GAMEPLAY IN AN UNFAMILIAR ENVIRONMENT: NOVICE AND
EXPERT ADULT PLAYERS ENCOUNTERING PORTAL FOR THE FIRST
TIME

by

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Abstract

Gameplay In An Unfamiliar Environment: Novice and Expert Adult Players
Encountering Portal For The First Time

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This thesis asks how adult video game players encounter an unfamiliar game for the first time by examining their gameplay. Gameplay is “the way a game is actually played” (Juul, 2005, p. 83). Players were invited to participate in a recorded gameplay session and share their reflections on their first encounter with Portal, a first-person puzzle video game. Using the video commentary model methodology with an exploratory approach, players reviewed and commented on their gameplay footage immediately following their session using a retroactive talk aloud protocol. These sessions were analyzed, comparing how different players encountered the game, how they identified challenges, and how they created solutions to those challenges. There was a noteworthy diversity in how different players encountered Portal with trends emerging amongst players with similar expertise. Novice players found it more difficult to progress through Portal than expert players. There were differences in times to completion, puzzle comprehension, and assessment of game mechanics when comparing novice and expert players. A continuum of players emerged between those with less gameplay expertise and those with significant gameplay expertise. There were considerable barriers to entry for novice players.
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Chapter 1

Introduction

In 1962, MIT purchased a state of the art computer called the PDP-1. The engineers who were put in charge of installing the computer decided to create a demonstration program. What good is an expensive computer without something to capture the imagination of all their colleagues and potential grant funding bodies? These engineers decided to make a game. Spacewar! was that game (Goodavage, 1972).

Spacewar! is a two-player spaceship battle, with each player controlling their own ship and trying to shoot the other one down. The premise of Spacewar! is simple: destroy the other ship. Each ship has a limited fuel supply and limited number of missiles. In the center of the screen is a star, which has a gravitational pull. If a ship makes contact with the star, or is pulled into the star, the ship is destroyed. This star can also be used as a gravitational sling shot. The final feature of Spacewar! is a hyperspace jump: a last-chance effort to avoid an incoming missile that makes a ship disappear and reappear randomly, and could even put a ship next to the star.

Spacewar! is a simple game by modern video game standards. The PDP-1 even lacked the processing power to have the missiles interact with the star's gravitational pull; a feature that was added to Spacewar! clones for other computers. Regardless,
Spacewar! was a hit. While other video games preceded Spacewar!, this was the first game to receive wide-scale popularity and was ported to several other systems (Goodavage, 1972). This sharing of Spacewar! amongst programmers started the first known video game player community outside a single institution.

Since Spacewar!, video games have evolved into a substantial entertainment industry and culture. Video games play an integral role in Canada's digital society. As of 2016, 52 per cent of Canadians play video game on a regular basis (within the last four weeks at the time when surveyed) (Entertainment Software Association of Canada, 2016). The average age of a player is 36. Canadians are nearly evenly represented by gender with 51 per cent males and 49 per cent females making up the Canadian player population. An estimated $3.0 billion is contributed to the Canadian economy by the digital game industry, and Canada's 20,400 employees make our video game industry the third-largest in the world (Entertainment Software Association of Canada, 2016).

Digital games are significant cultural artifacts, creating shared experiences for game players, with many popular modern titles originating in Canada from companies like Bioware, Capcom, Eidos, Electronic Arts, Rockstar, and Ubisoft.

Video games have also been championed as tools for digital competencies and 21st century skills (Dubé and Keenan, 2016; Gee, 2004, 2003; Jenson et al., 2011; Schrader and McCreery, 2008). Related research argues that video games provide players with significant learning opportunities and motivate players better than traditional instruction in a number of ways: 1. players engage in active or critical thinking; 2. players explore complex and compelling environments; 3. players take risks in a space that provides corrective and instructive feedback on failure; and 4. players contextualize different media (image, text, narrative, graphics, sound, etc.) through an embodied experience (Gee, 2003, 2004; McGonigal, 2011; Steinkuehler, 2006). Video games have been celebrated as spaces where players can develop digital literacies and skills for the
knowledge economy for participation in a global, digital society (Buckingham, 2003; Gee, 2008; Jenkins et al., 2009; Lankshear and Knobel, 2008). In fact, video games are considered a core component of digital literacy, defined as “the myriad of social practices and conceptions of engaging in meaning making mediated by texts that are produced, received, distributed, exchanged, etc., via digital codification” (Lankshear and Knobel, 2008, p. 5). These literacies arguably help to develop a person's collaboration, creativity, critical thinking, and communication skills (Gee, 2004; Jenkins et al., 2009; Jenson et al., 2011; Lankshear and Knobel, 2008; Steinkuehler, 2006).

Video games are an important part of Canada's digital society but there are significant barriers to participation. Learning to play a new video game can be a challenging process that requires interacting with complex systems and unfamiliar interfaces, along with difficult in-game problem solving or new gameplay concepts. Research on first encounters with an unfamiliar video game have been conducted for children and young adult players (Blumberg and Sokol, 2004; Hamlen, 2012, 2011) but there is no existing research on first encounters with a group of adult players. This dissertation addresses this research gap by exploring how different adult players approach an unfamiliar video game for the first time.

The focus of this exploration is gameplay. Gameplay is “the way a game is actually played” (Juul, 2005, p. 83), or the dynamic interaction between the player and the game. A player's decisions, strategies, and problem solving are all part of gameplay (Juul and Norton, 2009). These decisions, strategies, and problem solving are the focus of this study.

The game chosen for this study is Valve’s Portal (2007). Portal is a unique video game, best described as a boundary object between puzzle games, first-person perspective games, and adventure games. The main reason for selecting Portal is the new portal mechanic, which does not appear in any other video game. This mechanic
permits players to travel between two points using the portals as shown in Figure 1.1.

Figure 1.1: Portal as game mechanic

The most familiar analogy to the portal mechanic is the Star Trek transporter. Players immediately move from one place to another by moving through the portal. Portal asks players to use these portals to solve physics-based puzzles. These puzzles can only be solved using portals. The challenge of Portal is deciding where to place these portals. Portals let players move objects, avoid obstacles, travel to otherwise unreachable areas, and move quickly across long distances.

Portal is a 10 year old game which could be described as a bygone era of video games. Video game publishing is an ever-changing industry that seems driven towards new and novel experiences. Choosing a 10 year old game may seem like an outdated choice for a modern study. However, Portal is a unique game. The game is designed around a series of test chambers - levels where players solve discrete challenges, which become increasingly difficult as the player progresses. Portal has no scoring system, no additional objectives, and no time constraints. Players are asked to solve the puzzle and move to the next chamber. Portal's emphasis is on its novel game mechanic. This
simplicity gives Portal a timeless quality.

The unfamiliarity of Portal and the new portal mechanic was specifically chosen as a site for a first encounter. This new mechanic creates a common ground for all players involved in the study. I am most interested in how each player makes sense of Portal. All players involved will not have experienced the portal mechanic before, which is the exclusion criteria for this study. This unfamiliarity allows me to compare how a player's expertise influences their first encounter with an unfamiliar game as it has a unique game mechanic. This will allow me to assess how players learn to play and what influence, if any, their previous experience has on this first encounter. I draw on information studies and specifically information practice to frame this study.

1.1 Information studies and video game research

Savolainen's theory of information practice is a theoretical framework for how people generally deal with information (Savolainen, 2007). Information practice is a user-focused approach that emphasizes a person's lived experience. This approach is an established theoretical framework for studying how people use common sense practices to interact with information (Epp et al., 2016; Hartel, 2003, 2006; McEwen, 2010; McKenzie, 2002, 2003; Savolainen, 1995). These studies emphasize a person's internal experience and their description of that experience. I am applying this information practice approach to first encounters with Portal.

Information practice is further refined with Dervin's theory of sense-making, a subset of information practice. Sense-making theorizes "how people make sense of their worlds" (Dervin et al., 2003, p. 223) by examining instances where a person reaches a cognitive gap - a moment when a person does not have a clear way forward based on their current knowledge. These cognitive gaps are characterized by Dervin
as questions, confusions, muddles, riddles, or angst. When reaching the cognitive gap, a person attempts to bridge the gap and find an appropriate way forward using any number of practices. These practices can include standard information system queries like searching a database but often involves more situated approaches like drawing on previous experiences, thinking of new approaches, reframing the problem, or relying on emotions (Dervin, 1992). The number of ways a person may bridge the gap is varied and dependent on the individual.

Sense-making is a valuable approach for studying first encounters with an unfamiliar video game. Because first encounters with adult players is a new area of research, there may be unanticipated results. Sense-making allows for a diversity of experiences. As a methodology, sense-making asks players to share how they bridged their cognitive gaps in their own language (Dervin, 2008). Players are invited to share their experience, which may include unexpected practices. Sense-making provides a way to answer how different players approach an unfamiliar game.

1.2 Research design

I explore how different players encounter a video game for the first time by conducting gameplay sessions with each player. This study takes an exploratory approach and uses a combination of qualitative data collection methods. I collected demographic information, gameplay footage, passive observations of each participant’s gameplay session, and post-play semi-structured interviews based on the gameplay footage. Using an approach called video commentary model (VCM). I asked players to conduct a retroactive talk aloud and comment on their gameplay footage immediately following their gameplay session. Players controlled the playback of their gameplay footage and were asked to highlight moments that were meaningful to them. I took note of how
players identified challenges and created solutions to these challenges, as well as the ways players describe or represent their experiences in the interview.

VCM is a two-stage research design that combines: 1. a game play session with player observation; and 2. a post-play interview utilizing footage from the participant's game play session (Barnum and Dragga, 2001; Guan et al., 2006). VCM supplements observations with the subjective experience of participants, an ideal approach for examining video games where players are forced to make decisions constantly (Ribbens and Poels, 2009). This post-play review of gameplay footage is a retroactive think aloud, asking players to reflect on their gameplay session directly following that session.

VCM originally calls for the game play footage to be reviewed in its entirety during the semi-structured interview. As an amendment to VCM, I asked participants to control game play footage playback and highlight instances they felt were interesting or meaningful. This revision is intended to limit any potential uneasiness for the player. I did not want players to review portions of the gameplay footage that they felt were unimportant, repetitive, or even uncomfortable. I also wanted players to feel a sense of agency and control, ideally empowering players to share their experiences in their own language and on their own terms. I also took note of instances that I considered meaningful for further analysis. These instances that I identified consisted of two types: 1. significant milestones in the game, particularly those that required the player to learn a new skill; 2. unique decisions by the participant, particularly novel solutions or instances were the player was stuck.

This study involved 14 participants playing Portal for the first time (seven men and seven women between the ages of 24-49). Each gameplay session followed the same format. Before the gameplay session, players were given a short demographic survey. After completing the survey, players started Portal from the title screen and
played for a maximum of one hour, with the choice to stop playing at any time. After this session, I conducted a post-play interview using VCM. This approach provided thorough and exhaustive data from each player.

1.3 Significance

This study makes a theoretical contribution to information practice research (Savolainen, 1995, 2008; Savolainen and Wilson, 2009). Current research of information practices and video games involves practices that are supplementary to gameplay like browsing game-related forums, consulting wikis, reading guides and manuals, watching videos, or talking with fellow players (Adams, 2009; Harviainen and Savolainen, 2014; Storie, 2008). These are summative studies that ask players to share their information practices as they have developed over their career with a video game. This is similar to Hartel’s work on hobbyist chefs (Hartel, 2003, 2006).

This study is unique as it focuses on what a player does in their first encounter. I have chosen an episodic information practice approach that explores information practices exclusive to this first encounter. Episodic data collection has been used in other information practice research (Hartel, 2003, 2006; McEwen, 2010; McKenzie, 2002, 2003) but these studies use several data collection instances. This project is different as it focuses on how players make sense of an unfamiliar environment, which is only unfamiliar during the first encounter. I focus on sense-making and the strategies that players use when reaching a cognitive gap (Dervin, 2008, 1992). The significance of this approach is understanding how a player encounters a new game from their perspective, and the impact of their previous gameplay expertise on that first encounter.

Secondly, this study makes a methodological contribution to the fields of Infor-
mation Studies and Game Studies. I used a modified approach to video commentary model (Barnum and Dragga, 2001; Guan et al., 2006) inspired by sense-making methodology. Sense-making methodology focuses on specific instances where a person reached a cognitive gap and uses a series of prompts to explore that instance (Dervin, 1992, 2008). This approach was designed to empower players to talk about their experience on their own terms and emphasize gameplay instances that they felt meaningful. This new approach has potential applications for studies involving human participants and digital objects. Information Studies scholars can use this approach for understanding how different participants interact with unfamiliar digital objects. For Game Studies, this study makes connections with Information Studies theory and methodology, specifically sense-making and information practice as it relates to player-focused Game Studies research. Game Studies scholarship provides valuable directions for Information Studies research, particularly the focus on a player's lived experience.

Additionally, this study has significance for video game developers and video game design. This methodology provides a new approach for play testing, one that accounts for the diversity of player experience. Information Studies accounts for the diversity of player experience, and this diversity of feedback could provide valuable insights for video game development.

Also, this study has significance for players from diverse backgrounds. New and novice video game players are underrepresented in video game culture. As video games become an increasingly significant part of Canada's digital society, the new and novice gamer face a digital divide. New and novice gamers may be prevented from fully participating in a society that uses video games in areas such as education, civic engagement, and public health. This research provides a direction for assessing first encounters for new and novice players, and ideally reducing the barriers to entry
for these players.

Finally, this study makes a contribution to learning science. Learning to play video games is a complex process distributed across the player, the environment of the game, the rules of the game, and the activity taken by the player. To understand Portal as a learning environment, I draw from theories of constructivism, situated cognition, situated action, scaffolding, and affinity groups. This provides a unique theoretical lens for observing how learning happens in an unfamiliar video game.

1.4 Chapter overview

To understand how different adult players encounter an unfamiliar video game, this dissertation will begin with a review of previous literature on learning theories and the relationship between knowledge and action. I will discuss how research on situated learning and technology (Suchman, 2007) influence this study. Chapter 2 establishes a theoretical framework and provides a basis for how people “do things” with information (Dervin, 1992; Savolainen, 2007). I combine theories from information studies and game studies to establish the concept of gameplaying practices - the way a player plays a game to address challenges. This chapter concludes by discussing the assumptions that emerge from the literature review and theoretical framework.

