interactions with Snag'em players and the Snag'em system. These players indicated that Snag'em players were nice, excited, and average people. Attendees rarely attributed poor player behavior to Snag'em players, instead focusing criticism on the competitive game mechanics. While attendees did believe that Snag'em (or a game like Snag'em) had a place in their conference setting, some found some parts of the game frustrating, distracting, and detrimental to their conference experience. Attendees reported that, often times, being snagged felt like they

were used only for their Snag'em ID. They also expressed concern that when players only ask for their ID and walk away, it would keep other people from playing. Attendees that were approached by less engaged players, however, said that being snagged felt like they were a part of a more playful community and enjoyed the interaction (see Table 19). Some attendees indicated that no one seemed to be playing; others noted that the game was a great talking point and that they witnessed a lot of activity and conversation concerning the game.

The comments that stood out most concerning social acceptance addressed the *observed social weight* that players and non-players noticed when addressed by competitive players. During times of competition, players were merely harvested for their Snag'em IDs and no subsequent conversation was made about player tags. Active players often came by the registration table to understand more about the strategies they needed to employ to be successful at the game. One player mentioned in the Non-Player Survey feedback, that players were so bothersome that he removed his Snag'em sticker from his badge so that people would stop approaching him just to ask for his ID. Again, players were not fundamentally attributed as just being annoying people; but attendees could see that the social play being mediated by the game was competitive in nature and often led to disruptive game politicking²⁶ and to game sociability that was unwanted in a conference setting.

²⁶politicking occurs when players target other players in their actions in an arbitrary way.

5.4.5 Sense of Community Setup

For our sense of community study, a call for participation was sent to all of the pre-registered attendees of the conference two days before the conference started. Pre-

Table 19: Open-ended responses from attendees at FDG 2012 on beliefs / perceptions, acceptance, adoption, and usability.

Noteworthy Feedback from FDG 2012	
Acceptance – Belief / Perception <i>How would you describe Snag'em to someone else who isn't playing?</i>	A social networking graph visualization game.
Perception of Players <i>How would you describe a Snagem player?</i>	It is difficult to distinguish a snagem player from a normal person. If it was not for the stickers, I would not be able to tell the difference.
Acceptance - Belief / Perception <i>Do you think that Snag'em helps increase others' sense of community? Why or why not?</i>	I didn't hear any good things about Snag'em, but it is possible... The only people I know who talked openly about it complained about the way that others would grab their badges to look at their Snag'em ID and interrogate them until they found a match for a mission. In the end I removed my ID from my badge and pretended I wasn't playing, to avoid this grossness.
Acceptance – Belief/ Perception <i>Do you think that Snag'em helps increase others' sense of community? Why or why not?</i>	I believe so, because as I said above, even though I was a mostly passive player, I met other people through them coming to me with missions involving me. So, for both active and passive players, the number of people that you meet and your overall community grows.
Adoption – Perceived Usefulness <i>Do you think it is easier to talk to others after playing Snag'em? Please explain your answer.</i>	Definitely. In the other activities I was involved with in the conference, I felt like I already knew those people who had snagged me. Even though the initial contact through Snag'em was awkward, it facilitated communication afterwards outside of the context of the game.
Usability – System Design <i>What aspects of Snag'em did you find most appealing?</i>	I liked how this game is set up like a pervasive game or ARG. I liked that I could create my avatar on the site and add tags about myself. It's very creative and interesting to enable a pervasive game into a social network - I had not experienced that at a conference before.
Adoption – Perceived Usefulness <i>Do you think it is easier to talk to others after playing Snag'em? Please explain your answer.</i>	Yes, because you first start talking to them in a lighthearted fashion so afterwards there is already good feelings in your communication history.

surveys represented an evenly distributed sample population that fairly represented the basic demographics of the conference (see Table 16). A one sample t-test was performed on the players' Pre-SCI scores, comparing them to an average mean score of 2.5. Players' sense of community scores were lower than average overall ($M = 2.1$, $p = .002$) for the FDG community, clarifying that a strong sense of community had not been established yet among community members and there was room for our system to be of some benefit for the conference. As a community of game enthusiasts, high adoption rates were predicted, allowing focus on data collection about system impact when adoption rates are high.

5.4.6 Sense of Community Post-Test / Social Impact

The sense of community (SCI) study was performed on the FDG conference. Roughly one week after the conference ended, all of the conference participants were asked to complete a post-game evaluation. This evaluation included quantitative and qualitative research methods composed of the SCI survey, observational data, and several open-ended questions about game experience. At FDG, 22 attendees completed the pre-survey and 21 attendees completed the post-test survey. Of the two groups of survey participants, only six that took the pre-survey also took the post-survey, so there was not a big enough sample of participants to conduct a significant within-subjects paired analysis. Like the pre-test, however, there was a representative sample of the population that participated in the post-test ($N=21$) with similar enough variance to compare post-tests scores ($M=2.5355$, $\sigma = .1959$) to the mean pre-test SCI scores ($M=2.1547$, $\sigma = .1899$) of conference attendees. A one sample t-

test was performed between the pre-test mean ($M=2.1547$, $SD=.43582$) and post-test ($M=2.5355$, $SD=.44269$), detecting significantly higher sense of community scores after the conference ended and a high effect size among surveyed attendees ($p = .001$, $d= 0.8327$) . The analysis was then split based on whether the representative players in the post-test actively or passively (“interested” attendees) played the game versus attendees that demonstrated no interest in the Snag’em game (“non-interested” attendees). For interested players, sense of community was significantly increased ($p = .036$) between the pre-test mean ($M=2.1547$, $SD=.43582$) and the post-test ($M=2.5104$, $SD=.51466$) mean. Post-test SCI scores among non-interested players were also significantly different ($M=2.5689$, $SD=.35148$, $p = .008$) from pre-test mean scores. An independent samples t-test, establishes that there is not enough evidence between non-interested ($M = 2.5689$) and interested attendees ($M = 2.1547$) to imply significant differences ($p >.05$, $d=.8327$) in the sample.

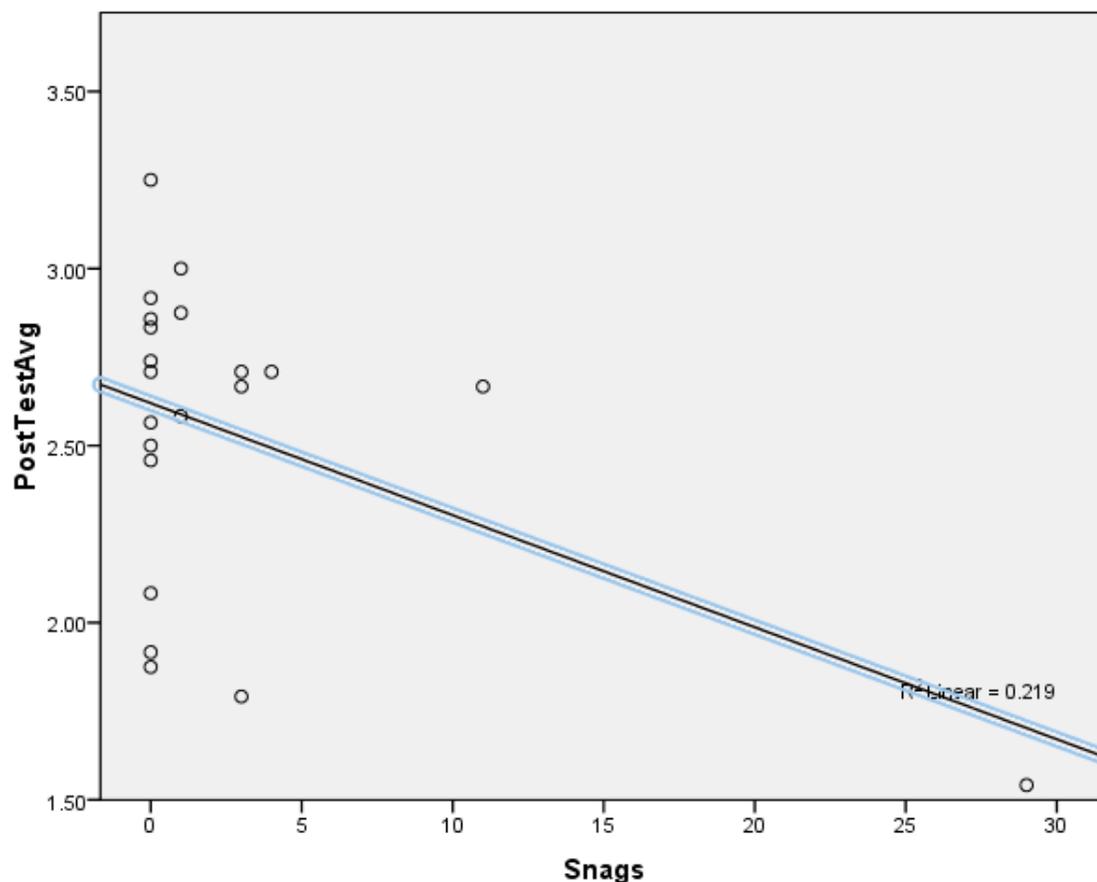
In order to further investigate the differences between interested attendees and non-interested attendees (an observed effect in qualitative data), a Cohen’s d effect analysis was performed. For interested players the difference between pre- and post-conference scores suggests a moderate to high practical significance ($d = .79$). For non-interested players, the difference between pre- and post-scores suggests a high to extremely high practical significance of over one standard deviation ($d=1.04$). While the mean differences between post-scores of interest versus non-interested players were not significant ($p >.05$), a moderate decrease in effect was detected as a result of game interaction; the lack of significant findings likely due to a small sample size. Likewise, in nearly every subsection of the Sense of Community Index Survey,

a smaller effect of community involvement was seen for interested attendees versus non-interested attendees (see Table 20). This data is a small indicator that Snag'em may have inadvertently introduced a *social weight* into the conference environment. In certain contexts, like a game conference, in which players enjoy a game experience much more than average, greater care would need to be taken to make sure that the sociality orchestrated by the game is acceptable in a conference setting.

Table 20: Cohen's d effect analysis constructed through pooled variance of pre- and post-test SCI scores.

Total	pooled variance	mean-post	mean-pre	cohens d
Non-interested	0.398148642	2.5689	2.1547	1.04031499
Interested	0.451472121	2.5104	2.1547	0.78786703
Reinforcement of Needs				
Non-interested	0.529947814	2.8333	2.3667	0.88046405
Interested	0.548131069	2.7361	2.3667	0.6739264
Membership				
Non-interested	0.498749726	2.3333	1.8283	1.01253188
Interested	0.486346504	2.1611	1.8283	0.68428579
Influence				
Non-interested	0.436182543	2.725	2.1983	1.20752196
Interested	0.507782995	2.6806	2.1983	0.94981519
Shared Emotional Connection				
Non-interested	0.46252175	2.3479	2.2807	0.14529046
Interested	0.497061637	2.4091	2.2807	0.25831806

Looking further into the interested groups, it is clear that the lowest SCI post-test score was reported by the highest pro-active player in the post-test sample (4th place on the leaderboard). When the two pro-active players are removed from the group of interested players, the mean of interested players versus non-interested players is higher for interested players. Qualitative analysis further emphasizes that high engagement of our game did not imply positive social impact. A correlation test



Correlations

		Snags	Snagged	PostTestAvg	PRONAvg	PMembership	PInfluenceAvg	PSECAvg
Snags	Pearson Correlation	1	.612**	-.468*	-.375	-.407	-.541*	-.346
	Sig. (2-tailed)		.000	.032	.094	.075	.014	.147
	N	70	70	21	21	20	20	19

Figure 33: Illustrating the negative correlation of snags to post-test SCI score.

between snags and SCI scores did not replicate the STARS 2011 findings. In this context, High pre-test SCI scores were not predictors of Snag'em performance. Instead, snags were significantly negatively ($p = .032$, Pearson = $-.407$) correlated with post-test SCI scores (see Figure 33). In this sample, qualitative data (and quantitative data to a lesser extent) indicates that the most active players at the conference experienced sense of community loss, while passive players at the conference may have experienced the greatest sense of community.

5.4.7 Design Conclusions

There were many unforeseen interactions that took place at FDG; primarily the re-introduction of social weight through game mechanics, something thought to have been overcome after STARS 2009 playtesting. Also, qualitative data indicates inconsistent social acceptance responses among conference attendees.