Chapter 3 outlines the research questions, research design, and methodology. I present the methodological basis and the procedures for data collection and data analysis. I draw on video commentary model (Barnum and Dragga, 2001; Guan et al., 2006; Ribbens and Poels, 2009) as the protocol for this study which emphasizes the gameplay session as the main site for data collection. I also provide a justification for why Portal was an ideal research site for this study, and connect Portal with learning theories established in the literature review. I provide an overview of the research
design including the data collection process, recruitment, and data analysis.

In Chapter 4, I provide a summary of the players including player demographics, previous gameplay experience and expertise, and player groups. This chapter emphasizes the diversity of players that participated in the study. I was able to recruit seven female and seven male players ranging in age from 24-49. For comparison, I created three player categories based on their in-game performance. This chapter outlines how these categories were formed and emphasizes the slippage between these categories.

Having established the theoretical framework, methodology, and players, Chapter 5 focuses on the findings from the gameplay sessions. This chapter outlines the five major themes that emerged from data analysis as they relate to the research questions. I compare how different players played Portal based on their gameplaying practices and their reflections from the interview. I compared players across all participants and according to their player groups. There was significant diversity when comparing all players but some noteworthy trends emerged when comparing players by the expertise.

Chapter 6 discusses the major questions from the study, specifically the research questions. I base this discussion on the five themes that emerged from the gameplay sessions. I also address the assumptions posed in Chapter 2. This chapter also includes a discussion on the relationship between gender and video game expertise. I conclude that there were differences between how novice, intermediate, and expert players approach an unfamiliar video game. Previous gameplay experience and expertise has a noteworthy impact on player expertise in an unfamiliar game.

The last chapter, Chapter 7, summarizes the noteworthy findings from this study. I revisit the concept of Canada's digital society and compare the findings from this study with an emerging digital society. I conclude with the contributions this study has made to information studies and game studies scholarship.
This study concludes that adult players had diverse experienced and approaches during their first encounter with *Portal*. Because there was a continuum of previous gameplay experience and player expertise, there was a divergence of comprehension. It was difficult for less experienced players to understand the basic metaphors and game mechanics of *Portal*. Without these core concepts, less experienced players struggled to make effective decisions and accurately assess puzzles. More experienced players found these same core concepts easy to grasp. There were considerable barriers to entry for less experienced players.
Chapter 2

Literature review and theoretical framework

This chapter conducted a literature review and establishes a theoretical framework for studying how different adult players encounter *Portal* for the first time. I frame this dissertation in the tradition of information practice, which takes a comprehensive view for how people “do things” with information. I draw on learning theories, game studies, and information studies for this literature review. Using a constructivist ontology, I establish a theoretical framework for exploring first encounters in video games. I will also discuss the assumptions for the user study based on the literature review and theoretical framework.

2.1 Learning to play video games

First encounters with an unfamiliar video game are complex experiences that ask players to learn. Players learn about new environments, new puzzles, new characters, new narratives, new interfaces, and new methods of interaction. To understand
Portal as a learning environment, I draw on a number of related learning theories including constructivism, zone of proximal development, situated cognition, and situated action. These theories are epistemologically connected as they emphasize the subjective nature of reality and the role of the individual in shaping that reality. These approaches create a toolbox for asking how a player encounters Portal based on their subjective reality and examines the role of the player in shaping that reality.

This approach, broadly labelled as constructivism, originates with the work of Jean Piaget and his theories on the developmental stages of children. Constructivism is famously summarized as “to understand is to discover” (Piaget, 1973, p. 20). Piaget’s work concludes that cognitive development is a process of learning through discovery. As people interact with their worlds, they reconstruct their understanding by rediscovery. For people to meaningfully participate in their world, and not simply repeat previous learning, they must engage in this constant process of discovery, rediscovery, and reconstruction.

Piaget's constructivist theory has been reformatted into a constructivist ontology:

As ontology refers to the study of the nature of reality, a constructivist ontological view is that reality is in fact constructed rather than 'set in stone' or objectively measurable, and furthermore, that individuals construct their reality by associating 'meaning' with certain events and actions (Bryman, 2012, p. 246)

A constructivist ontology focuses on a person's lived experience. Reality is constructed by a person's interactions with their world, their events, and their actions. For constructivists, there is no objective reality that can be measured. Instead, people reconstruct their realities based on their past experiences. “Individuals actively negotiate meaning and construe and construct what they experience drawing upon their
cognitive experience, which is . . . unique to them” (Billett et al., 2005). Applied to first
encounters with Portal, the constructivist ontology explores how a player draws on
their previous experiences to navigate an unfamiliar video game. This constructivist
ontology is applied in this dissertation as a meta-level framework, creating a lens for
examining how people learn in Portal.

2.1.1 Situated cognition

Knowledge takes on a different context in a constructivist ontology. I draw from
situated cognition which redefines knowledge as “situated, being in part a product of
the activity, context, and culture in which it is developed and used” (Brown et al.,
1989, p. 32). Knowledge is connected to lived situations and experiences and does
not usually involve applying facts, definitions, or generalizations (Gee, 2008, p. 255).
Situated cognition frames knowledge “not in terms of language but in something like
dynamic images tied to perception both of the world and of our bodies, internal
states, and feelings” (Gee, 2008, p. 255). This means that knowledge is complex
and subjective, closely linked to the lived experience of an individual. The lived
experience of the individual is inseparable from participating in an activity (Chaiklin
et al., 1993; Dede et al., 2004; Lave, 1988; Suchman, 2007). “Separating the learner,
the material to be learned, and the context in which learning occurs is impossible and
irrelevant” (Barab and Plucker, 2002, p. 169).

Game studies scholars have used situated cognition as a theoretical framework
(Gee, 2008; Squire, 2002, 2006; Squire and Klopfer, 2007) and a design philosophy
(Dede et al., 2004; Squire, 2005). Situated cognition has been broadly applied as
“learning by doing” (Bogost, 2007; Lave and Wenger, 1991; Squire, 2005). Gee has
further refined this reading of situated cognition by locating learning by doing in a
specific area: “[learners] think best when they have reason on the basis of patterns why have picked up through their actual experiences in the world, patterns that, over time, can become generalized but that are still rooted in specific areas of experience” (Gee, 2003, p. 8). As Bogost notes, locating these specific areas of experience is different from the standard constructivist approach (Bogost, 2007, p. 250). Rather than making a direct connection between expertise in a broad domain and a specific domain, Gee grounds situated cognition within a specific location. In other words, being proficient at one video game genre does not mean a player will be proficient in all genres. The player will draw on their specific area of expertise.

Orlikowski and Barab have chosen to use knowing rather than knowledge. Lave's work on cognition in practice, or cognition in the wild, conducted several studies examining how adults solve math problems. Lave found that competence in math is not an abstract knowledge that people either have or do not have. Knowledge for solving math problems is knowledge-in-practice - “knowledge is not primarily a factual commodity or a compendium of facts, nor is an expert knower an encyclopedia. Instead knowledge takes on the character of a process of knowing” (Lave, 1988, p. 175). The choice of “process of knowing” rather than knowledge is an important distinction. Knowledge functions as a noun, connoting things, facts, and processes. Knowing functions as a verb, connoting action, doing, and practice (Orlikowski, 2002, p. 250-251). Using the example of bike riding, as a person rides a bike they assume that they “know how” to ride and lose sight of the way in which “knowing how” is an ongoing and recurrent accomplishment (Orlikowski, 2002). Knowing has been further refined as knowing about, “a dynamic process distributed across the knower, that which is known, the environment in which knowing occurs, and the activity through which the learner is participating when the learning or knowing occurs” (Barab and Plucker, 2002, p. 170).
The key characteristic of situated cognition is *knowing* - a dynamic process that is distributed between the individual, the context, and the activity. Knowing is an ongoing and recurrent accomplishment. In a video game, a player is involved in a dynamic process. The player and the game interact, and knowing is a result of that interaction (Barab and Plucker, 2002; Brown et al., 1989; Suchman, 2007). Playing a game requires the player to demonstrate their knowing, that is to take action which is appropriate to that moment in the game. Returning to the definition of knowing about, playing a video game is a dynamic process distributed across the player, that which is known by the player, the environment of the game, and the activity taken by the player.

2.1.2 Situated action

Situated cognition provides an important framework for understanding how someone learns to play a video game, but it is an abstract framework. Applying a concept like *knowing about* to video games can be difficult to understand. To refine this approach but maintain the epistemological foundation of situated cognition, I turn to Suchman's *situated action*. Like situated cognition, situated action explores the relationship between knowledge and action based on the circumstances in which knowing and acting occur (Suchman, 2007). Both theories emphasize that knowledge is contextual, being situated in a specific activity, context, and culture. Suchman's theory is based on a case study conducted at Xerox PARC in the 1980s that involved a complex photocopier. This photocopier was not selling well because it was difficult to use. Suchman invited the engineers and designers of the complex photocopier to install one of the machines at PARC and invite their co-workers to try to use it (Suchman, 2007, p. 9). These encounters were videotaped and analyzed by Suchman.
She found that scientists and engineers working at PARC also found it difficult to use the machine, but their difficulties were not based on “any lack of general technological sophistication on the part of its users but rather of their lack of familiarity with this particular machine” (Suchman, 2007, p. 9). Suchman argued that the machine's complexity was not tied to its technical characteristics but rather to the mundane difficulty of an unfamiliar artifact. The problem was making sense of a new artifact: “I wanted to suggest that however improved the machine interface or instruction set might be, this would never eliminate the need for active sense-making on the part of the prospective user” (Suchman, 2007, p. 9). The user needed a level of familiarity with the machine to use it effectively. Understanding the mundane affordances of the machine was more important than the technical characteristics or the technological sophistication of the user. Returning to situated cognition, knowing is part of the activity, context, and culture in which it was developed and used. If the user has never encountered this kind of machine, they will not be able to know about the activity, context, and culture of that machine.

Suchman's analogy of navigating a series of rapids in a canoe is a strong metaphor for situated action:

in planning to run a series of rapids in a canoe, one is very likely to sit for a while above the falls and plan one's descent. The plan might go something like 'I'll get as far over to the left as possible, try to make it between those two large rocks, then backferry hard to the right to make it around that next bunch.' A great deal of deliberation, discussion, simulation, and reconstruction may go into such a plan. But, however detailed, the plan stops short of the actual business of getting your canoe through the falls. When it really comes down to the details of responding to currents
and handling a canoe, you effectively abandon the plan and fall back on whatever embodied skills are available to you. The purpose of the plan in this case is not to get your canoe through the rapids, but rather to orient yourself in such a way that you can obtain the best possible position from which to use those embodied skills on which, in the final analysis, your success depends. Even in the case of the more deliberative, less skilled activities we generally do not anticipate alternative courses of action or their consequences until some course of action is already underway. It is frequently only on acting in a present situation that its possibilities become clear, and we often do not know aged of time, or at least not with any specificity, what future state we desire to bring about (Suchman, 2007, p. 72)

Situated action is the exploration of this relationship between plan and action, or knowledge and action. After a planning stage, or what we might call knowledge gathering or information seeking, the person takes an action. Once the action begins, the plan may be altered or even abandoned all together. The course of action can result in unanticipated outcomes that require the person to react in unanticipated ways. This movement between plan and action is fluid and dialectical. Suchman also refers to the embodied skills, whatever previous experiences or skills may be available. As unexpected situations arise, a person relies on their embodied skills to solve the problem. This is closely related to Gee's concept of specific areas of expertise discussed in the previous section.

Moving forward, situated action and the canoe metaphor is a valuable framework for studying a first encounter with an unfamiliar video game. Applying the canoe metaphor, a player will undergo a similar plan and action process. First, a player
will try and make sense of a particular challenge and come up with a plan. Second, a player will carry out the action, using their embodied skills to complete the action. As the player takes action, they may face unexpected results and react to them. This relationship between plan and action provides a site for analysis.

2.1.3 Zone of proximal development and scaffolding

Situated cognition and situated action provide a framework for understanding the player. I use Vygotksy's zone of proximal development and scaffolding to understand Portal as a learning artifact. Learning occurs in Portal as the player progresses through the game. When encountering an unfamiliar video game, a player must acquire new skills to navigate through the game. This is an apprenticeship model of learning where learners move beyond their current skill level and understand new concepts with the help of a more-knowledgeable other. Traditionally this more-knowledgeable other is a teacher or skilled peer (Vygotsky, 1978) but in a video game this takes the form of the tutorial. With the support and guidance of the more knowledgeable other, learners are able to go beyond what they would be able to achieve in on their own. This elevates the learner to a space of potential development, acquiring new knowledge based on the assistance of the more knowledgeable other. This was traditionally the role of the teacher or skilled peer but takes the form of scaffolded learning through an in-game tutorial in Portal.

Scaffolded learning proposes that students can reach higher levels of comprehension and skill acquisition with the help of a more knowledgeable other (Fernández et al., 2001; Sherin et al., 2004; Wass et al., 2011). Scaffolding has also been applied in instances involving learning artifacts to replace the more knowledgeable other. These learning artifacts include standard classroom materials like textbooks or man-
uals, self-guided activities like homework or practice sessions, or digital materials like online tutorial videos or how-to guides (Sherin et al., 2004).

In video games, the zone of proximal development and scaffolding often takes the form of tutorials. Tutorials are introductory levels that teach video game players the skills required to interact with the game. This varies from game to game but generally reviews button assignments (like how to perform basic actions), interface navigation (like how to interact with menus), and strategy (like how to defeat enemies). This training should be difficult for a player but not beyond his or her capability (Orvis et al., 2008, p. 2416). If a player is experiencing a game type or game genre for the first time, these tutorial levels are important. “Good tutorials are essential for new gamers” (Hayes, 2005, p. 27). Tutorial levels are static. They do not account for differences in a player's skill level (Jenson et al., 2011). The levels themselves take on many different forms. Games like *Portal* integrate the tutorial into the early stages of the game, asking players to complete simple tasks embedded within the game's narrative as part of the learning process. Games like the NHL series (Electronic Arts) have optional tutorials that require players to select a tutorial from the main navigational menu, assuming that players have basic knowledge on menu navigation and controllers. These tutorial levels act as the more knowledgeable other.

The reliability of the more knowledgeable other has been critiqued. Cognitive apprenticeship theory argues that the more knowledgable other often fails to account for their tacit knowledge when teaching novices (Brown et al., 1989; Collins et al., 1988, 1991; Collins, 1991). Cognitive apprenticeship attempts to “bring these tacit processes into the open, where students can observe, enact, and practice them with help from the teacher” (Collins et al., 1988, p. 6). In this approach, the more knowledgeable other externalizes their inner discourse, describing their thought process in conjunction with the lesson itself (Collins, 1991). The more knowledgeable other also invites
novices to express their inner dialogue and assists them with their internal thought process as well as their external learning process (Collins et al., 1991). Cognitive apprenticeship is a more complex version of the zone of proximal development/scaffolding where the needs of the novice are met on the fly. The more knowledgeable other must adjust the lesson to meet the specific needs of each individual.

The zone of proximal development or scaffolding is only as effective as the more knowledgeable other/learning artifacts. If the more knowledgeable other/learning artifact does not meet the specific needs of a learner, the lesson could be ineffective. In an unfamiliar video game, the learning artifacts like the tutorial levels may not meet the needs of all players. Tutorial levels are not able to adjust to the specific needs of each player, as recommended by the cognitive apprenticeship theory.

2.1.4 Affinity groups

Being an expert video game player or “gamer” may evoke particular boundaries (white, male, youth, affluent), but this is not a complete picture of the modern video game player. In 2014, 48 per cent of all video game players were female (Entertainment Software Association, 2014). Similar percentages of female video game players were reported in subsequent reports from the Entertainment Software Association (Entertainment Software Association, 2016, 2015). In Canada, 52 per cent of all Canadians play video games (in the last 4 weeks at the time of survey) (Entertainment Software Association of Canada, 2016) and 49 per cent of players are female (Entertainment Software Association of Canada, 2016). Video games as an entertainment medium have attracted players from all demographics. As the popularity of video games increases, identifying a specific community of “gamer” becomes increasingly difficult (Davies, 2005, p. 106). Gee proposes that gamers can be defined as an affinity group:
Affinity groups are groups wherein people primarily orient toward a common set of endeavours and social practices in terms of which they attempt to realize these endeavours. In such groups people orient less towards shared gender, race, culture, or face-to-face relationships, although all of these can play a secondary role. People can be in affinity groups where they rarely see many of the members face-to-face (e.g., the group may communicate in part at a distance via media, whether it's print, the Internet, or what have you) (Gee, 2003, p. 183).

Gee argues that an affinity group share a semiotic domain or semiotic core. Words, symbols, images, and artifacts take on a situated meaning that depends on that shared semiotic core. “Learning in any semiotic domain crucially involves how to situate (build) meanings for that domain in the sorts of situations the domain involves” (Gee, 2003, p. 26). In a video game context, gamers share a semiotic domain of similar games played and similar gameplay experiences. Expert players in first-person shooter games are those who frequently play first-person shooter games. The semiotic domain of first-person shooter games shares common conventions like the interface, controls, task-based missions or quests, mechanics like aiming or using cover, stealth, etc. This allows for a more diffuse community, where traditional markers such as race, class, or gender may not be strong indicators for expertise (Jenson et al., 2011).

Affinity groups and semiotic domains are both theories to explain how learning occurs in video games. Video games are embodied experiences that require players to undertake a set of common practices (Gee, 2004). This falls under the same domain as situated cognition and situated action. Knowing in a video game is a process of learning by doing, then enacting that learning through action. Players rely on their embodied skills to solve problems and proceed through the game. The relationship
between planning and action is recurrent when playing a video game. Players draw on their previous experience, or their semiotic domain, using skills previously learned to help them negotiate new problems. This theoretical basis is similar to situated cognition and situated action, where knowing is situated in its activity, culture, and context.

Research on expertise closely resembles Gee's concept of affinity groups. Expertise is based largely on developing domain knowledge (Alexander, 2003; Alexander et al., 2004; Glaser et al., 1988; Grabinger et al., 1997; Murphy and Alexander, 2002; Stubbart and Ramaprasad, 1990). The transition from novice to expert involves situated learning where the problems and challenges of real life are reflected in the activity (Grabinger et al., 1997). This means that experience in a particular domain, like playing video games, translates to expertise. For example, Jenson's work on after-school video game clubs disrupts traditional notions of gender and expertise for elementary school boys and girls. Previous experience with video games was the defining feature on children taking a leadership role in the club (Jenson et al., 2011). Previous research in gender and elementary aged video game players attempted to catalog gender differences but “conflated facts about gender with facts about relative skill level” (Jenson et al., 2011, p. 150). Jenson's work affirms that domain knowledge in video games is the defining feature for expertise.

Research on novices versus experts has also been conducted by video game scholars in the context of massively multiplayer online games (MMOGs) (Gee, 2003; Schrader and McCreery, 2008; Squire, 2003, 2006). Acquiring expertise in domains like MMOGs is contingent on playing the game. This also translates to broader expertise with the MMOG genre. As a player becomes more familiar with MMOG domain knowledge, they can translate those skills to other MMOGs (Gee, 2003; Schrader and McCreery, 2008; Silverman and Simon, 2009; Squire, 2003, 2006; Taylor, 2006). Many
MMOGs also use similar narrative structures, such as the quest system that struc-
ture activities for groups and individuals to acquire game-related knowledge through
situated learning (Squire, 2006).

A noteworthy difference between novice and expert players is their gameplay, or
how players take actions in a video game (Hong and Liu, 2003). Novice players tend
to use trial-and-error thinking while expert players used more procedural thinking.
“The main difference between a novice and an expert lies in the depth of thinking. It
seemed that the novices used superficial thinking and concentrated less on problem
solving performance as many previous studies had concluded” (Hong and Liu, 2003,
p. 256). Depth refers to the specific problem solving strategies - experts carried out
solutions with more steps and executed these steps in less time. Novices tended to be
more scattered in their solutions. In the talk-aloud in Hong and Liu's study, novices
said things like “I don't know how”, “I have no idea”, and “I'm not sure” while experts
said things like “I encountered such situation just now”, “it will possibly solve the
problem”, and “this movement would lead to a new situation” (Hong and Liu, 2003,
p. 255).

Returning to situated learning, more experience in a particular domain translates
into a higher level of expertise, which means more experience in a particular game
translates into a higher level of expertise in that game. At a second level, this trans-
lates to expertise in a specific genre. As shown with the MMOG studies, players
who have previous experience with MMOGs can draw on that expertise when play-
ing other MMOGs (Gee, 2003; Schrader and McCreery, 2008; Silverman and Simon,
2009; Squire, 2003, 2006; Taylor, 2006). At a third level, this functions as a general
video game competence.

Chi and Glaser identify several characteristics of novices in relation to experts
with three major themes: 1. novices as slower than experts at solving problems; 2.
novices having more errors in their problem solving; 3. novices see and represent problems at a superficial level (Glaser et al., 1988, p. xvii-xx). Novices do not share a semiotic core but novices can be recognized for their differences in gameplay when compared to experts. Novices will take longer to solve problems, novices will not progress as far in the game, novices will make more errors than experts, and novices will have a more difficult time with puzzle comprehension.

For player assessment, this means that novice and expert players will serve as a guide rather than a rule. I am not attempting to recruit a specific number of novice and expert players. Rather, I am asking players to provide an approximation of their expertise using self-reporting during recruitment. I will be able to assess whether a player was a novice, expert, or somewhere in between following their gameplay session and comparing them with other players in the study. This will be discussed in more detail in Chapter 4 - The Players.

2.1.5 Problems of self-reporting

One of the approaches for determining expertise in this study is self-reporting. Players are asked about their previous gameplay experience using Likert scales. I ask players about their frequency of playing video games, frequency of playing first-person perspective games, self-perceived levels of experience and confidence in video games, and self-perceived levels of confidence and experience in first-person perspective games (see: Appendix G - Demographic Survey). Self-reporting is a useful approach for estimating a player's expertise but does suffer from over reporting and variance from actual behaviour (Boase and Ling, 2013, p. 517). As suggested by Boase, the survey uses terms like “how often” which are more useful than continuous frequencies or open-ended response approaches.
However, there is an inherent challenge in asking players to estimate their expertise (Bernard et al., 1984; Freeman et al., 1987; Sudman et al., 1997). Symbolic interactionism theorizes that there is a peculiar and distinctive character of interaction between human beings (Blumer, 1969, p. 78-79). “The peculiarity consists in the fact that human beings interpret or 'define' each other's actions instead of merely reacting to each other's actions”. A person's response is not made to the actions of another person but to the meaning which that person attaches to such actions. In other words, human beings act toward things on the basis of the meaning those things have for them (Blumer, 1969, p. 2). Meaning emerges from the social interaction one has with other people. These meanings are handled, modified and interpreted through an interpretive process used by each person to deal with things they encounter (Blumer, 1969, p. 2).

For the purposes of self-reporting, this means that players will define themselves based on their perceived expertise within their own experience. If someone is the most experienced video game player within their peer group, they are more likely to overestimate their level of expertise. However, this peer group could consist of people who are not experienced video game players. Conversely, if someone is the least experienced video game player within their peer group, they are more likely to underestimate their level of expertise. However, this peer group could consist of people who are highly experienced video game players. Moving forward, this means there will likely be slippage in the self-reporting of players. Some players may underestimate their expertise and other players may overestimate their expertise. The categories of novice and expert are an initial framework for comparison, but there will likely be a variance in skill level.

To deal with this variance, I use direct observation as a primary form of data collection. This informs both the gameplay sessions and the post-play interview. This
also draws on symbolic interactionism as a methodological framework. Symbolic interaction is a “down-to-earth approach” (Blumer, 1969, p. 47) that emphasizes direct observation and empiricism. This involves gathering data, finding relationships between the categories of that data, formulating propositions based on those relationships, and examining those findings based on the theoretical framework and empirical world (Blumer, 1969, p. 48). In this case, that data is the gameplay sessions, my observation and reflections from the gameplay sessions, and the post-play interviews. These gameplay sessions and interviews are examined in relationship to the other participants to build categories and recognize trends.

### 2.1.6 Summary of learning theories

These learning theories form the theoretical framework for how a player learns to play an unfamiliar video game. Table 2.1 includes a summary of each theory and how that theory is applied.

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Table 2.1: Summary of learning theories
2.2 Gameplay

Having established the constructivist ontology for learning to play video games, how to approach novice and expert players, and the problem of strict player categorization, I will now discuss gameplay as it relates to research from game studies.

Gameplay is “the way a game is actually played” (Juul, 2005, p. 83). Gameplay is dynamic and occurs in the interaction between player and game. In his famous definition of games, Canadian philosopher Bernard Suits emphasizes the act of playing a game, or gameplay. The compelling feature of Suits’ work, and why his definition was chosen for this dissertation, is his explicit inclusion of the player. Gameplay is a voluntary activity. Without a willing player, there is no game:

To play a game is to attempt to achieve a specific state of affairs [prelusory goal], using only means permitted by the rules [lusory means], where the rules prohibit the use of more efficient in favour of less efficient means [constitutive rules], and were the rules are accepted just because they make possible such an activity [lusory attitude]. I also offer the following simpler and, so to speak, more portable version of the above: playing a game is the voluntary attempt to overcome unnecessary obstacles (Suits, 1978, p. 54-55).

Suits proposes a portable version of his longer definition - “playing a game is the voluntary attempt to overcome unnecessary obstacles” (Suits, 1978, p. 55). Players willingly attempt to achieve a goal that is more difficult to achieve than normal due to the sacrifice of efficiency. This willing acceptance of unnecessary obstacles is called the lusory attitude. Suits uses the case study of golf to explain the willing acceptance of unnecessary obstacles. In golf, the purpose of the game is getting a small round
object into a hole in the ground. The most efficient means of achieving this purpose is placing the small round object in the hole with your hand. “But surely I would not take a stick with a piece of metal on one end of it, walk three or four hundred yards away from the hole, and then attempt to propel the ball into the hole with the stick. That would not be technically intelligent. But such an undertaking is an extremely popular game, and the foregoing way of describing it evidently shows how games differ from technical activities” (Suits, 1978, p. 34). Players willingly accept these obstacles or rules to participate in golf. This lusory attitude is a peculiar state of mind - “the attitude of the game player must be an element in game playing because there has to be an explanation of that curious state of affairs wherein one adopts rules which require one to employ worse rather than better means for reaching an end” (Suits, 1978, p. 52). Players voluntarily use worse rather than better ways to reach the goal. This is the novel component of games over other activities.

Gameplay has been defined by other game studies scholars in similar ways. Juul defines gameplay as the “how the game will be played...[the] dynamic aspect of a game” (Juul, 2005, p. 83). Salen and Zimmerman define gameplay as “the experience of a game set into motion through the participation of players” (Salen and Zimmerman, 2004, p. 310). Zimmerman defines gameplay as “a kind of dance of fate which occurs somewhere between the dice, pieces, board, and game players” (Zimmerman, 2004, p. 159-60), and as “the kernel at the centre of the machine, the engine which drives all other elements” (Zimmerman, 2004, p. 162). Rouse defines gameplay as “the degree and nature of the interactivity that the game includes, like how the player is able to interact with the game-world and how the game-world reacts to the choices the player makes” (Rouse, 2000, p. xviii). Like Suits, these definitions emphasize the interaction between the player and the game.

Focusing on gameplay is an ideal approach for studying player experience. Several
other studies on video game players have taken this approach (Bakioglu, 2009; Bartle, 2005; Chen, 2009; Consalvo, 2007; Kallio et al., 2011; Pearce, 2009; Sotamaa, 2010; Taylor, 2006; Williams et al., 2006; Yee, 2006). These studies emphasize the lived experience of the player and examine the gameplay of those players as the site of inquiry. In this study and related player-first video game research studies, the site of analysis is player experience. Following the tradition of Suits and player-focused game studies research, gameplay is the interaction between a player and a game.

2.2.1 The Possibility space and emergent play

Gameplay is different in video games when compared to traditional games. Video games present an additional layer of complexity (Bogost, 2007; Juul, 2005; Salen and Zimmerman, 2004). In Bogost’s framing of video games, players interact with two systems 1. system of the game; 2. system of code (Bogost, 2007). If someone plays Chess on a computer, they are interacting first with the system of chess (rules, pieces, checkered board, etc.) and second the system of the computer program defined by the language (Java, C++, etc.) and operating system (Windows, MacOS, Android, etc.). While the second system, the code, is normally invisible to the player, all video games require these two systems working simultaneously. Bogost’s theory of the “possibility space” examines this relationship between these two systems:

the possibility space refers to the myriad configurations the player might construct to see the ways the processes inscribed in the system work. This is really what we do when we play video games: we explore the possibility space its rules afford by manipulating the game's controls (Bogost, 2007, p. 42-43)

Bogost argues that when playing a video game, the player explores the rules of
the game and the rules of the system simultaneously. The rules are embedded in the system of the game and defined by the code and processes of the computer. When someone plays a video game they interact with those rules and processes. Bogost sees this as a space of potential action where the player explores what they can do based on the game's controls. This is a fundamental difference between video games and traditional games.