The inconsistency of beliefs and perceptions across FDG attendees leads one to believe that the boundaries of play spaces at FDG were harder and less porous than what were seen at STARS conferences. There were hubs of play and activity, most likely centered around the physical location of the Snag'em recruit table as well as on highly engaged/ active players. Non-players that were not near these closed circles of play and activity may not have gotten the same experiences as non-players that socialized with Snag'em players. More effort would have to be placed in Snag'em's design to directly influence players of reaching outside of their Snag'em circles in the FDG social context.

There are many possible reasons why game mechanics used at previous conferences did not lead to similar play experiences at the FDG conference. Recruit points, unlike what was seen in STARS 2011 conference play, were not enough motivation to cause players to reach outside and pull other players into the game (a key motivator of community engagement and viral game adoption). Looking for reasons why this may be so, the most obvious differences between demographics were explored. Active players at STARS have been primarily women players since STARS 2010, and at STARS conferences and BigSURS, entering game play seemed more inviting than

play at FDG. At FDG, the Snag'em leaderboard was dominated by men, a factor that was immediately investigated while exploring the ecology of Snag'em at FDG. It is possible that there is a hidden variable involving the overall level of introversion, higher than what is seen at STARS, contributes to this difference in behavior. As Ralph Koster presented at Austin GDC, the majority of current generation core-gamers are INTJ, INTP, ISTJ, or ISTP on the Myer's Briggs typology. INTJ and ISTJ personality types are also reported by Koster to be common to programmers[52]. Furthermore, these personality types only account for 19% of women[52][4]. Though this demographic has reportedly shifted in the last decade, it is fairly safe to assume that the largely introverted personality types represented at FDG were much different and less diverse personality types than those found at STARS. This difference could contribute to different behaviors with the same game at a similarly sized conference.

Social weight was also reintroduced to Snag'em, most likely also the result of different personality types representing the conference population (see Table 21). For this type of environment, it would be advantageous to move away from a gaming inner circle in general (see Figure 34). Roger Callois mentions in *Man, Play, Games* that the instability of society can be attributed to the play continuum from *paideia* to *ludic* play [13]. As players find themselves deeply engaged in ludic activity, the mindset starts to move back from relaxed and light hearted, towards serious and goal oriented. What this suggests is that for Snag'em, it may be possible to place players "too deeply" in a game circle (see Figure 34). The FDG SCI data, while of low sample size, suggest that players that were "active" ended up with lower SCI scores than those that were passively playing. Players appeared much more willing

to embrace competitive and strategic play than in any other conference in which Snag'em was deployed. As a result, the ethos of Snag'em players is believed to have been very different, even though the game succeeded in having a high adoption rate. In future iterations of Snag'em at this conference, it would be necessary to move even further away from gamification by altogether avoiding use of points as extrinsic motivation. There are many other ludic circles with which to focus a magic circle of play. Snag'em at FDG most likely would benefit from non-gaming ludic elements that structure play through mimicry, acting, or less competitive pottering and constructive play²⁷. In later iterations of Snag'em, elements were added that involve checking in at leisure times to see how the Snaggles are doing, motivating players to tend to the virtual community.

²⁷Pottering is a form of relaxed play that is satisfying in a meditative way [55].

Table 21: Open-ended responses by FDG attendees that indicated social weight.

Social Weight Feedback at FDG
<p>Sometimes people would only talk to me to get Snag'em information - not to network. I had far better networking success without Snag'em. Then again, playing in Snag'em quests can be a good "ice breaker" if you are shy.</p>
<p>Snag'em actually decreased my sense of community; I found that certain people I interacted with were only interested in using me for points, rather than getting to know me as a person.</p>
<p>I didn't hear any good things about Snag'em, but it is possible... The only people I know who talked openly about it complained about the way that others would grab their badges to look at their Snag'em ID and interrogate them until they found a match for a mission. In the end I removed my ID from my badge and pretended I wasn't playing, to avoid this grossness.</p>
<p>Some people played the game very well, others didn't play at all, and a few abused the system and cheated.</p>
<p>It [Sense of Community] depends on personality of players: knowing more about others' descriptors (tags) is not influent on sense of belonging unless it creates shared values. knowledge in itself can polarize differences rather than bringing people closer.</p>

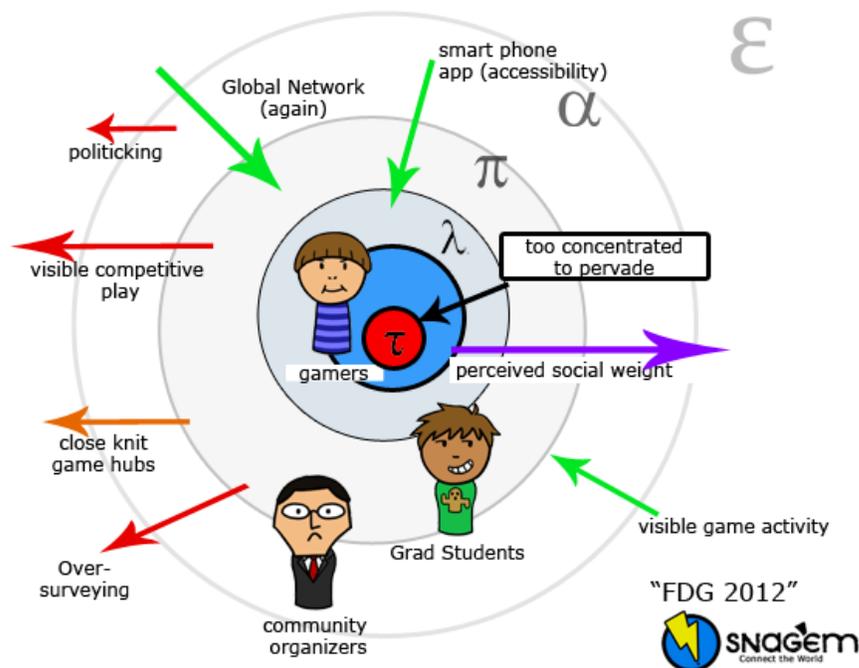


Figure 34: A play lens snapshot from FDG 2012. At this conference, active players were observed to rely on the extrinsic motivation of points more so than players at STARS. This conference featured a love of games, so adoption wasn't really a problem. The leaderboard, and the impossibility of achieving it, discouraged outside observers from joining the game. Since players interacted in closely knit groups, non-players could not observe positive game interactions from outside. Global networking visualizations once again kickstarted game adoption.

5.5 The Game Ecology

As anticipated, Snag'em's acceptance, adoption, and adaptability are not trans-historical properties among different social contexts. There is an ecology that interacts with players, non-players, and mechanics that make the overall conference experience different during each play session. Pervasive game models must be flexible enough to be adapted to these new ecologies if they are to be of extended use. 3PL is an attempt at such a pervasive game model. With this model of the game boundaries I can easily create snapshots of what a game ecology looks like: including the player and non-player interactions that effect factors relating to system success; the game

mechanics and elements that promote and resist entering into different boundaries; we can also see how the wrong kind of game adoption can lead to a socially unacceptable experience. Incorrect categorization can lead to an incorrect understanding of player interactions within the game ecology, leading toward incorrect generalizations about players.

For example, active and passive categories would not be useful as a player breakdown in the 3PL model. Through FDG study, it was clear that active players perform differently based on what appear to be factors concerning the ecology, including demographic makeup, perceived usefulness of an established gaming circle, and the personality traits of the players that have decided to adopt the game and play proactively. The behaviors across active players at different conferences were very different. STARS active players were made up of mostly women, and non-gamers. These players also started out with high SCI scores *before* the conference began. FDG active players, on the other hand, were males that reported low SCI before the game took place. The top two players were also international students that had the least amount of access to “preferable” mobile interfaces.

The personality traits of people that played actively were also different between conferences. It is important to identify what is similar about all of these player types and begin to understand the environment interactions that shape player behaviors. As 3PL is revised through different socially pervasive projects with different personality types of players, I anticipate an increased predictive power of the Pervasive Play Lens.

In order to better organize this space, a better categorization between players and non-players is needed so that player interactions can be modeled within 3PL

boundaries. These categorizations should be general enough that they are relevant within varying game ecologies.

5.6 Understanding non-players through 3PL

Non-players have proved themselves important to the game experience in a number of different ways. They are potential new players, they are potential advocates, and they are ex-players of the game. Their influence, however, depends on where they are in the circle. I've broken Non-Players down into the following categories:

5.6.1 The uninformed.

The uninformed do not know about the game and have never heard anyone speak of it. They are generally *unaware* of the game's existence. If your game is advertised and has any social impact whatsoever, this problem will be resolved. Designing the game to be "viral" can help reduce the number of people in this category more quickly.

5.6.2 The interested (aka Low Concentration player).

This person may have been a player at some point but had to abandon the game because of their need to do other important things. This type of non-player may or may not have abandoned the sense of being a player in the game. This non-player most likely sees the value of playing the game and is interested in devoting more time to the game after they take care of other priorities. A successful pervasive game should allow ALL players to assume this role easily. The game should allow for higher priority tasks to be done without frustration, guilt, or in-game loss. For the interested non-player, we should take note of any negative feedback that pertains to their ability to prioritize tasks, leave the magic circle, or be serious.

5.6.3 The Earnest (the disinterested non-player).

The earnest person has most likely not found a reason to participate in game play, or believes that their unique method of networking is more efficient, more fun, or more serious. I use the same word as the World of Earnest terminology, because this non-player most likely is of the belief that their interactions would be better suited as serious or goal oriented, and that there is no advantage in playing with the community. Often informed of the game's existence, this person has registered for the game, and/or believes that they understand the game and what it's about. An Earnest non-player will most likely say that they know what the game is, but then describe it wrong, or describe it in a way in which the implicit game rules are ignored (e.g. You play it like you play four square; you go around shouting "Are you a Pirate?"). If enough people are seen benefiting from the game, the Earnest non-player is most likely not so stuck in his belief that he will *never* play. The Earnest must not be forced to play, but should instead see convincing examples of how the game is beneficial. A successful pervasive game should appear non-destructive to the Earnest non-player. This prevents the Earnest from becoming a Dark Lurker and gives them more opportunities to change their mind about the game. Designers should look for ways to make players less bothersome for both Earnest and interested non-players. Avoid this problem by designing the game to coexist with the World of Earnest.

5.6.4 The Dark Lurker (aka the Spoil Sport or the Devil's Advocate).

In most text, a lurker is someone that sees a social thing happening from the outside but does not attempt to participate. In many cases, the lurker takes information from

one social group and presents it to another social group, indicating that while they are not clogging up social channels with unnecessary chatter (e.g. making posts on a group's listserve), they are contributing in some way [73]. A Dark Lurker, however, is someone that takes information from one channel (in game) and presents it to another as a way of preaching against it. The Dark Lurker, more than anyone else, is a destructive element in a pervasive game because they tend to make up the minds of Earnest non-players and convince players to stop playing. These non-players can be thought of as a disruptor of game adoption. The Dark Lurker also may try to break the game from the inside, usually by demonstration that the game's explicit or implicit rules can be broken. In Snag'em, the Dark Lurker has taken many forms: from an irritated professor who has been approached by one too many Snag'em players, to the security expert that does not believe that the game is safe to play. Unlike a typical game, a Dark Lurker cannot be easily ignored as they can have any amount of social status and capital. They may also have validity to their claims. It is therefore of utmost importance that the Dark Lurker be appeased or presented with options for rebuking the game in a more respectable way. Dark lurkers are typically louder and more disruptive if they believe that their convictions are not being addressed in some way (e.g.: this game is making people stupid, this game is making people network wrong, this game is trying to force me to play, this game just wants my credit card information, this game is hackable). For this group of people, it is important that outlets to vent exist, and that the option is well known and accessible. Dark lurkers, in the world of earnest, still have to try to conform to social rules and be polite. Dark lurkers are hardest to collect feedback from, because while very destructive to the

game ecology, they also make up a small percentage of the event population.

5.7 Game Adoption, Acceptance, and Adaptability

FDG and BigSURS demonstrate the relationship between acceptance, adoption, and adaptability to a pervasive game ecology. In traditional game design, a game's success is often measured by its adoption rates and its ability to achieve flow and high enjoyability among its players. These implementations of Snag'em, however, demonstrate that the ecology of a pervasive game extends beyond the traditional magic circle. In particular, acceptance and adaptability are important factors that contribute, along with adoption, to the overall enjoyment of the game.