While Bogost is a controversial figure in Game Studies, the possibility space is a useful concept for understanding player action. In the possibility space, players explore the rules of a game through a game's controls. Once a game is released, players are free to experiment with different strategies and approaches to play. The exploratory approaches that players take in the possibility space can also be called *emergent play*—“a complex interaction between players and the affordances of the play space they inhabit” (Pearce, 2009, p. 24). This complex interaction between players and affordances of the play space (or the rules) creates an opportunity for player agency within the structures of rules and code. Players find freedom within these strict boundaries of rules and code. Through emergent play, players can augment the goals of the game with their own goals, like creating a successful guild in *World of Warcraft*, improving their shooting accuracy in *Counter-Strike*, or acquiring a rare item in *Dark Souls*.

Emergent play emphasizes the agency of players. Players are ultimately responsible for their actions in a game and create their own path of play. “As game designers, you can never directly design play. You can only design the rules that give rise to it” (Pearce, 2009, p. 31). Players often create a game-within-a-game, where players invent different games or metagames aside from those intended by the game developers (Chen, 2009; Pearce, 2009; Silverman and Simon, 2009; Williams et al., 2006).

As players become more experienced, emergent play becomes a core feature of
their game play experience - “what distinguishes the power gamers is their constant engagement in dynamic goal setting and the focused attention to achieving those goals, which can range from gaining levels to securing particular weapons and armor, killing certain monsters, gaining admission to a specific guild, getting special skills, and exploring difficult zones” (Taylor, 2006, p. 75-76). This dynamic goal setting can change a player's path within a game from the path intended by the developer. Players find their own motivation for moving through a game, and that motivation varies widely.

Emergent play is most observable in sandbox games like Minecraft. In Minecraft, players are able to engage in an emergent play environment that most closely resembles digital Lego. The Minecraft world is made up entirely of 8-bit blocks which can be mined and reconfigured to create new structures. Minecraft allows players to create local servers and host their own worlds, resulting in specific rules and practices in each server. As the popularity of Minecraft grows, so does the complexity and scale of objects built in Minecraft by dedicated communities of players. From full scale replicas of the Sistine Chapel to the Starship Enterprise, some Minecraft servers have evolved into a series of complex architectural projects.

This gestures towards the paradox of agency in video games. Players are always limited by the rules of the video game, both the rules of the game world and the rules of code. There is no “free-form” play in the sense of boundless imagination run wild. Player agency is always constrained within the space of rules and code. Even if the code is altered by players, the new code will have new boundaries. However, players have the opportunity for emergent play, to redefine the conditions of success, or otherwise experience the game on their own terms. This is clearest in games like Minecraft, where large-scale architectural projects or surviving zombie hordes or player versus player battles are all possible within the sandbox structure.
The possibility space and emergent play both emphasize that gameplay is the interaction between player and game. This is a complex interaction between players and the affordances of the video game play space. Within this space a myriad of different ways to play can emerge. One of the more interesting cases is rationalized play.

### 2.2.2 Rationalized play

Emergent play takes a different form in the economies of massively multiplayer virtual worlds (Boellstorff, 2008; Chen, 2009; Silverman and Simon, 2009). *Second Life* has been examined as a space of creationist capitalism, where labour is understood as creativity, and production is the process of creation (Boellstorff, 2008). In *Second Life*, this means creating a persona, developing an avatar, but also producing in-game worlds or consumer goods, which are transferrable in a virtual economy. This as a participatory space where producers and consumers interact in new ways with persons drawing on their social networks as a resource in the same way they would draw from material resources (Boellstorff, 2008, p. 207).

This is also known as *prosumption*, where the lines between consumer and producer blur into a hybrid subject. Creativity becomes the mode of production, and this creativity is linked to self-expression and freedom (Boellstorff, 2008, p. 211). Player comments on their experience in *Second Life* reflect this interplay between creativity as game mechanic and creativity as product: “there is a lot of freedom here, in many more ways than rl” and “I just like being immersed in so darn much creativity” and “what appealed to me was that there were no goals, and freedom to do what you wanted” (ibid.). The player imagines themselves as a productive agent within a space of possibility and creativity. This is also a generative space, where player's creations...
can be exchanged in the virtual economy.

A different kind of economy emerged in *World of Warcraft* called dragon kill points (DKP) (Chen, 2009; Silverman and Simon, 2009). DKP was developed to distribute in-game capital (or loot) amongst players in large scale missions known as raids, multiplayer quests to defeat monsters and gain experience and loot. Players received cumulative rewards based on their participation in raids. These rewards took the form of DKP, a currency used to auction rare and valuable items to players within a guild (social group of co-operative players). This system created an emergent economy within guilds. DKP was initially developed in *EverQuest* and was adopted by *World of Warcraft* players to handle the increasing issue of capital distribution in large groups. This player-developed system was not formally adopted by the game developers, but became a method distributing in-game capital for high level players. DKP has been examined with a Marxist / Foucauldian critique, arguing that play becomes work-like in this system (Silverman and Simon, 2009). Players perform labour to accumulate currency and acquire better material objects. Committed players or power gamers are cast as the prototype for the player-workers of the information age.

This formalization of play is also known as rationalized play (Grimes and Feenberg, 2009). The experience of play changes as it becomes rationalized through technological mediation and widespread standardization as games become large scale social practices. This is common in massively multiplayer online games, where players must work together to complete the advanced levels of the game. Play becomes bound by an additional layer - social interaction.

Previously, play was bound by the rules of code and the rules of the game. This additional social layer creates another formal boundary of play. If you are not willing to participate in the social interaction required to succeed in the latter stages of *World of Warcraft*, you will not reach the furthest levels of the game. This is similar to a
skills gap, where a player's knowledge and/or ability are not to the same level as other players in a particular community: “One important problem with cooperative games is the gap between skills which causes players to wait for one another. Most of the time this builds frustration...[Another problem is] when one player wants to do an action, x, and the other wants to take a different action, y, and whereby taking these actions they will inevitably interfere or hinder each other's goals” (Seif El-Nasr et al., 2010, p. 5). This skills gap can have detrimental effects on a player's participation in cooperative games, particularly in an environment with strangers. If a player is unable to find a community that accommodates their skill level, the likelihood of an enjoyable and therefore repeat cooperative game experience decreases significantly. Play in this scenario is about success rather than a free form activity. Games become sites of achievement, progress, self-improvement, and conquest. In massively multiplayer online games like World of Warcraft, this requires a mastery of the rules and an additional mastery of social interaction and membership in particular communities.
Figure 2.1: Rationalized play

Transformation 3 in Figure 2.6 is the site where games becomes a player-determined institution. Players will set particular goals for their gameplay experience, much like quotas on a factory line. Players will want to collect a certain item, defeat a certain enemy, complete a certain quest, or organize a large-scale raid with fellow guild members. This introduces an additional layer of productivity onto the game, one determined and decided by players themselves. Players may willingly create these work-like practices onto their play experience.

2.2.3 Flow Theory

Gameplay is a highly subjective experience. Players will have different levels of expertise with certain aspects of a game, or proficiency in some areas and deficiencies in others, or potentially no experience with a game or a game genre. When playing golf,
everyone must use clubs to navigate each hole in the attempt to take as few strokes as possible. However, this does not account for different levels of expertise or experience amongst golfers. Some golfers may be excellent at putting, while other golfers may be able to hit the ball further than most players. The variety of skill amongst players means that each player experiences different kinds of challenges (Csikszentmihalyi, 1990). What is challenging for one player may not be challenging for another player.

Flow theory emerged from a study of the creative process (Csikszentmihalyi and Getzels, 1971) that observed artists working on paintings. While painting, the artists persisted with great focus, unaware of hunger, fatigue or discomfort, but lost interest in the painting once it had been completed. This phenomena was categorized as intrinsic motivation, or autotelic activity: activity rewarding in and of itself (auto = self, telos = goal) apart from the end product or any extrinsic reward for the activity. This work has been influential in game design as a framework for understanding how and why people play games (Bartle, 2005; Chen, 2009; Juul, 2005; Salen and Zimmerman, 2004; Seif El-Nasr et al., 2010; Squire, 2005).

A series of studies was conducted that investigated autotelic motivation by interviewing chess players, rock climbers, dancers, and other groups who emphasized enjoyment as their reason for participation. These studies focused on aspects of play where intrinsic rewards were salient to the activity. These studies were extended to include workers (Csikszentmihalyi and LeFevre, 1989) where extrinsic rewards (money, prestige, or social recognition) could explain participation. The phenomenological research from work and play settings had similar findings on how people experience autotelic activity, or intrinsic motivation. These studies form the concept of flow, or the general characteristics of optimal experience and its conditions:

- Perceived challenges, or opportunities for action, that stretch (neither over-
matching nor underutilizing) existing skills, a sense that one is engaging challenges at a level appropriate to one's capacities;

- Clear proximal goals and immediate feedback about the progress that is being made (Nakamura and Csikszentmihalyi, 2014, p. 60)

Participants experienced this flow state in a multitude of activities: “apparently the way a long-distance swimmer felt when crossing the English Channel was almost identical to the way a chess player felt during a tournament or a climber progressing up a difficult rock face” (Csikszentmihalyi, 1990, p. 48). Flow also crossed boundaries of “culture, stage of modernization, social class, age, or gender” (Csikszentmihalyi, 1990, p. 48). Participants engaged in a number of different activities from diverse demographics yet still “described enjoyment in very much the same way” (Csikszentmihalyi, 1990, p. 48). Csikszentmihalyi asserts that “optimal experience, and the psychological conditions that make it possible, seem to be the same the world over” (Csikszentmihalyi, 1990, p. 49).

Flow suggests there are several major components to the phenomenology of enjoyment, as described by Csikszentmihalyi (Csikszentmihalyi, 1990, p. 49): Flow occurs when a person confronts a task that they have a chance of completing. The task cannot be beyond the perceived expertise of the person. They must be able to concentrate on the task at hand. Flow theory states that concentration is possible because the task has clear goals and provides immediate feedback. For example, the artist working on a painting knows what they are trying to paint and has the immediate feedback of the brush strokes on the canvas. Their progress towards the goal is clear as each brush stroke adds to the painting. A person will act with deep but effortless involvement that is separate from the worries and frustrations of everyday life. They have a sense of control over their actions. Paradoxically, a person will
stop feeling a sense of self during the task but have a stronger sense of self after the experience is over. Finally, sense of time is altered, where hours can pass in minutes or minutes can feel like hours (Csikszentmihalyi, 1990, p. 49).

Entering flow depends on the balance between perceived action and perceived opportunities (Figure 2.1). This balance is intrinsically fragile: if challenges start to exceed skill, or if skill begins to exceed challenges, an individual is no longer in flow. This can be represented as a flow channel, the balance between challenge and skill progressing over time.

In a video game, this is also known as the optimal game flow (Falstein, 2005; Schell, 2014). As players progress through a video game, their level of skill and the level of challenge oscillate. In an ideal game, the player progresses and the difficulty of the game also increases to match their improving level of skill. This is a difficult balance to achieve.
2.2.4 Flow and failure

When playing a video game, players willingly subject themselves to failure. Ironically, failure is integral to player enjoyment (Juul and Norton, 2009). In an empirical study of the relationship between failure and enjoyment, the players who enjoyed a particular game the most were those who failed some and then completed the game. Players who completed the game without failing rated the game lower than those who had failed at least once (Juul, 2013).

Failure in video games shares the main characteristics of flow. The first principle of flow is that perceived challenges or opportunities for action stretch existing skills. The second principle of flow is that a person has clear goals that provide immediate feedback about their progress. In an instance of failure, a player has likely been challenged beyond their current skill. They must overcome a challenge or complete a task that they were not previously able to complete. Ideally, the video game will return them to the point just before the failure occurred that allows them to attempt the task again. The player can attempt the challenge again that stretches their existing skill until completing the task. As the player improves and increases their expertise, past challenges will ideally become easier. Second, the game ideally provides immediate feedback about how the player has failed. This can take a number of different forms but can be abstracted as halted progress. A player cannot proceed forward after failure and a well designed game provides immediate feedback to let the player know their progress has stopped.

Flow and failure also connects with Vygotsky's zone of proximal development - the site of learning is that which is just beyond the reach of the learner (Csikszentmihalyi, 1990; Vygotsky, 1978). Players want to have a certain amount of challenge, but not so much challenge that they cannot eventually succeed. Challenges that were once
too difficult to solve become easier as time progresses and the player's skill improves. This process would not be possible without failure: “failure is more than a contrast to winning - rather failure is central to the experience of depth in a game, to the experience of improving skills” (Juul and Norton, 2009). As a player fails, and learns from those failures, they develop the necessary skills to succeed in the game. In well designed video games, this follows a trajectory of increasing difficulty and refined skill development. As players progress further through a game, their skills increase to meet the ever-increasing level of challenge.

Drawing from the work of Csikszentmihalyi, this dissertation emphasizes the subjective experience of players as it relates to their perceived level of skill and their perceived level of difficulty. I use the term *challenge* as a way to address the subjective experience of difficulty. Each player experiences different kinds of challenges based on their previous experience, expertise, and skill. All players experience the same system (rules, interface, code, etc.), but not all players experience the same challenges. Systems are the formal infrastructure of games. Challenges are the subjective experiences of difficulty in games.

### 2.2.5 Summary of gameplay theories

These game studies theories form the theoretical framework for gameplay, the interaction between the player and the game. Table 2.2 includes a summary of each theory and how that theory is applied.
<table>
<thead>
<tr>
<th>Theory</th>
<th>Summary</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gameplay</td>
<td>The interaction between the player and the game</td>
<td>Site of analysis from the user study</td>
</tr>
<tr>
<td>Lusory attitude</td>
<td>Voluntary attempt to overcome unnecessary obstacles, the peculiar state of mind in gameplay</td>
<td>How players understand their gameplay</td>
</tr>
<tr>
<td>Possibility space</td>
<td>The myriad of possibilities a player can explore in a video game</td>
<td>Different choices players make in the gameplay session</td>
</tr>
<tr>
<td>Emergent play</td>
<td>New or unanticipated ways of interacting with a video game</td>
<td>Different strategies players take in the gameplay sessions</td>
</tr>
<tr>
<td>Flow theory</td>
<td>Right balance between player skill and game difficulty provides engaging experiences for players</td>
<td>How players of different skill levels approach Portal, subjective experience of difficulty</td>
</tr>
</tbody>
</table>

Table 2.2: Summary of gameplay theories

2.3 Information practice

I propose that the theories of gameplay and player experience (Bogost, 2007; Consalvo, 2007; Gee, 2003; Juul, 2005; Salen and Zimmerman, 2004; Taylor, 2006) can be furthered by combining information studies scholarship and the emphasis on practice. While game studies has provided valuable exploration of the player experience, information studies provides a new perspective on how people generally deal with information.