At BigSURS, both active and passive players were observed being ejected from the Ludus and Paideia circles as a result of over-zealous play. At FDG, high levels of competitive engagement negatively impacted the game ecology despite the high adoption rate of the game at the conference. In a pervasive game ecology that blends into a non-play setting, balancing game adoption (implying high levels of enjoyment, concentration, and engagement or flow), with the acceptability of the game is pivotal towards orchestrating a useful and appropriate game environment. Usability is another factor that affects pervasive play space while minimally affecting adoption. System usability makes the game playable for those that enter the circle, but for those outside the circle, it plays only a small part in the acceptance of the game. Snag'em's results showed that it is ultimately the game's physical artifacts, observed pleasantness, and similarity to socially acceptable behaviors that promote high acceptance (and then adoption) rates.

By understanding acceptance, adoption, and adaptability, designers can better deduce what elements should be adjusted to positively affect the game circle. Tables 22 and 23 show all the game elements of Snag'em and how they impacted the affordances of acceptance, adaptability, and adoption to modify the game ecology. Each game element or feature can significantly alter one primary affordance of the game to change player behavior, but in some cases they will change two or more. These tables show that the addition or removal of one feature can change several affordances, demonstrating the great complexity present in the magic circle of play. Interestingly, some game elements seem more likely to impact one area than another. For example, removing or hiding competitive game mechanics does not directly bring new players into the Game (τ) circle. The direct impact of changing game mechanics would (hopefully) shape more observable positive networking interactions, that would pull more non-players from Earnest (ε) to Agalma (α). Also, more positive-sum play would allow more late-in-game Ludus players to compete for leaderboard positions, moving them from Ludus into Game (τ).

As discussed in Table 24, the affordances measured in Snag'em can all be tied to the overall goal of sense of community, our current measure of meaningful play. Adoption, Adaptability, and Acceptance affordances are, themselves, layers of community in some ways. Adaptability of a game allows the player to take control of their own personal or individual sense of community. When the game adapts to player behavior, the community adapts similarly, allowing a player to feel comfortable with the idea of networking at their own convenience.. Adoption is ultimately amplified by the briefly discussed network effect (see Figure 3). When the game has large adoption rates,

it creates its own internal community. Players often report that they met people they would not have met otherwise as a result of playing Snag'em. That means that Snag'em is helping these players build relationships outside of previously established social circles. High adoption rates ensure that a community is established within the game (τ) circle. Ideally, the game makes this community more approachable than the pre-existing community outside of the circle. Acceptance is what links the Snag'em community to the outside, pre-existing community. In FDG, even though adoption rates were high, the Snag'em community ultimately failed to integrate with the FDG community. Measuring acceptance re-orientes Snag'em's design back to the needs of the pre-existing community so that Snag'em can help both players and non-players meet their professional networking goals.

Table 22: Game elements and how they relate to affordances.

Game Ludus) Paideia) Agalma) Earnest

Game Features	Affordances	Lens effect
System Design Security Connectivity Latency Registration Surveys	Adoption - The system's interface design proves critical to game adoption and system use. A poorly designed or unfamiliar interface can cause expulsion from even the most inner circles of play. A good system design can help retain players, but the main concern here is preventing negative effects.	Ludus → Paideia Game → Ludus Game →→→ Earnest
Non-Competitive Play Badges Events/QR Codes Levels/Growth Recruitment Points	Adaptability - These features allow for structured play among different types of players. Non-competitive elements help people be playful in the game, even if they cannot make it on the leaderboard. Adoption - These features also promote frequent and sustained game play.	Ludus ← Paideia Game ← Ludus
Competitive Elements* Points Missions Leaderboard Prizes Mutual benefit from game interactions	Adoption & Acceptance - The innermost circle sets the mood of the game. To ensure that observable behavior does not besmirch the game, win/lose conditions should be hidden to less active players (acceptance) and reveal themselves as players become active (adoption). Relying too heavily on competitive play mechanics can <i>cause over adoption</i> , introducing social weight where players perform well in the game at the risk of being ostracized by community.	Game ←← Agalma Paideia → Agalma Ludus → Paideia Game → Ludus Game →→→ Earnest
Shared Elements Teams, Visualization Large # of players Visible game interactions	Acceptance - These features promote perceived usefulness. When non-players believe that the system can be of use or is widely adopted, they will often resist speaking against the game and sometimes help promote the game.	Agalma ← Earnest Paideia ← Agalma

Table 23: Game elements and how they relate to affordances (continued).

Aesthetics Graphics, Avatars Interface Repetition Similarity of game interactions to acceptable social behaviors	Acceptance- These features affect the overall look and feel of the game and its environment. The acceptability of a feature is different depending on a person's mindset (telic or paratelic). A boring or unappealing aesthetic, or too much repetition can hurt interest in game.	Agalma ← and → Earnest Paideia ← Agalma
Usefulness Notes Messages Events Tags	Acceptance- These features promote acceptance through perceived usefulness. Notes and messages (in-game and after the game is over) help people communicate and remember contacts. Tags can help players learning something new about one another. Adaptability- Tags allow players to shape interactions in the game. In this way, structured play is always adapting to the changing social context.	Ludus ← Paideia Agalma ← Earnest
System Controls Support for various levels of engagement Accessibility: SMS, Mobile, Web, Kiosks Game moderation	Adaptability- These features allow player control over how and when to play. Players resist entering the game when a channel is thought to introduce a disadvantage. Moderators should be able to monitor and adapt it as needed.	Ludus ← Paideia Game ← and → Ludus
Game environment Duration (~3 days) Voluntary play	Acceptance, Adoptions, and Adaptability – The game needs a day to build acceptance, a day for players to get truly engaged (adoption), but not so long that player attention turns to other things (since adaptability is least developed in Snag'em). If play is involuntary, no one is truly playing; all participants are in Earnest.	Time and choice are needed to achieve : Game ← Ludus ← Paideia ← Agalma ← Earnest

Table 24: Affordances and how they relate to sense of community.

Sense of Community and a Socially Pervasive Game... a theory

Affordance Type	Relation to Sense of Community	Type of Interactions
Adaptability	Promotes Personal Sense of Community	Player to Game Interactions
<p>'Adaptability' affordances help players feel in control of their participation in the game. System flexibility promotes game behavior that players engage in at their convenience. When a game is adaptable, players may go about their lives but still feel continually connected to the game community, promoting a stronger sense of community.</p>		
Adoption	Builds a Community within a Community	Player to Player Interactions
<p>'Adoption' affordances help players feel they are part of a smaller community of game players within the larger community. Such affordances help players engage other players in game-related interactions. When a game has successful adoption affordances, the game helps players can feel more connected to one another through meaningful game interactions, promoting a stronger sense of community through building player to player relationships.</p>		
Acceptance	...But the Game Community is not Separate	Player to Non-Player Interactions
<p>'Acceptance' affordances help non-players see the value of the game and promote their willingness to interact with game players. When acceptance affordances are low, player behavior differs significantly from the social norm, and this can result in social weight (where there is a negative cost associated with game-related interactions). When acceptance affordances are successful, the game becomes acceptable to community leaders and other non-players. This helps ensure that the game community has potential to improve relationships within the larger community. To be most successful, acceptance affordances should help the game grow by encouraging players to include non-players in (socially acceptable) game interactions. Acceptance affordances remove visible barriers between the game community and the larger community, encouraging sense of community to grow overall.</p>		

CHAPTER 6: CONCLUSION AND FUTURE WORK

There are three main contributions of this dissertation. The first is a narrative of the design iterations of the Snag'em game in the field over several years. This game is the first game developed to research the effects of socially pervasive games on networking at conferences, particularly for novice conference attendees. The second main contribution is Powell's Pervasive Play Lens, that breaks down the space of human endeavor by intention and motivation. Using 3PL to view a game and its ecology can be particularly effective when studying and designing socially pervasive games, where boundaries of the magic circle are intentionally expanded into "non-game" space. The third contribution is the identification of the primary affordances of acceptance, adoption, and adaptability for socially pervasive games, and the features that can promote these affordances to enhance the game ecology. Through consideration of the features of Snag'em and how they affected acceptance, adoption, and adaptability, designers can better predict what features they may need in similar game environments.

Powell's Pervasive Play Lens (3PL) and the Snag'em design narrative are a start towards clarifying the initially vague magic circle of play into concentric zones related to the intentions of people who come into contact with the game. Since Snag'em was evaluated in several different academic environments, and longitudinally evaluated

at the STARS Celebration conference for three years, this design narrative lends considerable insight into the process taken to achieve a successful socially pervasive game. 3PL evolved from a grounding in a comprehensive review of pervasive games research and play theory with iterative refinement through large scale field studies on Snag'em. As a theoretical framework, 3PL is constructed to enable designers to build and intentionally direct and predict the impacts of their designs of play for complex social settings.

There are several limitations to this work, due in large part to performing research on a completely voluntary game in diverse real-world settings. Pre-post test design is a particular challenge for pervasive games, where the goal is to blend into people's daily lives; a survey just doesn't fit with this idea, and taking two surveys is even more unlikely. The game surveys all had very low survey response rates, and it was particularly unlikely that a participant took both the pre- and post-surveys. Collecting data in these settings is difficult for a number of reasons:

- Integrating a pre-test into registration significantly increases registration time, leaving less time to explain the game to new players at the registration table, who are trying to start playing during short conference breaks. This leads to less active players in the game.
- Sending the pre-test to all attendees gives attendees less motivation to complete the survey than integrating it into the game.
- There is little overlap between people that take the pre-test and those that take the post-test.

- There is no guarantee that sending the instruments to all attendees will result in a balanced sample of active players, passive players, and non-players.
- Increasing the number of survey items has a large impact on participation. Participants skip questions and sparsely answer open-ended questions when the survey takes an excessive amount of time.

The lack of reliability in our pre- and post- survey instruments is one of many reasons that Snag'em research relies more heavily on formal ethnographic observation. Over time, observations are matched with trends in the log files, leading to better understanding of play behavior in and around the game. Observation is also critical for understanding non-player activity, as non-players have even less motivation to fill out pre- and post- surveys.

The application of the 3PL model to Snag'em illustrates the beginning of generalizable non-player interaction and factors that affect the constructed game ecology. The subsets of concentric 3PL model highlight the fact that there are features that affect play that are not necessarily "play factors". For example, physical artifacts and general aesthetics play a role in affecting social acceptance, with the potential to pull people deeper towards the game circle. Likewise, technical usability issues (bugs) and involuntary play prevent the formation of a true game ecology. In all the observations of Snag'em, system bugginess not only repelled players from entering the game circle, but also ejected them out of the game circle. In the Leadership Seminar, involuntary, required play kept most participants in the world of Earnest, distorting all observations of game play, so predictions could not be made based on

game interactions.

There are other factors that may affect play that have only begun to be evaluated. The Snag'em game is effective at engaging both men and women in the game. Though the studies of Snag'em did not reveal statistically significant differences in logged behavior of men and women, observations suggest that there are play style differences between genders that may help us understand more about personas and personality-driven play behaviors. Player personality types affect how players interact with the competitive and non-competitive game mechanics of Snag'em.

In the several iterations of Snag'em discussed in this dissertation, competitive play has affected different players in different ways. For some, it provided more motivation to actively make connections with others. For others, it primarily causes undesirable interactions, like badgering and refusing information to other players. There is some indication that hard core gamers have a tendency to concentrate too much on the game's points and not on its overall purpose. Such observations suggest that deriving personas, or dominant personality types, to outline user characteristics and how they relate to 3PL could be particularly useful in understanding how changes in the game design would impact people and the game ecology. In future work, a deeper elaboration of personas of both players and non-players would help build a more predictive model that could anticipate the needs of people with different motivations and characteristics, particularly in terms of adoption, acceptance, and adaptability.

A better understanding of personas would enable designers to motivate people, and particularly highly engaged players, to contribute to the overall game experience in ways that appeal to them. At STARS 2011, data suggested that SCI pre-survey scores

were predictive of engagement values (making many snags). However, this effect was not found in later BigSURS and FDG conferences. Also at STARS 2011, players were motivated by recruitment points to pull non-players into the game. Had that trend continued for BigSURS and FDG, Snag'em's designed mechanics could have easily supported directing Snag missions towards high SCI-scoring players in early game, and having those players form and lead teams of passive players through recruitment. It is unclear why highly engaged players at these conferences did not engage in more recruitment. It is possible that the extended use of Snag'em at STARS Celebrations meant that prior exposure led people to want to explore the game more, and less time was needed for attendees to understand the intention and mechanics of the game. By better understanding personas, the 3PL model could be extended to help predict what types of structures could motivate particular types of players to expand the game and its influence to create better game ecologies. It would also be particularly useful to better understand what characteristics of people and the game promote both active and passive play.

In other future work, socially pervasive games could explore replacing game mechanics as the focus of the 3PL model with other ludic structures. At FDG, players that were attracted to competition played the game individually, even when mechanics (such as recruitment points) were introduced to promote play that benefitted and engaged others. It may be that for some settings, gamification* through point structures may not be effective or appropriate for creating a meaningful play ecology. Other ludic structures, like acting, role-playing, building, and narrative, could all be useful for pulling people into a playful mindset without putting players in direct

competition with one another. In other cases, we may find that competition may be appropriate within a particular setting. For example, Table Tilt's success as an ice-breaker and team-builder demonstrated that competitive game play could be used to motivate players to engage in particular social behaviors. It's important to realize that no ludic or paidic activity is inherently "bad" or "good"; the effects of an activity are dependent on the surrounding context and the people involved. When applying 3PL to model other game/play spaces, future designers could try replacing the game mechanic as the focus of the lens with other ludic structures, and evaluate how these different ludic structures impact the game ecology.

This discussion of the future work possibilities for 3PL demonstrates the powerful nature of creating a model that elaborates on the fuzzy idea of the magic circle to understand the concentric boundaries of play that people must cross to make a socially pervasive game a success. This model enables designers to concentrate on particular features and how these features can be used to increase a socially pervasive game's acceptance, adoption, and adaptability, providing people with affordances that can lead them deeper toward engagement with the designed game experience. Building a sense of community is just one goal that can be achieved through the application of 3PL, but it is a central goal in creating truly pervasive games that become socially integrated.

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GLOSSARY

- Acceptance- a measure of tolerance of play system, particularly among non-players and key community members. 9, 64, 190
- Adaptability- Ability of the game to adapt to players' varying levels of engagement [41]. 35, 64, 190
- Adoption- a measure of play activity, either first time and repeat activity, among a potential player population. 1, 190
- Asynchronous play- multiplayer play system that can be experienced in small intervals at different times for each player. 34, 190
- Context- information that can be used to characterize the situation of an entity. An entity is a person, place, place or object that is considered relevant to the interaction between a user and an application [92]. 190
- Context-aware- any system that can detect changes and make use of context. 13, 14, 190
- Diegetic- a game element (like a HUD element) that lends itself to the story or narrative of the game. 44, 190
- Earnest- defined by Huizinga as being the antithesis of play. Alternatively to serious, earnest behavior includes that which is grave and highly consequential. 58, 190
- Flow- a mental state in which a person is fully immersed in a feeling of energized focus, full involvement, and success in the process of the activity [79]. 47, 190
- Gamification- The use of game mechanics to enhance non-game contexts, typically to make a task or concept more engaging or appealing. 180, 190
- Immersive gameplay- Games that include immersive gameplay seek to completely erasing the boundaries of play. When successful, this gameplay and aesthetic makes for some of the most pervasive, persuasive, and powerful game experiences in games [61]. 13, 190
- Ludic play- the formal play space in which emphasis is placed on strategy and rigid rules. Ludic play is often agonistic or competitive behavior and results in a win or lose state for players. 1, 190
- Lusory- The lusory attitude is a frame of mind that motivates players within a magic circle to do activities otherwise thought to be inconvenient or unsavory for the sake of game play. Conforming to game rules is the result of adopting a lusory attitude [63, 82]. 68, 190

- Magic circle of play- the boundaries of play that separate the play from the ordinary. 5, 190
- Middleware- typically a computer software that provides services and a framework for a more complicated and specific software system. In the context of pervasive games, these systems anticipate services needed for context-aware games and provide an easy development environment for systems that make use of ambient, context-aware, and mobile hardware. 20, 190
- Ordinary- that which is normal. Includes social activity that is usual and common. Used as the antithesis to playful activity, which is typically abnormal and unusual. 1, 190
- Paedic play- a subset of play that represents child-like play behavior. Usually opposed to structure, paedic play is more exploratory and less strategy dependant. 1, 190
- Paratelic- A playful mindset, where one is more motivated by the enjoyment of the present moment rather than their pursuit of future goals. 68, 190
- Pervasive game- any game that has one or more salient features that extend the magic circle of play spatially, socially, or temporally. 1, 190
- Play- a voluntary, free activity that stands outside of ordinary life. Typically bounded by time and space. 1, 190
- Seams- Chalmer's et al describes seams as "a break, gap, or 'loss in translation' in a number of tools or media, designed for uses together as a uniformly and unproblematically experienced whole". 13, 190
- Social adaptability- Eriksson defines transformative play as "the ability of a game to adjust, either actively or passively, to changes in the social environment so that negative effects on gameplay or activities overlapping play sessions are minimized [32]". 40, 190
- System heterogeneity- the use of a heterogeneous system of tools to create a solution. In this context, designers opt for a diverse system of tools for two reasons: in order to create an ambient system with context; or for higher accessibility of the solution. 20, 190
- Tech Major- a game whose design focuses and relies on the implementation of hardware, sensors, or context systems to make an immersive game experience. 8, 190
- Tech minor- a game that focuses on the social construct of the game rather than its technical construct. 9, 190

Telic- A serious mindset, where one is motivated by achievement and future goals rather than by enjoyment of the moment. 58, 68, 190

Transformative play- Salen defines transformative play as “a special case where free movement of play alters the more rigid structure it originally resisted [82]”. 10, 190

World of Earnest (WOE)- the space outside of all playful boundaries in which earnest mindset/behavior is prevalent. 58, 190

APPENDIX A: EVALUATION INSTRUMENTS

In this section, I present the instruments (surveys and observation rubrics used to conduct evaluations at academic conferences and events. I also present some surveys used for general playtesting and feedback. The pre- post- test design is centered around Chavis et al Sense of Community Index 2, a “frequently used quantitative measure of sense of community in the social sciences”. the SCI scale is sometimes used as a predictor of behaviors as well as a measurement instrument in pre- post test survey designs. Chavis also claims that the index is useful in many social contexts including, schools, workplaces and universities.

A Sense of Community Index

The SCI is comprised of 24- Likert Scaled questions. The SCI uses a 4-point scale that ranges from Not at All, Somewhat, Mostly, and Completely for each item. Wording is changed minimally to apply to each conference or event. Each set of six questions is broken into the following categories: Reinforcement of Needs(ROn), Membership(Mem), Influence(Inf), and Shared Emotional Connection(SEC).

Reinforcement of Needs

1. I get important needs of mine met because I am part of this community.
2. Community members and I value the same things.
3. This community has been successful in getting the needs of its members met.
4. Being a member of this community makes me feel good.

5. When I have a problem, I can talk about it with members of this community.
6. People in this community have similar needs, priorities, and goals.

Membership

7. I can trust people in this community.
8. I can recognize most of the members of this community.
9. Most community members know me.
10. This community has symbols and expressions of membership such as clothes, signs, art, architecture, logos, landmarks, and flags that people can recognize.
11. I put a lot of time and effort into being part of this community.
12. Being a member of this community is a part of my identity.

Influence

13. Fitting into this community is important to me.
14. This community can influence other communities.
15. I care about what other community members think of me.
16. I have influence over what this community is like.
17. If there is a problem in this community, members can get it solved.
18. This community has good leaders.

Shared Emotional Connection

19. It is very important to me to be a part of this community.
20. I am with other community members a lot and enjoy being with them.
21. I expect to be with this community for a long time.
22. Members of this community have shared important events together, such as holidays, celebrations, or disasters.
23. I feel hopeful about the future of this community.
24. Members of this community care about each other.

B Pre-survey Questions

This section contains the pre-survey questions given to attendees asked to participate in the Sense of Community Study. These questions give us an understanding of what players want from the system, what kind of experience they are expecting, and a general demographic breakdown of our players. In cases where we were able to pre-register players for the game, question 1 is not necessary as we already know the numbers of each player.

1. Type in your Snag'em ID
2. Gender? (M/F)
3. Race?
 - White / non-Hispanic
 - African American

- Hispanic
- Asian
- Indian
- Other

4. What is your occupational status?

- Undergraduate
- Graduate Student
- Faculty Member
- Post Doc or research staff
- Industry
- Other

5. Are you a student volunteer?

- No.
- Yes, and its my first time volunteering at this conference.
- Yes, and I've volunteered at this conference before.

6. What age group are you in?

- Under 18
- 18-21
- 22-25

- 26-29
- 30-39
- 40-49
- 50-59
- 60+

7. (Insert Sense of Community Index here)

8. What is your level of extroversion/ introversion?

- Under 18
- Very extroverted
- Pretty extroverted
- Mildly extroverted
- Mildly introverted
- Pretty introverted
- Very introverted

9. How stressful do you find the idea of talking to people you don't know in this community?

- Not at all stressful
- Mildly stressful
- Pretty stressful

- Very stressful
- Extremely stressful

10. What are your thoughts on video games?

- I'm not into them/ They're not for me
- I'm a casual gamer
- I'm a moderate gamer
- I'm a hardcore gamer

11. How often do you sign-in to social networking sites for 10 minutes or more?

- Never / I don't have any accounts
- Rarely
- Sometimes
- Fairly often
- Often
- Very often

12. If you are planning on playing Snag'em, why do you plan on playing? (Select all that apply)

- I want to meet other people in my community
- I want to see how the game works
- I like to be involved in my community in any way I can.

- Someone told me to sign-up / I have no real interest in the game
- Some of my friends are doing it, and I want an excuse to interact with them.
- Other

13. What do you hope to get out of this game? (Open answer)

C 2009 Post Test Survey

At STARS Celebration 2009, an informal survey was used to gather playtesting feedback about the game system, usability, and game enjoyment. We only used this survey at STARS 2009.

Thank you for playing SNAGEM Protoype! Your feedback is much appreciated! The following questions below ask how much you agree or disagree with the statements. (1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree, 4 = Agree, 5 = Strongly Agree)

- The registration was simple and easy to do.
- The browser's menu bar was laid out logically and made sense to me.
- The graphics and colors of the game were appealing to me.
- I understood the provided instructions clearly.
- I understand the concept of SNAGEM.
- The gameplay was easy to follow and comprehend.

- I understand the goal behind SNAGEM.
- I was confused about how to play SNAGEM.
- I was aware that I could play in the web browser and by texting with my cell phone.
- The option to play with different mediums(cell phone, web browser) appealed to me.
- I didnt feel like I received enough instructions to understand how to play SNAGEM.
- What would you like to see added to the game?
- What would you like to see removed from the game?
- What was your favorite feature/experience of SNAGEM?
- About how many people do you know at this conference who are not from your school?
- What age bracket are you in?
- What is your gender?
- How would you rate yourself on a scale of 1 to 5, where 1 is very reserved and 5 is very outgoing?
- On a scale of 1 to 5 (1 is low and 5 is high), how often do you play video games?

- On a scale of 1 to 5 (1 is low and 5 is high), how often do you play casual games (ex. cell phone games)?
- Do you find it easy to meet new people?
- What is your birth date? (MM / DD / YY)
- How much did you interact with the other players during the game? Rate your interaction from 1 - 5, where 1 is no interaction and 5 is a lot of interaction.
- After playing the game, did you interact again with the new people that you met during the game?
- If you answered yes to the previous question, then did you feel that the game gave you some common ground to interact with those people?
- Is there anything that you would change about the game to make it easier to network with the other players?
- Is there anything that you would change about the way in which people were selected to play the game?
- Is there anything that you would change about the times that the game was played during the conference? Would you have the game be played more or less?
- Did playing this game help you progress in your Snag'em missions?
- Do you feel that playing the game was a waste of time?

- Was the game confusing?
- Did you have fun while playing the game?
- Did you like the look and feel of the game?
- The game crashed (open-ended):

D Post Test Survey

To wrap up a Sense of Community study, we follow with the following post test. This survey contains a repeat SCI as well as several open ended questions about their play experience and suggestions players (and non-players) have for system/game improvement.