According to Savolainen, two concepts exist to characterize how people generally deal with information (Savolainen, 2007): 1. information behaviour; 2. information practice. Both concepts examine the same phenomena - how people “do things” with information. The range of those things is noteworthy, from hobbies to job searching to legal cases to consumer decisions and so on. The major difference between these two groups is an epistemological disagreement on what constitutes meaningful
data. Information behaviour focuses on the observable actions of users in various contexts. Information behaviour exclusively studies the exterior behaviours that are “identifiable, observable and hence, researchable” (Wilson, 1994, p. 16). The data set for information behaviour research is the observable actions of individuals. In contrast, information practice emphasizes a person's lived experience, one that is contingent on social and cultural factors (Savolainen, 2007, p. 126). Information practice focuses on a person's habits and the activities of their daily life.

Savolainen argues that information practice is a comprehensive view of how people experience information in their daily lives. This includes information seeking, information use, and information sharing (Savolainen, 2008, p. 65). Information practice is a “set of socially and culturally established ways to identify, see, use and share the information available in various sources such as television, newspaper and the Internet” (Savolainen, 2008, p. 2). The emphasis on practice and the lived experience of information is closely related to situated cognition and situated action. Both approaches use an ontological framework that incorporates a multifaceted approach to the human experience with an emphasis on knowledge as situated in a person's lived experience.

Savolainen identifies information practice as a meta-theoretical approach (Savolainen, 2007, 2008; Savolainen and Wilson, 2009). Information practice is an umbrella concept that includes several other user-focused approaches including sense-making, information grounds, and small world theory (Savolainen, 2008). Traditionally, information studies research examined the collection, organization, and retrieval of information from a system-based perspective. The field has shifted to incorporate user-focused perspectives on how people interact with information (Kuhlthau and Bates, 1993). User-focused or participant-focused research explores the experience of individuals rather than evaluating the functionality of a specific information system like a library.
catalogue (Case, 2006; Wilson, 1999).

Information practice as a research approach “encompasses assessing human motivations and technological contributions to interactions, particularly when in the course of practice the human and the technological elements become integrated” (McEwen, 2010, p. 39). Like situated action, information practice examines the interaction between human and technology. This project follows in this tradition of information practice research and situated action research by assessing the interaction between player and video game.

This emphasis on the lived experience is similar to player-focused research in Game Studies. As discussed earlier, players often create new forms of play, games-within-games, metagames, and unique forms of interaction aside from those intended by the game developers (Chen, 2009; Pearce, 2009; Silverman and Simon, 2009; Taylor, 2006; Williams et al., 2006). Information practice and player-focused research in Game Studies follows similar epistemological motivations and examines player action from their lived experience.

2.3.1 Episodic information practice

This dissertation focuses on a specific episode of information practice - an hour-long game play session. For the purposes of this dissertation, I am calling this episodic information practice research.

The origins of information practice come from Savolainen's earlier theory of everyday life information seeking, or ELIS. ELIS offers two frameworks for studying how people experience information: 1. Way of life - a day to day approach concerning a person's order of things, like the relationship between work time and leisure time. This addresses the daily practice of a certain order of things as it suits their own
interests and adheres to that order, so long as it remains meaningful (Savolainen, 1995, p. 259). This is typical of the broader lifestyle studies. 2. Mastery of life - an episodic display of mastery. This is the active process of pragmatic problem solving, where the order of things has been challenged (Savolainen, 1995, p. 259). Overcoming challenges and achieving mastery results from effective information practices, or using information effectively to satisfy the challenge. If there is no challenge, mastery of life becomes a passive monitoring of everyday life events. In other words, when something is not particularly challenging, there is no active mastery required.

Information practices also refer to the strategies that users undertake. This approach stresses the knowledge of individuals and how they use common sense practices to analyze their actions and create meaning. Data is drawn from the participant's internal experience and their description of that experience. Participants are asked to describe their thought process, decision making, actions, and reflections. Information practices has been applied with human-computer interaction (HCI) theory to explore how special education students use a touch-input mobile application (Epp et al., 2016). Along with the participant's internal experience and description of that experience, this HCI approach also examines the choices that participant's make when using the mobile application. The information practice lens provided a new perspective on the user's experience and revealed that students engaged in unanticipated information practices. Students “demonstrated agency by developing information practice strategies despite the information processing and user interface obstacles they faced. These strategies included the repurposing of locations as categories and mode switching to support information seeking” (Epp et al., 2016, p. 1454). Participants found ways to interact with the system that were appropriate for their needs, finding strategies that were unintended by the developers. This approach is a way to study how participant's make unique choices and find unique strategies when interacting with
Episodic data collection has been used in a wide range of information practice research (Hartel, 2003, 2006; McEwen, 2010; McKenzie, 2002, 2003). The difference between these approaches and the approach of this dissertation is the number of data collection instances. In other information practice studies using episodic data collection, the researchers wanted to examine the totality of a participant's experience around a certain topic. This included the career of hobbyists chefs (Hartel, 2003, 2006), the information practices of expecting mothers of twins (McKenzie, 2002, 2003), and the role mobile phones play in supporting relationships of first-year university students (McEwen, 2010).

The nature of this dissertation is different. I am focusing on first encounters with a new video game. This prevents me from studying more than one encounter. While I am borrowing the same episodic approach, I am not using multiple episodes. Instead, I am comparing the first encounters between different types of players. An exemplary approach to this episodic information practice research is Dervin's sense-making metaphor (Dervin et al., 2003).

2.3.2 Sense-making

Sense-making explores “how people make sense of their worlds” (Dervin et al., 2003, p. 223). In Dervin's approach, humans move through time and space until reaching a “cognitive gap”. A cognitive gap is an instance where a person does not have a clear way forward, which Dervin characterizes as questions, confusions, muddles, riddles, or even angst. Individuals must seek inputs to help bridge this cognitive gap before they can move forward, or make sense of the situation (Dervin, 1992, p. 67). Inputs can include standard scholarly tactics like searching for information in a system like
a library catalog but may also include a number of other strategies like drawing on past experiences, thinking of comparable stories, reframing the problem, relying on emotions, etc. This process is called “bridging the gap”. The sense-making method asks participants explicitly how they bridge those cognitive gaps - what conclusions they reached, what insights they arrived at, and how they reached those conclusions in their own way (Dervin, 2008). This process of sense-making is shown in Figure 2.2.

Figure 2.3: Sense-making metaphor (Redrawn from Dervin, 2006)

Sense-making allows for diverse approaches to bridging the gap including ideas, cognitions, thoughts, attitudes, beliefs, values, feelings, emotions, intuitions, memories, stories, and narratives. This is a holistic viewpoint of information practice that includes a diverse set of variables.

Dervin's sense-making is useful for this study as it provides a specific focus on
moments of challenge. In Dervin’s approach, every person is an expert in their world (their body, their work, their life). People proceed through their daily life until reaching a problem they are unable to answer. To solve this problem, people must engage in sense-making to “bridge the gap”. This bridging provides them with an answer, and if that answer is unsuccessful, the person repeats the process until finding an appropriate answer for them. Savolainen argues that Dervin’s “bridging the gap” metaphor provides methodological and heuristic guidance for asking questions about how people interpret information (Savolainen, 2006).

This sense-making approach can be applied to video games. Players proceed through games using their existing skill sets until reaching a challenge they are unable to solve. Players must “bridge the gap” to solve these challenges by creating a new solution. If their solution solves the challenge, they move on to the next challenge. Otherwise, the player must seek a different solution. Dervin’s definition of sense-making, or “how people make sense of the world” can be reformatted as “how people make sense of games”. This serves as a guiding principle for this dissertation - how do different players make sense of games.

2.3.3 Gameplaying practice

With gameplay and information practice established, I propose a combination of these theories - gameplaying practice. Returning to the previous definition, gameplay is “how the game will be played...[the] dynamic aspect of a game” (Juul, 2005, p. 83). From information practice, I draw on Dervin's sense-making theory which explains how people make sense of their worlds when encountering an unfamiliar situation. This is applied to a first encounter with an unfamiliar video game - how do different players make sense of an unfamiliar game. I am examining the strategies that
users undertake when encountering unfamiliar situations in video games. This is a subjective exploration and asks players to share their experience in their own terms. Returning to situated cognition and the reconfiguration of knowledge as knowing, I propose the term *gameplaying practice* to emphasize a player's subjective experience.

This definition can be further specified with the concept of challenge - the subjective experience of difficulty in a game. Gameplaying practice is the way a player plays a game to address challenges. Players encounter moments where they are unable to overcome challenges and must create new strategies to solve the challenges. This is similar to flow theory (Csikszentmihalyi, 1990), where optimal experiences result from a fine balance of player skill and game difficulty. Players are ideally pushed just beyond their skill level as they progress through the game. Flow theory argues that this balance of skill and challenge creates a sense of enjoyment and timelessness. This also relates to the zone of proximal development theory, where the ideal site of learning is that which is just beyond the reach of the learner.

Why are gameplaying practices important? Gameplaying practices allows for a specific study of how players make sense of a new game. Other studies have examined first encounters with games (Blumberg and Sokol, 2004; Giddings and Kennedy, 2008; Hamlen, 2011, 2012; Orvis et al., 2008; Squire, 2005) or how players use tutorials (Bartle, 2005; Cox et al., 2012; Ellis et al., 2008; Schrader and McCreery, 2008; White, 2012). Gameplaying practices captures both the gameplay session and a player's reflections on their experience. This creates a focal point for this dissertation and poses the question of how a player encounters a game from an information studies perspective.

While gameplaying practices is not a new concept, the study of gameplaying practices is a novel approach. The specific discussion of challenge, how players perceive challenge, and how they negotiate that challenge guides the data collection process.
I am identifying moments in the player's gameplay session that appeared challenging and asking players to identify moments they found challenging. These moments are examined closely, using the video footage from the gameplay session during the interview. This allows for a specific exploration of gameplaying practices. Asking players about their gameplaying practices may yield unanticipated findings.

### 2.3.4 Summary of information studies theories

These information studies theories form the theoretical lens for how people do things with information in *Portal*. Table 2.3 includes a summary of each theory and how that theory is applied.

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<thead>
<tr>
<th>Theory</th>
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<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information practice</td>
<td>Comprehensive framework for how people do things with information</td>
<td>Interaction between humans and technology from an information studies perspective</td>
</tr>
<tr>
<td>Episodic information practice</td>
<td>Discrete instance for studying information practice</td>
<td>Studying the information practice of the first encounter exclusively</td>
</tr>
<tr>
<td>Sense-making</td>
<td>How people make sense of challenging moments using information practices</td>
<td>Analyzing player experiences based on their information practices in challenging moments</td>
</tr>
<tr>
<td>Gameplaying practice</td>
<td>Subjective experience of difficulty in a game</td>
<td>How players attempt to overcome challenges based on their previous gameplay experience and expertise</td>
</tr>
</tbody>
</table>

Table 2.3: Summary of information studies theories
2.4 Assumptions

Based on the theories discussed in this chapter, I will discuss the assumptions of this project. There are five assumptions based on the literature. After each assumption, I will provide references to the appropriate arguments.

**First assumption:** Players with more previous gameplay experience and expertise will perform better than players with less previous gameplay experience and expertise. More experienced players will progress further through the game than less experienced players, complete chambers more quickly, and solve puzzles more accurately using fewer portals. This previous gameplaying experience will make their first encounter with *Portal* less challenging.

Expertise is based on domain knowledge (Grabinger et al., 1997; Murphy and Alexander, 2002; Stubbart and Ramaprasad, 1990). Knowledge is complex and subjective, closely linked to the lived experience of the individual. (Chaiklin et al., 1993; Dede et al., 2004; Lave, 1988; Suchman, 2007). Expertise in a particular domain, like video games, results from experience in that domain. Another way to frame this expertise is previous gameplaying experience. The more video games someone has played the better they will be at future video games. This has also been called learning by doing (Bogost, 2007; Lave and Wenger, 1991; Squire, 2005). Previous gameplaying experience is the most important factor for a player's skill level (Jenson et al., 2011). Expert players can be recognized as being faster than novices at performing skills in their own domains, solving problems with little error (Glaser et al., 1988, p. xvii-xx). This means players who have more previous experience will complete chambers more quickly and more accurately than players with less previous experience, according to the literature.

**Second assumption:** Experts will show similarities with other experts while
novices will have more divergence with other novices. Experts will use similar gameplaying practices while solving puzzles in *Portal*. Experts will be able to understand the semiotics of *Portal* and find similar paths through the game. This shared semiotic expertise will distinguish expert players from novice players. Novice players, lacking the semiotic familiarity from previous video games, will show more divergent gameplaying practices. Novices will have a more difficult time finding optimal paths through the game. The lack of experience of novice players will make their gameplaying practices look divergent as they do not have a shared semiotic domain.

Because of their previous gameplaying experience, expert players will have a shared semiotic domain. Words, symbols, images, and artifacts take on a situated meaning that depends on that shared semiotic core. “Learning in any semiotic domain crucially involves how to situate (build) meanings for that domain in the sorts of situations the domain involves” (Gee, 2003, p. 26). This means that the gameplaying practices of expert players will have similarities as they draw on a shared set of meanings. According to MMOG research, this similarity in gameplaying practices will be most evident with experts in first-person perspective games. Players who have previous experience with MMOGs can draw on that expertise when playing other MMOGs (Gee, 2003; Schrader and McCreery, 2008; Silverman and Simon, 2009; Squire, 2003, 2006; Taylor, 2006). Because *Portal* is a first-person perspective puzzle game, there will likely be a relationship between success in *Portal* and expertise in first-person perspective games. This can take on a myriad of forms but could include familiarity with controls, puzzle comprehension, shooting mechanics, or spatial awareness. Novices do not share a semiotic domain. They will appear more divergent in their gameplaying practices as they do not have a shared set of meanings from previous gameplaying experience.