- Please rate your response to the following questions about social networking from 1 (Not at all) to 6 (Absolutely)
 - Do you think that social networking in school clubs and organizations should be facilitated?
 - Would you have been more willing to participate in a social networking activity that was not a game?
 - Do you think you benefited from using Snag'em as a social networking tool?
 - Do you feel as if most people would benefit from using Snag'em as a social networking tool?

- Please rate your answer in response to the following comments about Snag'em.

1(Strongly Disagree) to 7 (Strongly Agree)

- I would have played Snag'em more if more people are playing.
- I thought it was too difficult to find people to fill my missions.
- I thought that finding people to fill the missions was fun.
- I didn't play Snag'em because I was embarrassed to go up and talk to people
- I put effort into trying to play Snag'em
- I thought the Snag'em game mechanics were unappealing
- I wanted to play, but it was too difficult to find other people who were playing.

- Please rate you answers in response to the following comments about Snag'em's

design. 1(Strongly Disagree) to 6(Strongly Agree)

- I had no idea what to do to play Snag'em
- I didn't know how to play the test messaging version of Snag'em
- I liked being able to see my network connections
- I played through text message
- I would have played (or played more) with text messaging if it had worked better
- I liked being able to add my own tags about myself

- Do you think that Snag'em helped increase your sense of community? Why or why not?
- Do you think that Snag'em helps increase others' sense of community? Why or why not?
- Do you think it is easier to talk to others after playing Snag'em? Please explain your answer.
- What aspects of Snag'em did you find most appealing?
- What aspects of Snag'em did you find least appealing?
- Can social networking games (such as Snag'em) increase a feeling of community among academic communities? What aspects? Explain your thoughts.
- Insert Senses of Community index here.

E Non-Player Questions

The following questions target attendees that do not appear to be actively engaged in the game. They may be playing the game at the time, or they may not have yet registered for the game. These questions reveal the user stories of the different types of non-players present at a conference or event. There are three sets of Non-Player Questions (A, B and C) that moderators are encouraged to ask non-players either through in person interview or through open ended survey questions.

A1 What do you know about Snag'em?

A1.1 Are you a Snag'em player?

A2 Describe an experience you've had with a Snag'em player?

A3 Snag'em players are typically (fill in blank)to me.

A3.1 Why did you answer with that word?

A4 How many new people have you introduced yourself to in the last 1 hour?

A4.1 How many of those people gave you their contact information?

A5 What social networking tools are you using at this conference?

A5.1 For the one you use most, why do you use this tool?

A6 When is it inappropriate to play Snag'em?

A7 In what ways are Snag'em players bothersome?

A8 In what ways do Snag'em players enhance the conference experience?

A9 Based on what you know about Snag'em, what would you change about it?

B1 How would you describe Snag'em to someone else who isn't playing?

B2 Why do you think that people use Snag'em?

B3 Describe the impact of the Snag'em game on your conference experience right now?

B4 How do you feel about the presence of Snag'em players at this conference?

B5 How would you describe a Snag'em player?

B6 How do you think that non-players perceive Snag'em players?

B7 Describe an experience where someone tried to convince you to play Snag'em?

B7.1 If no, why haven't you been approached?

C1 Based on what you've seen of the Snag'em game: Describe Snag'em.

C2 Describe what people do with Snag'em?

C3 What kind of person would not play Snag'em?

C4 When would someone choose never to play Snag'em?

C5 List 3 possible reasons why someone would not play Snag'em.

C6 The presence of Snag'em at this conference is (fill in blank).

C6.1 Why did you give that answer?

C7 Which aspects of Snag'em do current players find beneficial in terms of their conference experience?

C8 How likely are you to play Snag'em later in the conference?

C8.1 What factors affect this likelihood?

C9 Does any part of Snag'em make you nervous or uncomfortable?

C9.1 - Can you tell me the most important thing?

F Kiosk Questions

These questions address the experiences of players that are actively engaged in the Snag'em system. When players come to a Snag'em Kiosk in order to play Snag'em, moderators asks them to complete a short survey. The surveys are broken into short survey groups so that players generate a complete user story, even though each participant answers very few questions.

- Please enter you Snag'em ID Number:

- Please indicate all the levels in which you are playing Snag'em right now?
 - I never play Snag'em
 - Only when someone asks to Snag me
 - When my friends drag me back into the game
 - Whenever I think about it
 - Whenever I'm not doing something more serious/pressing
 - I play off and on
 - I'm playing all the time
 - I pull new people into the game
 - I wish I could keep playing when the conference is over

- Have you learned anything while playing Snag'em that will help you with professional networking in the future?

- Why do you play Snag'em?
- How do your peers react to you playing Snag'em?
- What would you change about Snag'em to make it better?
- How do you think that playing Snag'em can help you?
- Can games help people network more effectively? How so?
- How do you believe that the connections you've made via Snag'em can help your professional network?
- How do you approach people when you are playing Snag'em?
- Do you think you'll end up staying in contact with people you met playing Snag'em?
- Is there anything interesting that has happened while playing Snag'em that you'd like to share?
- Does this game belong at this event? Why or why not?
- How do you think non-players view this game?
- Describe an experience that you've had with a non-player?
- Describe an experience that you've had with a Snag'em player?
- How would you describe a Snag'em player?
- How are the Snag'em game moderators affecting the experience of the game?

- How is using Snag'em as a social networking tool different than exchanging business cards?
- How is using Snag'em as a social networking tool different than using Facebook?
- Explain how your mentor would perceive your playing Snag'em now?

G Player Feedback

Lastly, players always have access to a feedback page that allows them to give me general feedback with two open ended questions.

- Snag'em made me happy because:
- Snag'em made me sad because:

APPENDIX B: NORMALITY TESTING

In this section, a series of tests are presented to determine variables modeled by a normal distribution. SCI scores in pre- and post- test conditions are used to measure whether a population gained sense of community after attending a conference with a Snag'em intervention. Here, I ensure that probability measures are valid for this dataset. This appendix also includes an explanation of the “active” and “interested” groups categorization strategies. Active and interested groups are a way of evaluating participants affected by Snag'em based on data collected by the Snag'em system. These groups were necessary to evaluate activity among dedicated players as well understanding behaviors of attendees that are not active, but who still seem affected by game play.

At every conference in which the SCI study was performed, the pre-test SCI scores were normally distributed. When compiled between all conferences (STARS 2011, Leadership Seminar, and FDG), the data maintained normality, indicating that the scale is balanced and consistent across several academic social contexts. The following graphs (Figures 35, 36, 37, 38, 39, 41, 40, 42) are the normal distributions at every event followed by a composite of all the conferences (Figures 43 and 44).

Among the post test SCI scores, FDG ($W=.903$, $p=.040$) and Leadership Seminar ($W=.962$, $p=.037$) rejected the Shapiro-Wilk tests for normality. There is small visual indication that the FDG distribution is bi-modal as well as it contains several extreme negative values. It is yet to be determined whether or not the second mode is due to Snag'em game interaction. The Leadership seminar on the other hand,

shows evidence of a non-linear distribution. Since it was a controlled environment, it is likely that a Snag'em interaction disrupted the bell curve.

From several Snag'em events combined (STARS 2010, STARS 2011, Leadership Seminar, BigSURS, and FDG), we can see in Figure 45 that Number of Snags per registered player is not well modeled by a normal distribution, further rejected by a Shapiro-Wilk Test for Normality ($N=414$, $W=.432$, $p = .000$). This was consistent in every version of Snag'em. Excessive zero cases, where players register for the system and subsequently never score a snag, is largely responsible for lowering the mean of player snags.

The histogram in Figure 45 suggests that there is a large percentage of registered players that never become actively engaged with the system. As Snags are the primary indicator that a player is actively approaching players and collecting points, I break Snag'em participants into groups of non-activity and activity. The "active" players category is where I remove large frequencies of excessively low values (below the *original mean*) in attempts of evaluating a distribution more representative of the attendees that actually played the game. In earlier versions of the game, this value was always around 5 snags (46). In STARS 2011, this value shot up to nearly 10 (Figure 47).

In 2011, qualitative data from STARS 2011 and Leadership seminar suggested that it was not just *snagging* players that were being affected by the game. Another culling method was needed for looking affected players from non-affected players in the game data. In this case, I looked at other variables including: recruits, logins, number of times snagged, as other criteria for separating "interested" (attendees interested and

participating in the game at least passively), from “non-interested” attendees (players that never demonstrated interest within the system in Snag’em). The criteria for interested players included:

- Recruiting one player OR
- Being snagged 5 times OR
- Having over 10 tags OR
- Making 5 snags

From STARS 2011 and forward, I used “interested” player categorization to perform analysis on players suspected to be somewhere in the agalma and paideia spaces of play. The interested player categorization should be used when attempting to evaluate attendees affected by the play space or deeper. Active player categorization should be used to evaluate players that are in the ludic space or deeper. It would be beneficial in future versions of Snag’em to separate interested players from active players to see if effects are different based on level of engagement, since FDG suggested that competitive play could, in some instances, introduce significant negative effects.

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PreSOCAvg	.116	21	.200 [*]	.973	21	.807

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

PreSOCAvg

Histogram

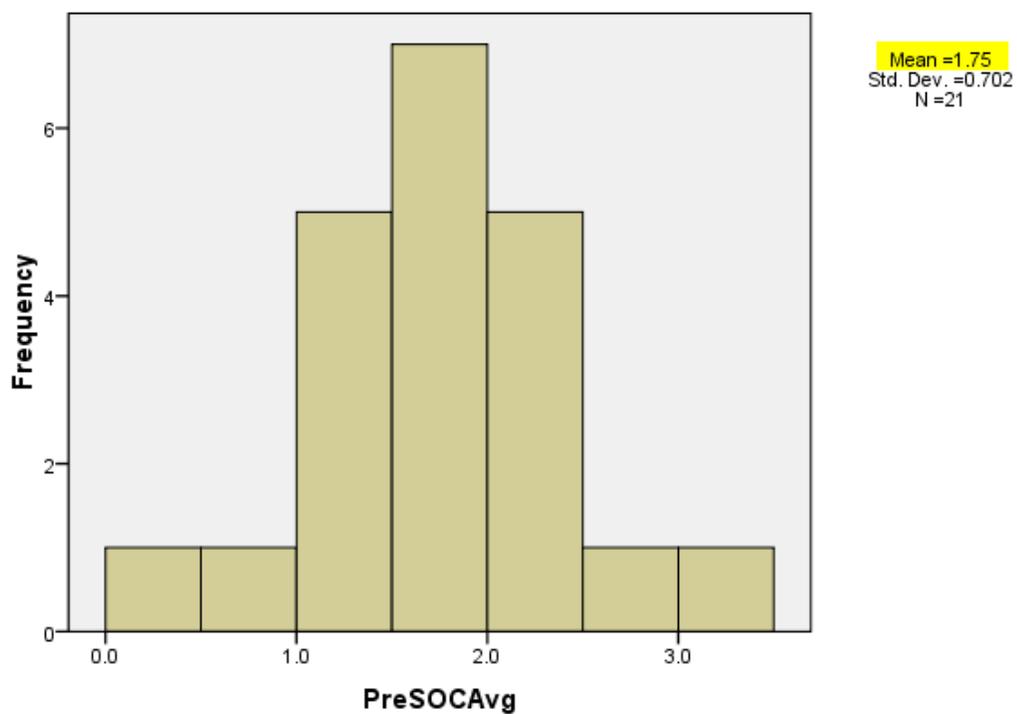


Figure 35: The normal distribution of STARS 2011 Pre-SCI scores. The distribution does not reject the null hypothesis and is visibly bell shaped.