**Third assumption:** Experts will articulate their gameplaying practices more
clearly than novices. Experts will have previous understanding of video games and familiarity with the kind of language used to describe video games. This should contribute to a sense of certainty when discussing their gameplay sessions, as well as possessing specific language to describe their strategies. Novices will have a more difficult time than experts when articulating their gameplaying practices. Novices lack the previous understanding of video games and will potentially lack the language to describe their specific decisions. This may also contribute to feelings of uncertainty when discussing their gameplay session, like lacking a vocabulary to describe a particular strategy.

Experts have domain knowledge with a specific vocabulary for video games. The shared semiotic core gives experts a language to talk about their gameplay experience (Gee, 2003, 2008; Squire, 2003, 2006; Taylor, 2006). They can draw on previous experiences and compare *Portal* with other games they have played, referring to specific mechanics or instances. Novices do not share this domain knowledge and potentially lack the vocabulary to describe their gameplay experience. In a similar comparative study, novice and expert players were asked to articulate their gameplay using a think aloud protocol (Hong and Liu, 2003). Novices said things like “I don't know how”, “I have no idea”, and “I'm not sure”. Experts said things like “I encountered such situation just now”, “it will possibly solve the problem”, and “this movement would lead to a new situation” (Hong and Liu, 2003, p. 255). Based on Hong's study, I argue that novices will also find it more difficult to articulate their gameplaying practices in the post-play interview. Experts will have a vocabulary to talk about their specific strategies during the post-play interview and find it easier to articulate their gameplay practices.

**Fourth assumption:** Novices will be discouraged more easily while playing. Novices will not have the previous experience of struggling through a difficult moment
in video games. This may result in novices becoming discouraged or even ending the gameplay session earlier than anticipated. Expert players will have the previous experience of encountering a challenging moment in a video game. These moments require players to think about what the game has taught them thus far and implement that skill in a new situation. Novice players are less likely to have encountered that situation in a video game which may contribute to discouragement.

Flow theory has been applied to video game design as the optimal game flow (Falstein, 2005, p. 90). Ideally, as a player progresses through a video game their level of skill and the game’s level of difficulty reach a balance. This is a difficult balance to achieve because of the varying nature of player expertise. All players will not have the same skill progression or understand what the game is trying to teach them. Novice players may find certain challenges more difficult. This relates to the lusory attitude, where the player accepts the obstacles of the game because they make the activity possible. I argue that difficult moments in Portal are more likely to break the lusory attitude for novices because the difficulty of the game will exceed their skill and lead to frustration. The acceptance of the obstacles of the game will end as the novice player does not see a way forward. In addition, expert players also have the advantage of encountering difficult moments in previous video game experiences. This could translate into resilience for expert players who understand that difficult moments are normal and solvable.

Fifth assumption: A third player-type category will emerge on the continuum between novice and expert. Some players may overstate their abilities and perceive themselves as experts, other players may Understate their abilities and perceive themselves as novices. I anticipate a third category emerging, intermediate players. Intermediate players will have previous video game experience but limited experience with first-person perspective games, or with console video games. These intermedi-
ate players will bring varying levels of expertise from other types of games or other game platforms, like an avid mobile phone game player or a tabletop game player. They will understand some of the semiotic practices of Portal but will not have the expertise of someone with previous experience in first-person perspective games.

In the demographic survey, I will ask players to estimate their level of expertise in video games. Self-reporting presents a problem when defining players as novice or expert. This approach is limited by a person's self-perceived expertise who may suffer from overestimation or underestimation of their skills (Bernard et al., 1984; Boase and Ling, 2013; Freeman et al., 1987; Sudman et al., 1997). There will be slippage in the categories due to this self-reporting. I propose a third category as a way to account for this variance, but there will likely be a broad continuum amongst the players. These categories serve as initial ways to analyze the data rather than strict definitions.

2.5 Conclusion

This chapter established a theoretical framework for three key areas: 1. learning theories and video games, 2. game studies and the concept of gameplay, and 3. information studies with an emphasis on information practice. A full summary of the theories used in this chapter can be found in Appendix O - Summary of theories. These theoretical frameworks inform the research questions for the gameplay study and provide an analytical lens to examine the results. The next chapter will explain the methodology and research design.
Chapter 3

Methodology

This chapter details the methodology for an exploratory study of how different adult players encounter Portal for the first time. This study draws from a human computer interaction method called video commentary model (VCM) (Barnum and Dragga, 2001; Guan et al., 2006; Ribbens and Poels, 2009) as a basis for exploring gameplay. VCM combines a gameplay session followed by a semi-structured interview based on footage from that gameplay session. I propose a revision to the standard VCM protocol, emphasizing specific instances of gameplaying practices rather than the entirety of the gameplay session. The data collection and data analysis are designed to capture and analyze the player's experience in their own words based on their gameplaying practices. I also discuss the various apparatuses of the research design including the research site, interview protocol, recruitment process, pilot study, research site, and data security procedures. I refer to participants as players and will do so through the remainder of this chapter and this dissertation. I prefer the term players as it provides agency to the people involved in this study. I am studying their experience of Portal and their gameplaying practices. Player is more appropriate for conveying this active role.
3.1 Research questions

This dissertation focuses on three research questions to guide the study. In this section, I will discuss each research question and how it relates to the theoretical framework. I will also provide subquestions that arise from these three research questions.

3.1.1 Research question one

*How do different players encounter Portal for the first time?*

1. *What are the consistencies and continuities in gameplaying practices of different players encountering Portal for the first time?*

2. *What are the divergences and variations in gameplaying practices of different players encountering Portal for the first time?*

The way to determine how different players encounter *Portal* for the first time is an exploration of their gameplaying practice, or the way a player plays *Portal*. Dervin's sense-making suggests that players will follow a similar pattern in their gameplay session (Dervin et al., 2003). Players will proceed through the game until reaching a challenging section, or cognitive gap. When they reach this challenging section, players will search for new ways to solve the challenge, or bridge the gap. This will result in players having to try new strategies or new gameplaying practices to overcome the challenge. Players will go through a similar process of: 1. encounter a challenge; 2. devise a strategy; 3. attempt that strategy; 4. if successful, challenge solved; 4a. If not successful, repeat until challenge is solved. What is challenging for one player may not be challenging for another player but players will follow a similar sense-making process.
In data collection, the exploration of gameplaying practices will involve a gameplay session followed by a semi-structured interview. Questions in the interview will be based on the gameplay session. I will ask players about their gameplaying practices with an explicit focus on how they devise strategies and attempt those strategies.

According to Suits' lusory attitude, a player willingly accepts unnecessary obstacles when playing a game. This means that players will interact with *Portal* in similar ways as they accept the same unnecessary obstacles such as the rules, interface, heads up display, level design, portal mechanics, etc. All players must follow particular paths to move through the game as most levels in *Portal* only have one solution. As players progress through *Portal* they will encounter levels in similar ways. This will create consistencies and continuities in gameplaying practices of different players.

However, the steps a player takes to reach those solution can vary greatly. The possibility space allows a player substantial freedom to explore the myriad of configurations (Bogost, 2007). What is simple or straightforward for one player may be difficult or unclear for another player. The specific actions taken by each player to reach the same solution can vary widely. This will create divergences and variations in gameplaying practices of different players.

Players learn different skills in each level of *Portal* to progress of the game, which follows Vygotsky's zone of proximal development. *Portal* teaches different skills to overcome increasingly complex challenges as the game progresses. One skill builds on another in a linear progression. Players follow a path designed by *Portal* developers that scaffolds game concepts in a timely manner. Ideally, this guides players to use similar methods to solve challenges. This scaffolded design may or may not be effective at teaching players the necessary skills to play *Portal*. This will be reflected in both the consistencies and divergences in the gameplay practices of different players.
3.1.2 Research question two

Does previous video game experience and player expertise inform the gameplaying practices of first encounters with Portal?

1. What connections do players make with video games they have played before?

2. What are the gameplaying practices of novice players?

3. What are the gameplaying practices of expert players?

Gameplaying practice is the way a player plays a game to address challenges. Drawing from situated cognition, situated action, and information practice, gameplaying practices are an embodied set of practices that include the dexterity and reaction of the body, the decision making and strategizing of the mind, and the cultural context of video game familiarity (Barab and Plucker, 2002; Brown et al., 1989; Lave, 1988; Savolainen, 2007; Suchman, 2007). According to research comparing novices and experts, previous gameplay experience and player expertise will influence the gameplaying practices of first encounters with Portal as experience is directly related to expertise (Glaser et al., 1988; Grabinger et al., 1997; Jenson et al., 2011; Murphy and Alexander, 2002; Stubbart and Ramaprasad, 1990). The specificity of that impact is difficult to predict for a first encounter with an unfamiliar video game - what will be the differences in the players, and what differences will emerge within those specific groups? This requires conducting gameplay sessions with players.

Gee's concept of affinity groups argues that video game players share a similar semiotic domain (Gee, 2004). Players with previous video game experience are likely to draw on that semiotic domain when encountering an unfamiliar game, in the same way a person with previous experience navigating rapids in a canoe would draw on that expertise when encountering a new series of rapids (Suchman, 2007). This
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concept of affinity groups and the impact of the semiotic domain on expertise will be explored by asking players about their previous video game experience and comparing gameplaying practices as they relate to that previous experience. In particular, I will focus on the connections players make with games they have played before and ask them how they draw on specific strategies from other games during their first encounter with *Portal*.

Similarly, Savolainen's information practice theory argues that players who are actively engaged in video game play as part of their everyday life will progress through the game more easily than players who are not actively engaged in video game play as part of their everyday life (Savolainen, 1995, p. 259). Players with more previous video game experience, and more first-person perspective video game experience, will likely be the most skilled and progress the furthest through the game.

However, these theories do not account for the specific gameplaying practices of each group. Instead, they describe a general aptitude for video games. This requires further exploration to understand the gameplaying practices of each group. What are the gameplaying practices of novices and experts, and what can we learn from those practices? What is the relationship between previous gameplaying experience and expertise? How does each group describe their previous experience and what kind of games do they discuss during their first encounter with *Portal*? These questions provide new directions into how different players and different groups of players approach a new game.

3.1.3 Research question three

*How do different players identify challenges in Portal?*

1. *How do different players describe challenges in Portal?*
2. What do novice players identify as challenging?

3. What do expert players identify as challenging?

Returning to Dervin's sense-making and the metaphor of bridging the gap, players will reach challenges during their gameplay session where they are unable to proceed forward (Dervin et al., 2003). These moments will be sites of inquiry during the post-play interview session. I will ask players to describe these moments of challenge and explain their gameplaying practice to solve that challenge. These moments will provide points of inquiry to understand the lived experiences of the players. What were players thinking when encountering a challenge, how did players form particular strategies to overcome those challenges, and how do they execute those strategies?

Of particular interest is the way players describe challenges in Portal. How do they describe their process, what steps do they take to solve a particular challenge, and how do they articulate their solution? Returning to Gee's affinity groups (Gee, 2004), a player's identification and description of challenge will be influenced by their previous gameplay experience and expertise. Their previous encounters with the semiotic domain of video games will shape how they negotiate challenges. The specific ways that different players describe and identify as challenging require gameplay sessions with players. While it is likely that trends will emerge within novice and expert players, the specificity of those trends is unknown.

Csikszentmihalyi's flow theory (Csikszentmihalyi, 1990) predicts a subjective optimal balance for players between in-game challenge and a player's skill. This means that players will likely identify different parts of the game as challenging. What is difficult for one player will not be difficult for another player. Some players may find the game too easy, other players too hard. As players progress through the game, they will likely encounter a portion of the game where their skill level meets with the
level of challenge in the game. This is a Goldilocks effect - too easy, too hard, just right. Players will likely oscillate between these different states, with some puzzles being easy to solve and other puzzles presenting a substantial challenge. What different players identify as too easy, too hard, and just right will provide meaningful insights into how players experience challenge.

3.2 Research Design

The research design for this exploratory study uses a pre-play demographic survey, a gameplay session that records a player's first encounter with *Portal*, and a post-play interview that uses that recorded gameplay session to guide the interview. This approach is designed to understand the gameplaying practices of different adult players from their perspective. I draw heavily on video commentary model (VCM), a method originating from human-computer interaction (Barnum and Dragga, 2001; Guan et al., 2006; Ribbens and Poels, 2009). VCM combines observation of player's gameplay session and a post-play interview, allowing the investigator to observe players while engaged in the game and review the video of their play session immediately after (Ribbens and Poels, 2009). “VCM supplements the observation with the subjective experience of the participant, which is especially useful in the context of the video game world where the player is constantly being forced to make decisions. In that the VCM combines observation and conversation, it consists already of a form of triangulation” (Ribbens and Poels, 2009, p. 5).

VCM consists of three phases: 1. The player engages in a gameplay session, during which time an audiovisual recording of the player and the game is made using screen capture software; 2. The researcher passively observes the gameplaying practices of the player while taking notes of their activities and of key findings that emerge during
3. A semi-structured interview is then conducted with the player, based on the recordings and observation notes. This model uses a retrospective think aloud (RTA) protocol where players reflect on what they have done. This differs from a concurrent think aloud (CTA) protocol, where a player verbalizes their experience while performing an activity, which is used commonly in usability testing (Barnum and Dragga, 2001). RTA has been selected because CTA places a higher burden on the player during gameplay and interferes with the flow and immersion of the player (Guan et al., 2006; Lang, 2014).

To address the issue of poor recall in a retrospective think aloud, the specifics of gameplay session are recorded in the researcher's observations. I used time-stamps in my notes and noted moments were players made interesting decisions or found something difficult. VCM originally calls for the video of the session to be reviewed by the player and the researcher during the semi-structured interview, but this may cause uneasiness for the player. As an amendment for this study, I modified VCM to allow the player to have access to the video and control playback. If a player wanted to refer to a specific instance in their gameplay, they navigated through the video and commented on that instance. This provided the player with agency in determining which portions of the video to review, rather than potentially watching self-perceived mistakes in play.

This approach does not use gameplay as an experimental instance but rather uses the gameplay session to inform the semi-structured interview. I observe how different players encounter Portal for the first time and make note of their gameplaying practices in specific instances. Particular focus was placed on identifying key instances of where players appeared to face substantial challenges. Drawing on the work of Dervin's sense-making (Dervin, 1992; Dervin et al., 2003; Dervin and Naumer, 2009), players will move through Portal until reaching a challenge they cannot solve. To
overcome these challenges, players must devise new strategies and attempt to execute these strategies. I examine how players describe this sense-making, how they devise these strategies, and what impact previous gameplay experience and player expertise has on sense-making.