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
SOCavg	.100	65	.170	.984	65	.545

a. Lilliefors Significance Correction

SOCavg

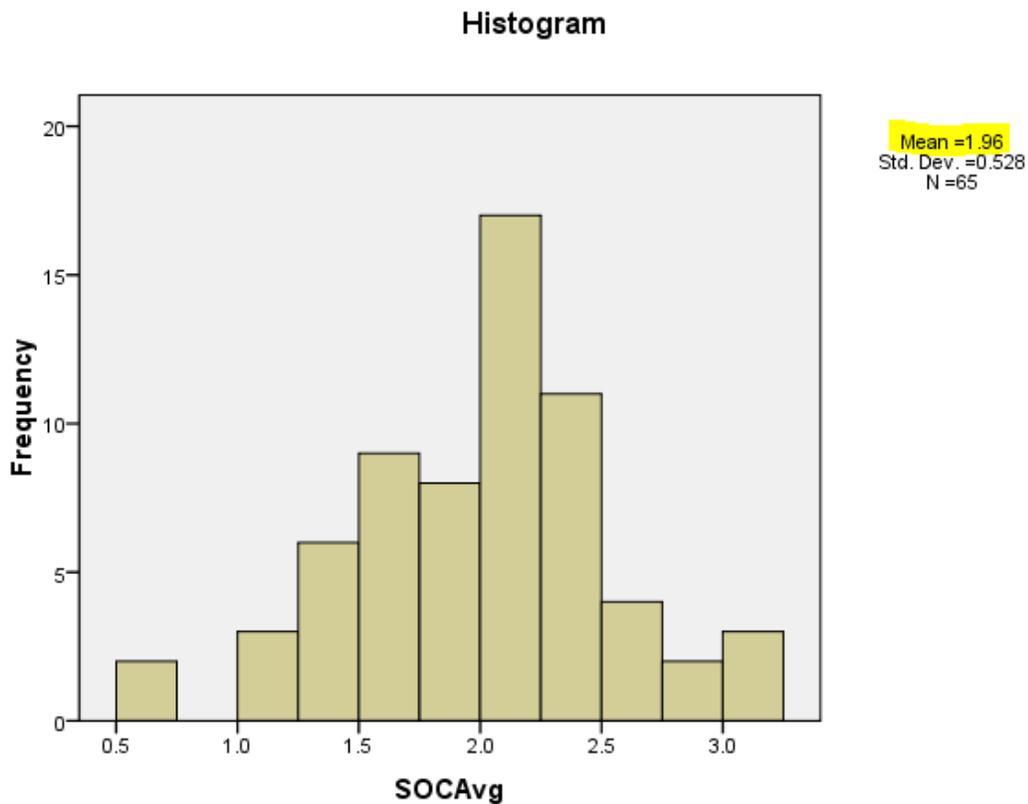


Figure 36: The normal distribution of STARS 2011 Post-SCI scores. The distribution does not reject the null hypothesis and is visually bell shaped.

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PreTestAverage	.083	72	.200 [*]	.985	72	.541

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

PreTestAverage

Histogram

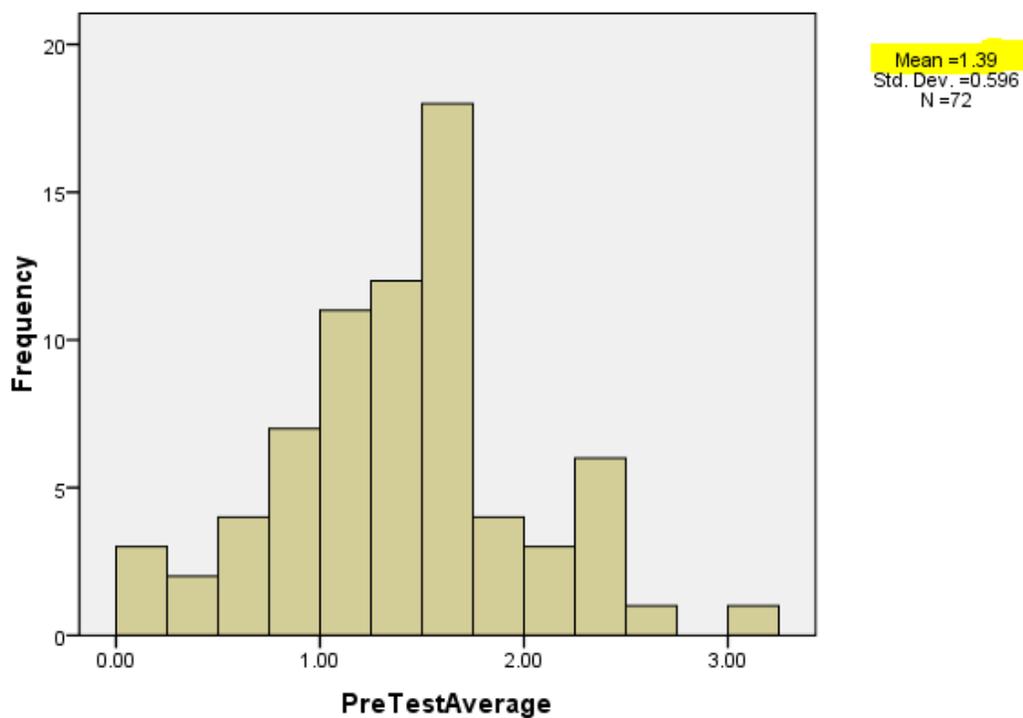


Figure 37: The normal distribution of Leadership Seminar Pre-SCI scores. The distribution does not reject the null hypothesis and is visually bell shaped.

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PostTestAvg	.104	67	.069	.962	67	.037

a. Lilliefors Significance Correction

PostTestAvg

Histogram

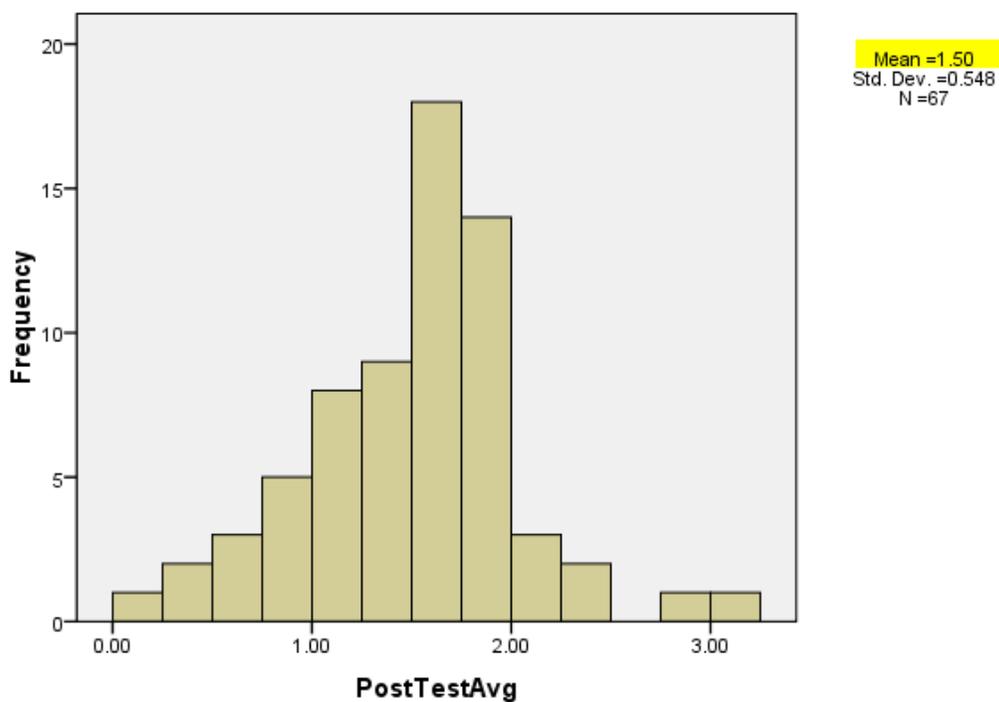


Figure 38: The normal distribution of Leadership Seminar Post-SCI scores. Though the distribution appears to be visually bell shaped, it fails the Shapiro-Wilk normality test.

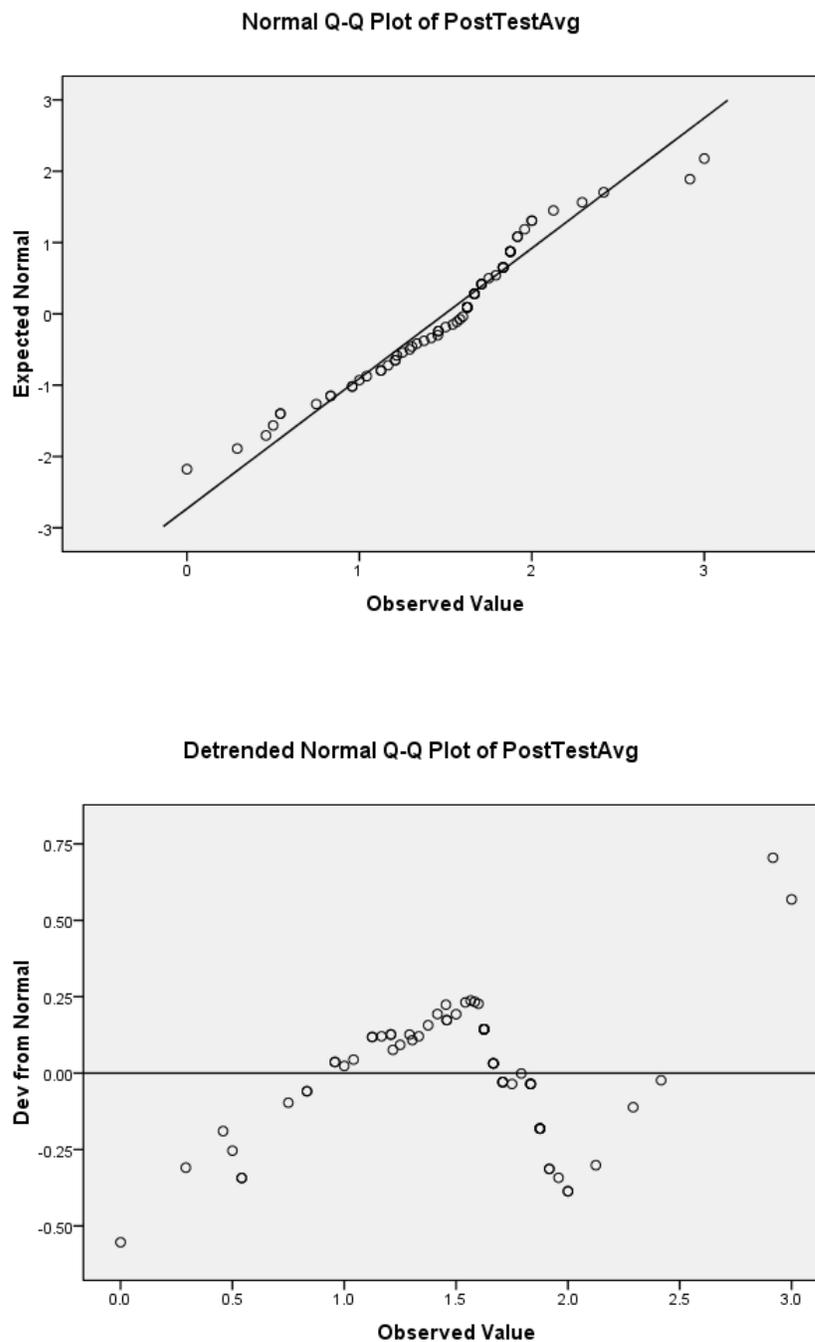


Figure 39: Further analysis of the Leadership Seminar POST SCI scores reveals that the distribution has substantial gaps (grouping) that suggests an unmeasured interaction.

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PreTestAvg	.151	20	.200*	.970	20	.757

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

PreTestAvg

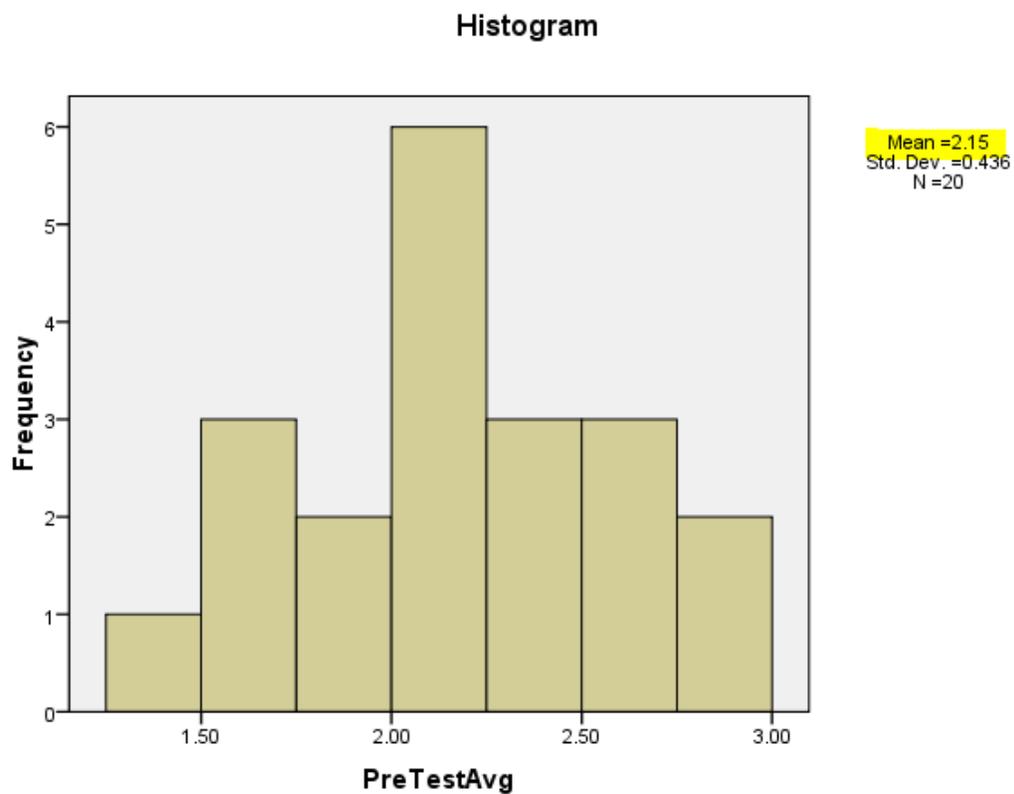


Figure 40: The normal distribution of FDG Pre-SCI scores. The distribution does not reject the null hypothesis and is visually bell shaped.

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PostTestAvg	.193	21	.039	.903	21	.040

a. Lilliefors Significance Correction

PostTestAvg

Histogram

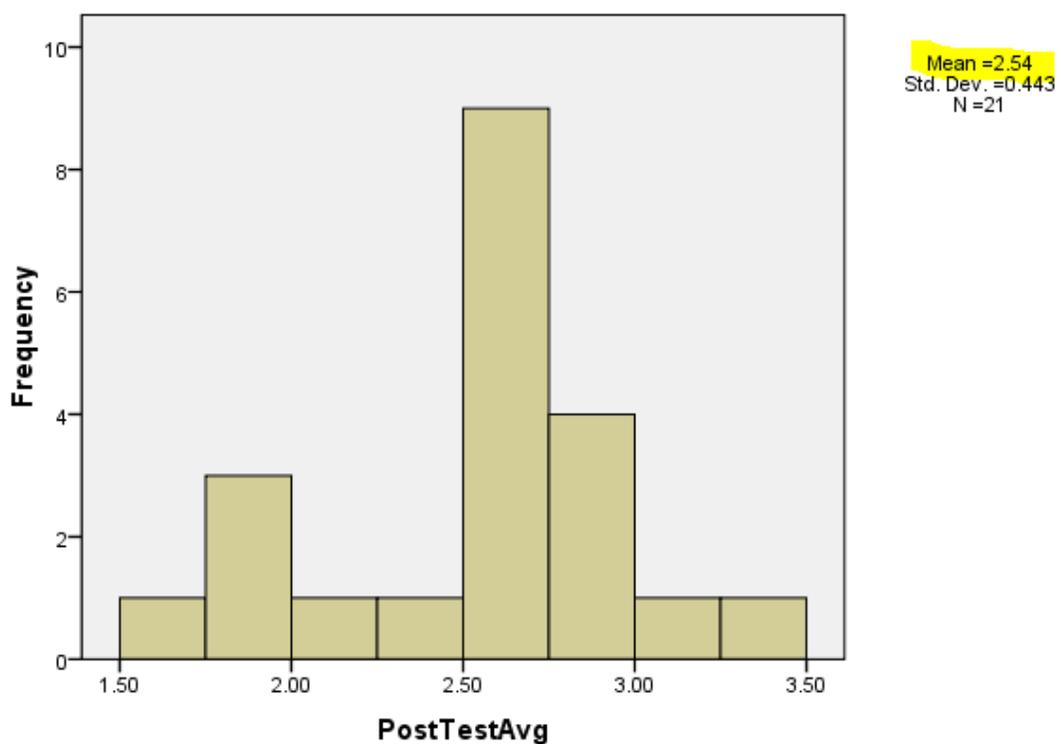


Figure 41: The normal distribution of FDG Post-SCI scores. Though the distribution appears to be visually bell shaped, it fails the Shapiro-Wilk normality test.

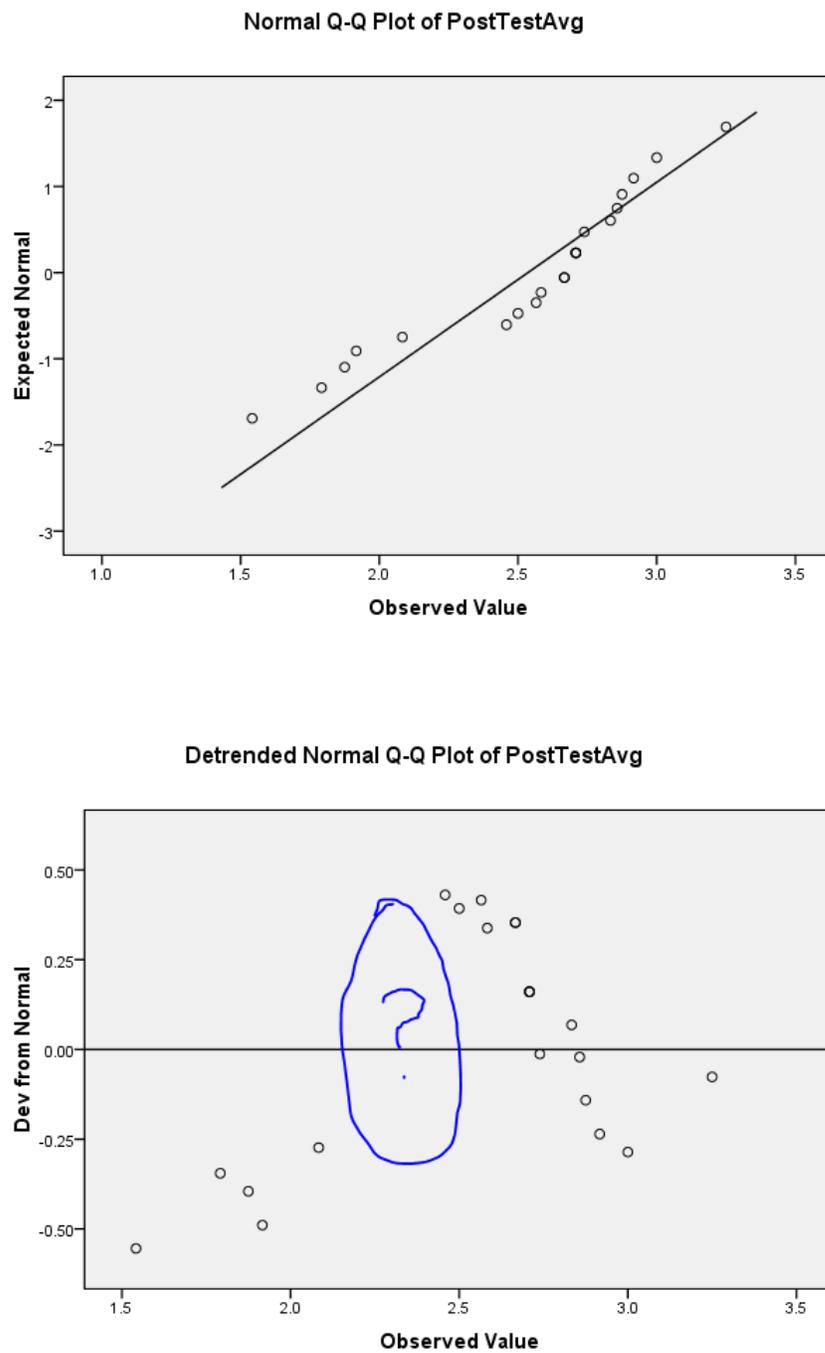


Figure 42: Further analysis of the FDG POST SCI scores reveals that the distribution has substantial gaps (grouping) and several extreme measurements that suggests an unmeasured interaction.

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PreSOCAvg	.049	113	.200 [*]	.987	113	.373

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

PreSOCAvg

Histogram

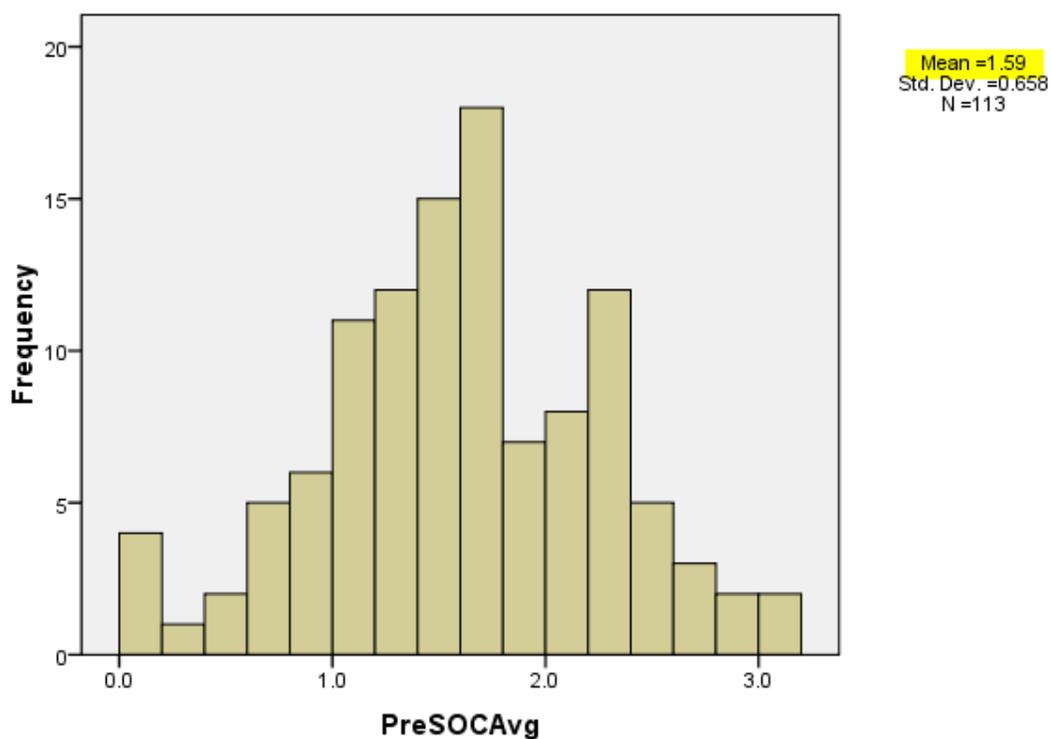


Figure 43: The normal distribution of composite Pre-SCI scores. The distribution does not reject the null hypothesis and is visually bell shaped.

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
SOCAvg	.070	153	.063	.988	153	.237

a. Lilliefors Significance Correction

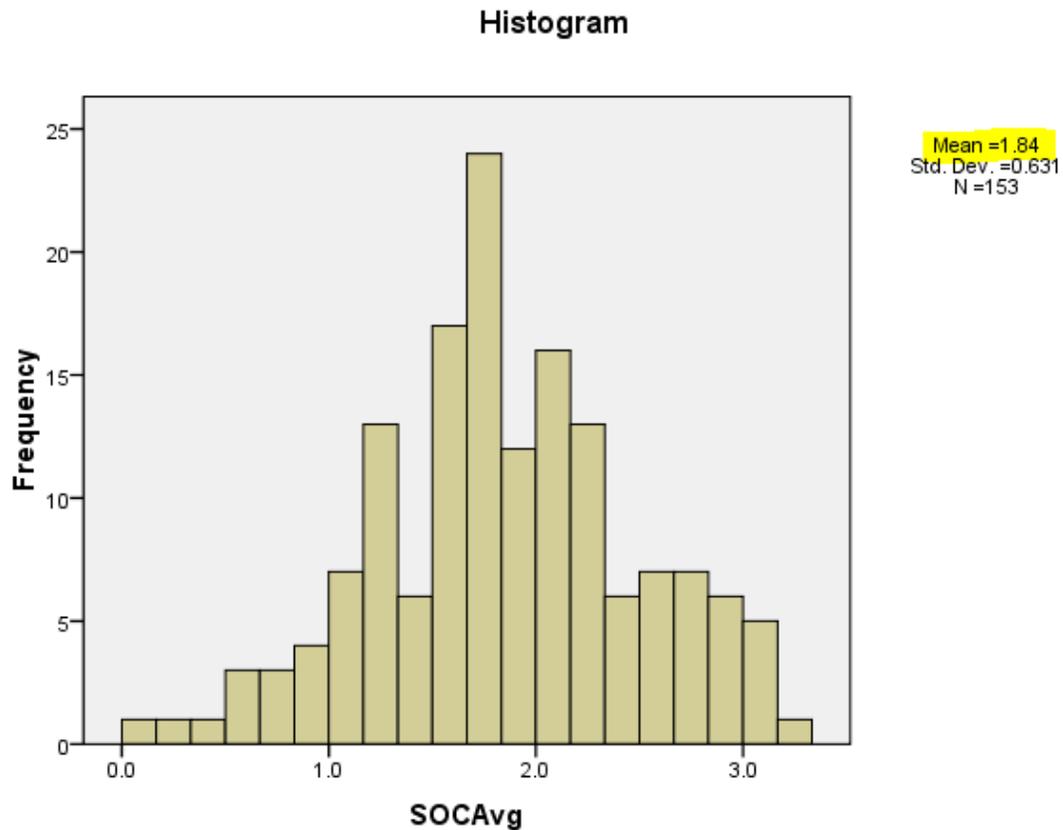
SOCAvg

Figure 44: The normal distribution of composite Post-SCI scores. The distribution does not reject the null hypothesis and is visually bell shaped.