3.2.1 Similar gameplay research design

This research design draws inspiration from other studies that look at gameplay and player practices. Consalvo's work on cheating is an exemplary case of research in player practices. Her main research question was how players' definitions of cheating vary and what the difference could mean (Consalvo, 2007, p. 87). She used two data collection methods: 1. in-depth interviews with twenty-four self-identified game players ranging in age from fourteen to forty-one; 2. open-ended surveys of fifty game players ranging from nineteen to thirty-two who were part of a college-level course on digital games and culture (Consalvo, 2007, p. 86).

Consalvo's approach allowed for emergent categories of cheating. She found that player definitions of cheating are divergent. Cheating is a complex phenomena and the motivations for cheating vary depending on the player (Consalvo, 2007, p. 4). Players do not have a clear definition of what they consider cheating, but a variety of practices can fall under the larger construct of cheating. Consalvo's examination of cheating is consistent with the other accounts of player practices - players cheat for a variety of reasons, just as players experience a video game in a variety of different ways.

Understanding how people play video games is a question that cannot be answered with a monolithic statement, but must be discovered by surveying the players involved in a specific game or specific study. How does a multifaceted understanding of player
practices inform this dissertation? Rather than search for specific answers to how people play, I proceed forward with the recognition that gameplaying practices are as diverse as the players.

A similar approach combines gameplay sessions and participant observation followed by qualitative post-play interviews (Ermi and Mäyrä, 2005; Hong and Liu, 2003; Juul and Norton, 2009; Steinkuehler, 2006, 2007; Taylor and Witkowski, 2010). Juul's work on failure and difficulty in video games included an experimental game to test different levels of failure and punishment in games (Juul, 2009). Juul's study involved a gameplay session with participants followed by a semi-structured interview. Players discussed their levels of frustration with the games and their varying levels of failure and punishment. He discovered that players are most satisfied with “just enough” failure - not so hard that the game is frustrating, but not so little that the game is easy. Juul's combination experimental gameplay sessions and participant observation with post-play interviews was later expanded to a larger study involving a web-based version of the experiment. This second phase involved a larger participant pool and open-ended survey questions.

Also, several studies have emerged from Human Computer Interaction and Game Studies that use gameplay sessions to inform game design (Byrne, 2005; El-Nasr et al., 2015; Erfani et al., 2010; Greenfield et al., 1994; Isbister and Schaffer, 2015; Joorabchi and El-Nasr, 2011; Milam and El Nasr, 2010a,b; Milam et al., 2011, 2012; Seif El-Nasr et al., 2012; Whitton and Whitton, 2011). These works are from an area of scholarship called Games User Research that focused on player psychology and their behaviour. The primary methods of data collection are playtesting, analytics, and expert analysis for the purpose of improving game design. These works share similar methodological influences particularly the emphasis on player experience using gameplay sessions. However, there are differences with information practice particularly the distinction
between practice and behaviour. Influential works from this field look at Gestalt psychology and visual attention (Milam et al., 2012), object motion and visual load in 3D games (Milam et al., 2011), and design patterns for level design to guide player movement (Milam and El Nasr, 2010b). While these studies have a more quantitative focus than information practice, the emphasis on a player's experience is an important influence for this study.

Other studies have used more traditional experimental approaches with quantitative data collection based on in-game performance, measuring player motivation and skill acquisition (Cox et al., 2012; Kuikkaniemi et al., 2010; Montoya et al., 2011; Orvis et al., 2008; Seif El-Nasr et al., 2010). Orvis et al's (2008) research investigates how task difficulty in video games impacts a player's performance. Participants played different versions of a simple game with varying levels of difficulty. Participants were randomly selected, counterbalancing for gender, and mixing both novice and expert players (Orvis et al., 2008, p. 2419). The game itself was a first-person shooter military training game. Players completed an introductory level - a firing range with targets at varying distances. Targets are more difficult to hit at longer distances, so more difficult levels required players to hit more targets at further distances while easier levels required players to hit more targets at closer distances. Data collection consisted of player's in-game performance, or how many targets could they hit in a certain time. Following the gameplay component, players were surveyed on their levels of motivation and task self-efficacy. The findings were noteworthy: player performance and motivation improved in more difficult conditions, with experienced gamers having the highest increase in performance and motivation.

I have chosen an approach that combines aspects of Consalvo's study on cheating and Juul's study on failure. Borrowing from Consalvo, I recognize the complexity of gameplaying practices. How a player approaches a game depends on many previous
factors. When studying gameplaying practices, recognizing the diversity of player experience is critical. Borrowing from Juul, I used the gameplay session followed by the semi-structured interview for data collection. This approach allowed me to capture a player’s reactions and experiences in their own words.

3.3 Choosing Portal as the research site

*Portal* is ideal for examining gameplay in an unfamiliar environment. There is no game that uses game mechanics similar to *Portal* other than *Portal 2*. Not only is this the first encounter with *Portal* but this is the first encounter with the game mechanics of portals. This was an explicit requirement of the recruitment process - no previous experience with *Portal* or *Portal 2*. More information on the history *Portal* can be found in Appendix I - Development, and more information on *Portal 2* can be found in Appendix J - Portal 2.

*Portal* is a short game. A player can complete the game in less than 2 hours. *Portal* is also a simple game. Aesthetically, the test chambers are simple. There are few features - grey walls that permit portals, black walls that do not permit portals, along with puzzle elements including energy pellets, energy pellet receptors, moving platforms, buttons, and cubes. Players are primarily interacting with grey walls in grey rooms. The only real colour comes from the portals themselves. The controls are also simple on the controller - two joysticks, two triggers, two buttons. While a modern first person shooter takes advantage of all 16 inputs on a controller, *Portal* only uses six.

*Portal* is a simple game compared to other popular first-person perspective video games. There are no extraneous elements. No map, no inventory, no complex role playing game system of avatar progression, no additional objects, no characters, no
side quests, no lavish environment. *Portal* asks players to interact with the game mechanic of portals to escape the labyrinth. Because of this explicit interaction with the game mechanic, players can ideally evaluate the portal mechanic and reflect on how this mechanic influences their gameplaying practices. More information on the setting of *Portal* can be found in Appendix K - Portal Setting.

### 3.3.1 Game mechanics of Portal

The action that is most commonly performed within a specific game is known as the game mechanic: “the essential play activity players perform again and again in a game” (Salen and Zimmerman, 2004, p. 316). In *Portal*, the game mechanic is placing portals to navigate through an otherwise impassable section of each chamber. Portals are reminiscent of other ideas in science fiction that permit instant passage - worm holes, Acme portable hole, Star gate, or a Star Trek transporter. Portals are gateways that allow players to move from one location to another by stepping through the portal. If you placed a blue portal in Toronto and placed the orange portal in Edmonton, players could step through the blue portal in Toronto and immediately arrive in Edmonton through the orange portal. Portals permit efficient travel from one location to another. To place these portals, the player needs a portal gun. Once the player controls this portal gun, they can place portals and move between different locations.

Players must place portals in appropriate locations in order to solve each puzzle. There are only two portals - the blue portal and the orange portal. The player is initially given control of the blue portal while the orange portal remains static. This is intended to reduce the difficulty. By only giving players control of the blue portal, the game's developers are attempting to reduce the difficulty and teach players the
relationship between the blue and orange portal.

Generally speaking, players use the blue portal as the “entrance” and the orange portal as the “exit” but this is not a requirement. If a player decides to enter through the orange portal they will always exit the blue portal. If a player decides to enter through the blue portal they will always exit through the orange portal.

![Portal diagram](image)

Figure 3.1: Portal as game mechanic

Figure 3.1 demonstrates how players must use portals to proceed through a chamber. A player cannot reach the high ledge on the right without using this technique. Players must place one portal, in this case the orange portal, high on the adjacent wall and use their momentum to reach the high ledge on the right. Players must place another portal, in this case the blue portal, in the pit below and jump through the blue portal to exit the orange portal. Momentum is always conserved while passing through portals. This technique is known as “flinging” or “momentum jump” as described by GLaDOS, the omnipresent computer that narrates *Portal*. More information on GLaDOS is available in Appendix L - Portal Characters.

As players progress through the game, they must learn a number of these tech-
niques with portals. In more difficult levels, players are required to combine these previously learned techniques in novel ways. This forms the game mechanic for *Portal* - by placing portals effectively, players can proceed through the level.

### 3.3.2 Learning to play Portal

Modern first-person perspective video games often have introductory sections called tutorials that teach players how to play a game. These tutorials are usually incremental, taking players through the range of actions they can perform in the game and showing players how to perform those actions sequentially. This begins with basic actions, such as movement and looking, and progresses into more complex actions like how to perform unique actions with specific button combinations. More complex games have more complex tutorials but the process is similar. A player is introduced to the features of a particular game through an incremental process. This begins with easy tasks, such as movement, and progress to the most complex tasks. Players are prompted with on-screen information and asked to complete the task using those prompts.

For example, in *Battlefield 4* (EA, 2013), the game opens in a flooded school in a war torn location. Players move through a narrow hall way and are forced to encounter a number of obstacles that require basic actions to complete. First, there's a fallen book case on the ground that players must jump over. As they approach the book case, a prompt appears “A - jump”. Next is fallen debris that does not let the player pass, a prompt appears “B - crouch”. This continues through the basic actions, providing the button prompt and the action. There is no other task for the player to complete. The game reduces the complexity and focuses on learning interactive features with clear audio and visual prompts. This tutorial level in *Battlefield 4* lasts
approximately 20 minutes and covers nearly all the actions a player will make during the game.

*Portal* does not provide an explicit tutorial. There are no explicit step-by-step instructions on how to complete tasks in the beginning of the game. There are no on-screen prompts of how to progress through a chamber. Players learn by attempting to solve the puzzles, and potentially failing. *Portal* does not prompt players on how to complete tasks, or remind them to use skills they have acquired in previous chambers. The semiotics of *Portal*, that is the language of the game, build new challenges from these previous skills as a player progresses through the game. This is accomplished through scaffolding (Fernández et al., 2001; Sherin et al., 2004; Wass et al., 2011).

### 3.3.3 Scaffolding

Scaffolding, or support in key areas, allows learners to go beyond what they would be able to achieve on their own with the help of a more knowledgeable other, such as a teacher or skilled peer (Vygotsky, 1978). This metaphor has been extended to include technological artifacts, particularly those found in software (Sherin et al., 2004). The same principle applies to *Portal*. By teaching players portal-related skills in an incremental process, *Portal* scaffolds the complex skills needed to complete the game.

In *Portal*, players complete new challenges that draw from expertise learned in previous chambers. As the chambers progress, the challenges become more difficult. However, they always rely on the same principles learned from previous chambers. Viewing *Portal* as a technological artifact, the game provides prompts that encourage players to use previously learned skills to complete a new puzzle. This places the player into an environment where the current task is just outside their normal ability.
Their previously learned skill assists them to accomplish the current task. While this initially may seem out of reach, a player ideally begins to recognize that the game does not ask them to use a skill beyond their current ability. The game asks them to apply that ability in a new way.

The skills that the game teaches are initially simple, with each chamber teaching players a slightly more complex version of the previous skill. As the player progresses they must combine these skills in novel ways. The path of the game is specific - only certain types of actions will let players progress. However, players must make those decisions on their own. The game does not instruct them on how to combine their previous skills. Instead, the game provides environmental clues in the form of placards. When learning a new skill, a player is shown a tile on the floor at the location where that skill will be used. For example, when learning to use momentum, a player is shown a stick figure flying through a portal reminiscent of a super hero in Figure 3.2.

This show-don't-tell approach lets players know they will be using the portal in a unique way. After completing the action, GLaDOS provides them with a brief overview: "You appear to understand how a portal affects forward momentum, or to be more precise, how it does not. Momentum, a function of mass and velocity, is conserved between portals. In layman's terms, speedy thing goes in, speedy thing
comes out”.

Rather than showing the player how to succeed with on-screen prompts, Portal provides a clue in the form of a placard and affirms that the player has made the right decision after successfully completing the task. This approach occurs throughout Portal. Players learn a new skill experientially rather than being shown explicitly what to do, mirroring situated cognition and situated action.

3.3.4 Not quite a first-person shooter

Portal does not conform to a traditional video game genre. Portal is a boundary object, occupying a space between two video game genres: first-person shooter and puzzle game.

First-person shooter games involve shooting enemies; constantly shooting enemies. In first-person shooters, players take on the perspective of a gun-carrying avatar and proceed through the game by accurately shooting enemies. These games can take on a number of different themes, from futuristic encounters with invading aliens to re-enactments of historical battles to modern urban warfare in a dystopian alternate reality. In all these scenarios, players are required to shoot enemies and avoid being shot from a first-person perspective.

Portal involves shooting, but not shooting enemies. Players “shoot” portals from their portal gun, but this could be better described as “placing” portals. Players must place portals in the appropriate locations to move through each chamber and reach the appropriate place in the level.

First-person shooter games require a player to shoot accurately and quickly. Players are faced with a seemingly endless stream of enemies, requiring them to move quickly between cover and fire their gun accurately. If a player does not move quickly,
they will be overwhelmed by enemies. If a player does not fire accurately, they will 
run out of ammunition or be killed for not eliminating enemy shooters quickly enough.

*Portal* does not require this same level of accuracy or quick actions. Players are 
assisted in *Portal* with a friendly aim-assist feature. If a player is attempting to place 
a portal in a specific area, the game will auto-adjust a player's portal shot to find 
the right area. If a player is required to make a shot on a panel the size of a portal 
and does not have the perfect aim, the game autocorrects this off-target shot into the 
right area.

In a first-person shooter game, the player's shots are mapped accurately to the 
enemy. If a player shoots at the enemy's left arm, the game will register a hit on the 
enemy's left arm. Because this is a non-lethal area, this means players will have to 
keep damaging the enemy. In effect, *Portal* autocorrects misfired shots, like a shot in 
the left arm, to register as a headshot. The same way a headshot will immediately 
kill an enemy, *Portal* will autocorrect a player's shot for the perfect placement. Also, 
the portal gun does not require ammunition. There is an infinite supply of portals. 
This means that players do not need to be accurate in order to conserve ammunition.