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Snags	.247	414	.000	.732	414	.000

a. Lilliefors Significance Correction

Snags

Histogram

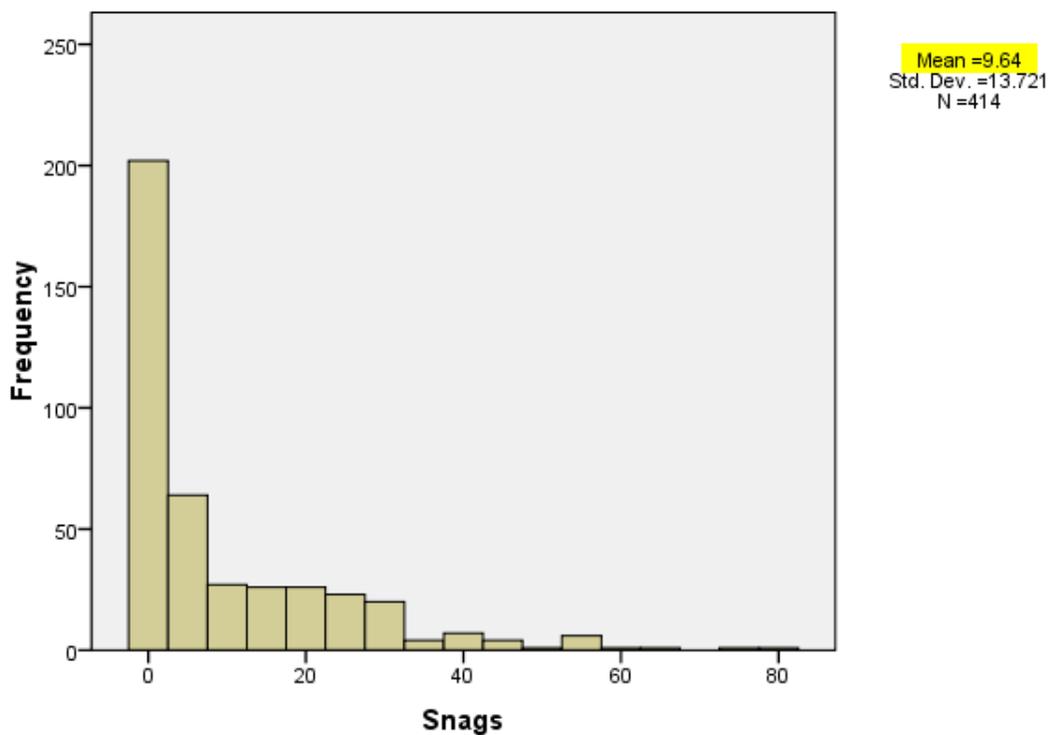


Figure 45: Composite normality testing for number of snags. The distribution appears to be nonlinear (logarithmic distribution).

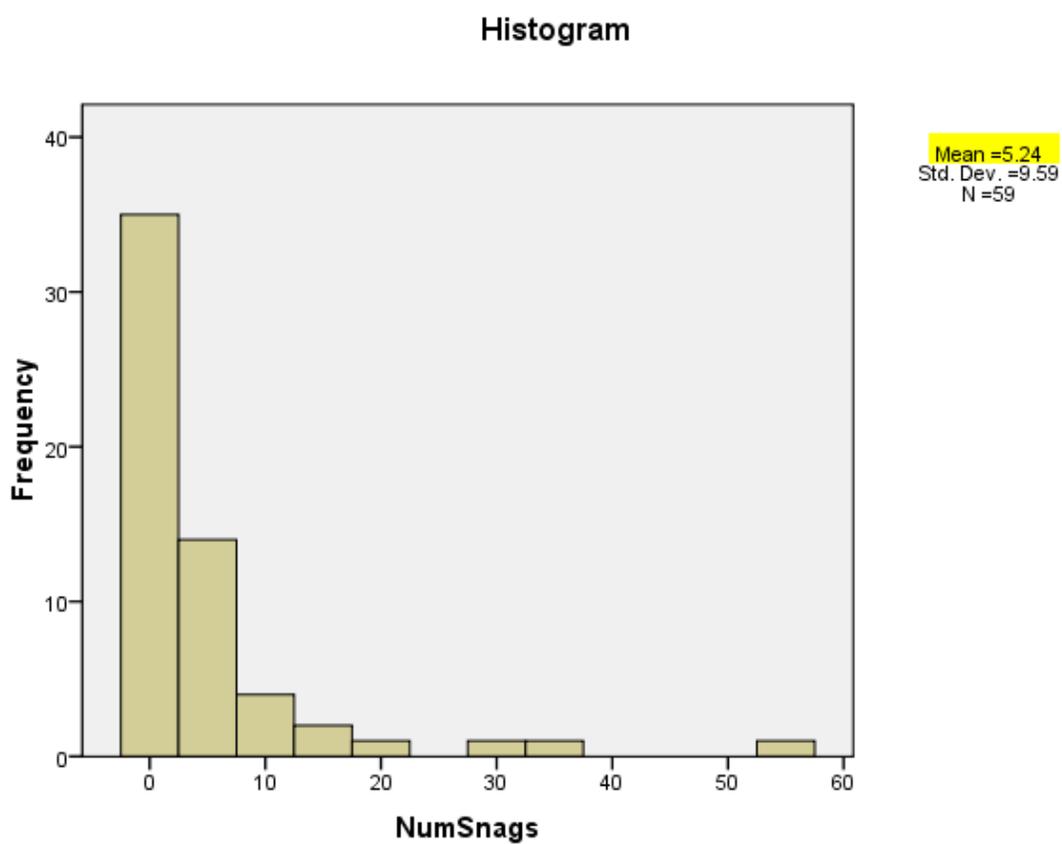
NumSnags

Figure 46: Histogram of Snags in STARS 2010.

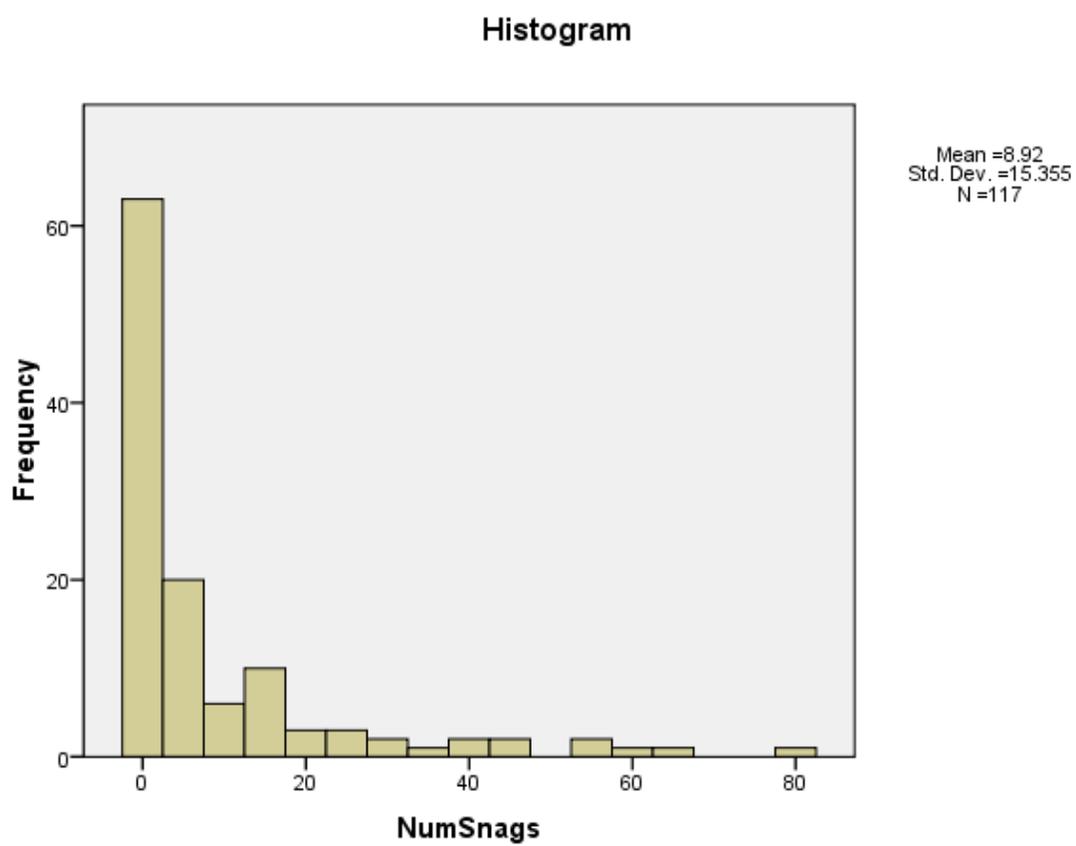


Figure 47: Histogram of Snags in STARS 2011.

APPENDIX C: SNAG'EM ROSTER

Snag'em was designed and implemented by many different people in the Games2Learn Lab and outside of UNCC. In this section, I list all of the people that helped develop different parts of Snag'em. I am also grateful for everyone else that contributed through playtesting and breaking the game, specifically Anne Watson and the NC State hackers that were always present at STARS conferences.

My role in Snag'em was primarily lead designer and director, but I also contributed largely to the codebase. Sole programming contributions include: admin page, original avatar builder, HTML5 app, auto updating news feed and leaderboard, advanced mission generation, global network page, and notes and messages. I am also responsible for many revisions to tags, network page, SMS mission, and registration page. Everyone else's role is presented in Table 25.

Table 25: The Snag'em Roster. Names are listed in order of appearance. I starred the names of Snag'em members that proofread and/or edited this dissertation.

Snag'em Team Roster (in order of appearance)

Evie Powell	Lead Designer, Director, Programmer
Thomas Phifer	Original Web Prototype
Joshua Schroeder	Original SMS Prototype, QR code interface design, Security
Christie Thornton	Original Lead Artist
Rachel Brinkman*	Quality Assurance, Security
Drew Hicks	Original Tags interface, Original Database Design, Security
Samantha Finkelstein	Lead Writer
Katie Doran*	Writer, Promotional Material, Original How to Play page
Antoinette Parnter	Database Design
Sandhya Charugulla	Original Network page, Original Events page
Veronica Catete*	Badges, Database Design, Writer, Investigator
Felesia Stukes	Writer, Investigator
Ivanna Gutierrez	Pong for Snag'em
Richard Suarez	Promotional Material
Janna Reid	Original mobile web design
Rose Abarnathy*	Avatar revision, Lead Artist
Chirag Patel	STARS website support
Advisors and Supporters	
Dr. Tiffany Barnes (primary)	UNC Charlotte
Dr. Heather Lipford	UNC Charlotte
Dr. Teresa Dahlberg	UNC Charlotte
Dr. Marguerite Doman	Winthrop University
Dr. Kera Watkins	Wilberforce University

* stars are next to people that proofread and provided feedback for this dissertation.