*Portal* does not require quick actions. Players do not face any time pressure while 
playing *Portal* until the final chambers of the game. Success in *Portal* is based on 
assessing the spatial puzzle. Players proceed forward by finding the appropriate path 
through a chamber. This requires spatial awareness and an understanding of how to 
place portals effectively. There is no threat of an attacking enemy, no expiring clock, 
no threat of running out of portals, and no other pressures related to time. Players 
amay take as long as they wish to assess a puzzle and try different tactics. Whether 
a player takes 30 seconds or 30 minutes, every player must find the appropriate path 
through the chamber to proceed forward.

*Portal* lacks the conventions of a standard first-person shooter but does have two
familiar features. First, the portal gun is a gun, and that gun fires. The portal gun is mapped to the controller's triggers which mimics the conventions of a standard first-person shooter. Second, the player needs to fire portals in order to proceed through the game. Like a first-person shooter, there is no progress without shooting.

I prefer to classify Portal as a first-person perspective game. Like a first-person shooter, the player occupies the body of their avatar. They look through the avatar's eyes, taking their perspective. Portal introduces a different kind of genre by combining this first-person perspective with a physics-based puzzle. Essentially, Portal is a labyrinth. Players are attempting to escape the labyrinth using a portal gun.

This is an ideal site research site for analyzing gameplay in an unfamiliar environment. The portal mechanics and hybrid genre create a unique game that will be novel for both novice and expert players. Portal has been chosen specifically for study because of its unique design. The intention is that players will be able to evaluate the portal mechanic and reflect on his this mechanic relates to their gameplaying practices.

### 3.4 Data collection

The study uses multiple points of data collection including: 1. pre-play survey collecting demographic information and a brief history of the player's previous gameplay experience; 2. recording of the gameplay session using screen capture software; 3. over-the-shoulder camera recording of the gameplay session to capture the player’s utterances or reflections on the gameplay session, as well as provide redundancy in case the screen capture software did not work; 4. field notes of the researcher's observations during the gameplay session; 5. audio recordings of the semi-structured interview with the respondents.
I conducted one-on-one research encounters with 14 respondents (seven male, seven female). Each of these sessions followed the same format. Before the play session, the player completed a short survey collecting demographic information and their previous gameplay experience, attached as Appendix G. Using Google forms, I created a short survey to assess a player's previous gameplay experience. This included age, gender, most recently played video game, genres of games preferred, frequency of video game play, experience with first-person perspective games, and confidence with video games and first-person perspective games. To protect the anonymity of participants, I assigned each participant a number. Aside from this number, no identifying information was collected in this survey. The master list of participants and numbers is a hard copy, kept in a locked filing cabinet.

The player was then shown a personal computer running Portal with screen capture software running in the background. I provided players with a brief overview of the computer and reminded them of the basics of the research protocol - that they are invited to play for 1 hour, but that they have the option to stop at any time, etc. Since the goal of the study is to better understand how players navigate challenges when encountering a new game for the first time, instructions about the game itself were kept to a minimum. The player then began playing Portal, during which time I observed the player and took notes on their progress, including noting the time of them completing tasks.

Each player played Portal from the opening screen, that is the menu, the opening sequence/tutorial, and however many “chambers” (levels) they could complete within 1 hour or less depending on the player's interest in continuing. To reduce potential impact on the player's performance, I observed the player over the shoulder. I noted when players seemed unclear on their next task or appeared to be searching for solutions. I used a guide that I have created that maps out the game in its entirety,
noting the times and paths players took in each game play session. These observations informed the semi-structured interview when asking players about instances where they were unsure what to do next.

Following the gameplay session there was a five-minute break for the player. During the break I set up the video of the gameplay session on a separate laptop. The player was given control of the video playback. I conducted a semi-structured interview that lasted between 25-60 minutes, depending on the player's interest. Some players were succinct with their comments and others had additional segments they wished to discuss. With the player's consent, I recorded the interview with a digital recording device. The interview protocol was based on the questions outlined in Appendix C along with an exploration of specific instances where the player was searching for solutions. At the start of the interview, I reminded the player that their performance in the game is secondary to their described gameplay experience in an attempt to reduce the uneasiness of self-perceived mistakes. The interview uses a technique adapted from Dervin's sense-making interview framework that prompts players with an open ended question such as “can you tell me what you were doing in this instance?” (Dervin, 1992) to explore a player's practices when reaching a cognitive gap. I focused on five instances with each player where they appeared to reach a cognitive gap and then asked players if they had any additional moments they would like to discuss. The interview also asked players if they would like to change anything about the game adapting another technique from Dervin which asks “if you had a magic wand, what would you like to happen?” (Cheuk and Dervin, 2011, p. 128).
3.4.1 Interview design

Before starting the interview, I reminded players again that their performance in the
game was not being evaluated. I wanted to assure them that whatever they did in
the game was neither right or wrong, and they should feel comfortable to share their
experience, whatever that experience entailed.

First and foremost, I want to hear about your experience. There is no
right or wrong answers, and no right or wrong way to play the game. If
there's something you didn't like, tell me. If there's something you think
could improve about the game, tell me. The most important part of this
interview is hearing about your process and your decisions. There is no
wrong answer (Excerpt from Appendix C - Interview Protocol)

The interview was divided into three major sections: 1. general experiences; 2.
specific instances; 3. closing thoughts. I explained to the players that this would be
the structure of the interview but they were welcome to return to previous questions
if they had any additional thoughts during the interview. The interview was mapped
to follow the structure of the research questions. First, I asked players about their
encounter in general terms, asking them to talk broadly about their experience, referring
to RQ1. Second, I asked players about the similarities between Portal and other
games they have played, and how they may have drawn on that previous experience
during their Portal game play session, referring to RQ2. Finally, I ask players about
their experience of challenge, first by focusing on specific instances of challenge and
then by asking about the most challenging part of their gameplay session, referring
to RQ3. I used neutral language to create these questions, not referring to terms
like gameplay or gameplaying practices. Instead, I used terms like “learned” and
“similarities”.
Questions 3 and 3b transitioned players from talking about the previous experience to their gameplaying practices in *Portal*, specifically around the idea of challenges. I wanted to frame this as comprehension rather than challenge, namely was anything unclear, and did the game make it clear what you were supposed to do. I used this as a general prompt to start players thinking about challenges, and what they found generally challenging. This was intended to bridge the discussion between an overview of their gameplay session to specific instances.

During the specific instances section, I asked players to show me a clip of their gameplay footage that they thought was interesting or meaningful. We watched the clip together and I asked players to narrate their experience as the video played in the background. Players were invited to pause, rewind, fast forward or discuss any portion that they felt was meaningful. These specific instances used a series of prompt questions, but this served more as a semi-structured guide. Players generally raised these points without specific prompts. I would open by asking “what were you trying to figure out” or “can you tell me what you were doing in this instance?” I was expecting that this section would require a number of prompts, asking players about how they came up with specific solutions or how they identified challenges. Instead, players eloquently described their gameplaying practices, often identifying the gap in their thinking and realizing why this was a challenging instance for them. These prompts, an adapted version of Dervin's sense-making interview framework (Dervin, 1992), were not used specifically in any of the interviews as players started to answer those questions with the initial prompt of “can you tell me what you were doing in this instance?” I repeated this gameplay footage review for 5 instances with each player, and then asked if players had any additional moments they wanted to discuss. Generally, we covered all the key instances in those 5 moments, and players were satisfied that we had covered all meaningful instances. Only two players (P02-E,
P03-I) wanted to include an additional moment that they felt was meaningful.

Closing thoughts provided a moment to specifically introduce the concept of challenge, asking players what was the most challenging part of the game for them. Players were able to take their reflections from the discussion of specific instances and identify a major theme for the challenging moment of their gameplaying practices. Most players identified a thematic challenge rather than a specifically challenging instance. This also informed an important interview question - “anything you want to change about the game?” I adapted this question from Dervin’s sense-making methodology which asks “if you had a magic wand, what would you like to happen?” (Cheuk and Dervin, 2011, p. 128). Generally, players wanted something changed that would help them overcome their major challenge.

Overall, the structure of the interview was useful and generated rich responses from the players. The review of the gameplay footage provided specific instances for players to explore their gameplaying practices and recount their sense-making process in detail. Players were able to describe their approach in their own language, identify challenging moments, and articulate their gameplaying practices.

### 3.4.2 Mapping Portal

I created two tools for mapping Portal. The first is a visual tool to help track the specific paths taken by each player. The second is a text walkthrough tool that describes the steps required to solve each puzzle. I combined these two tools into one map attached as Appendix F.

It was difficult to create images of each level. I attempted to use a level creator released by Portal developer Valve to re-create the levels, but found it difficult to match the spatial layout. Instead, I made scans of each map from the Half Life 2
Prima guide, which also included maps for *Portal* (Hodgson and Stratton, 2007).

To create the walkthrough text, I re-played *Portal* in its entirety three separate times and mapped out all the various paths a player could take in the game. Unlike many other games, the available options for solving a puzzle in *Portal* are limited. Players must follow a narrow series of choices in order to progress through the puzzles. *Portal* provides the illusion of a sandbox world, but the solutions to the puzzles are limited.

After creating a walkthrough of all the various paths a player could take, I verified my findings with the Prima guide and The Portal Wiki, a fan made resource that provides players with solutions to all *Portal* levels. I made a few minor changes to my own wording but confirmed that the solutions within the Prima guide and The Portal Wiki matched my own walkthrough.

I added the images from the Prima guide along with the walkthrough text and created the game map. This served as a reference for charting a player's progress and examining specific instances.

### 3.4.3 Recruitment

This study drew players from a diverse group - women and men between the ages of 24-49 who are located in the Greater Edmonton area and available to participate in the study at the time of data collection (Winter 2014 to Spring 2015). The exclusion criteria for this study was players who had previously played *Portal* games or were outside the 18-49 age range. I recruited 14 players to participate in the study. All players who contacted me were included. After reaching 14 players, I stopped recruitment.

I used snowball sampling for recruitment, maintaining an arms-length distance
(no previous relationship) from the investigator. I recruited friends of friends who have not played Portal before. Informal conversations with members of my personal network on social media sites (Facebook and Twitter) returned an initial 8 potential players at arms-length. From these initial recruits, I distributed a Snowball Sample Recruitment Letter (Appendix D) and a Recruitment Flyer (Appendix E) and asked if they would be willing to pass it on to others who may be interested and eligible.

Following each gameplay session and interview, I asked each player if they were willing to pass along a Recruitment Flyer (Appendix E) to potential recruits in their social network. I reminded players that they are under no obligation to pass these materials along. I also provided them the option of paper or electronic copies of the flyer. I did not ask for contact information of potential recruits, but rather asked potential recruits to contact me using the details on the recruitment flyer. Following the initial contact with potential players, I sent out a formal request and consent letter through email (See Appendix B - email query, and Appendix A - consent letter).

My ideal player pool for this study was seven males and seven females. I also hoped that I would be able to get a near-equal number of novices and experts from each gender such as four female experts, three male experts, three female novices, and four male novices. In the snowball sampling phase, I would ask players if they knew any more male players or female players depending on the current balance. Also, I asked players whether their friend played video games or not and attempted to find the right balance of expert and novice players from each group. This was not a strict guideline but rather an ideal player pool.

Returning to the problems of self-reporting, there is an inherent challenge in asking players to estimate their expertise (Bernard et al., 1984; Boase and Ling, 2013; Freeman et al., 1987; Sudman et al., 1997). Snowball sampling adds an additional layer of complexity by asking players to recall whether or not their friend plays video
games and potentially estimate their friend's level of expertise. This complexity resulted in the open-ended recruitment structure where all responding players were welcomed to participate. The recruitment process provided an equal number of female and male players but there were differences in the number of experts and novices from each gender. This study was comprised of five self-described expert males, two self-described expert females, two self-described novice males, and five self described novice females. Specific details about the players will be discussed more thoroughly in Chapter 4 - The Players.

3.4.4 Pilot study

Before recruitment for the study, I conducted a pilot study to assess this research design. The pilot study was a thorough rehearsal of the data collection procedures to identify any snags, oversights or problems with the design. Respondents selected for the pilot study resembled the intended players to the greatest extent possible (two players, one female novice player and one male expert player). I used the same snowball sampling methods for recruiting the pilot players, using friend of a friend referral. During the pilot, I took notes on the procedures of the research design as well as the regular data collection processes.

There were two changes needed for the research design following the pilot. First, players were more interested in discussing the specific instances that I had identified rather than controlling video playback. While I still gave players specific control of the mouse and keyboard to direct the video, they were interested in knowing the time stamps for moments that I thought they appeared stuck or searching for solutions. Also, I did not need to follow the specific series of prompts outlined in the specific instances section. Players addressed those points without specific prompts, and I
started using the open ended question of “can you describe what you were doing here” to open those specific discussions.

3.4.5 Research Site

The site for data collection was a population research lab at the University of Alberta. The University of Alberta is unaffiliated with this study but one of my colleagues (Professor Harvey Quamen in the Humanities Computing Department) provided me with space for this study. The lab space has been used for similar user studies including testing experimental web-browser interfaces and experimental database interfaces. The lab space was on the University of Alberta campus and accommodated the data collection for this research, providing ample space and a locked door for privacy. I used a set-up and tear-down approach, bringing in the necessary equipment for each session and storing all data off-site in my office and on an encrypted external hard drive. The identities of all players were kept in strict confidence. The game play footage, interview transcripts, and over the shoulder video recordings have been kept in an encrypted directory on the investigator's external hard drive.

3.5 Data analysis

Following data collection, I transcribed the interviews from the post-play session. For data analysis, I did not draw on the audio recording of the interview or the over the shoulder video of the gameplay session. Both sources proved redundant - my notes from the gameplay session and the transcription of the interview thoroughly covered the over the shoulder video camera recording and the audio recording.

In the initial coding stages, I started with three broad categories based on the research questions: 1. a player's description of their gameplaying practices - how they
played the game and how they made sense of the game (RQ1); 2. a player's experience with other games - what other games have they played and how did they draw on those experiences (RQ2); 3. a player's description of what they found challenging - what was challenging for a player, how did players describe these challenges (RQ3).

With these categories in mind, I started a preliminary coding process. My approach borrowed the principle of constant comparison - “the process of breaking down, examining, comparing, conceptualizing, and categorizing data” (Strauss et al., 1990, p. 61). I made paper copies of each interview and went through each interview writing down the emergent themes. I used a notebook and started an entry for each participant, along with a master list of codes. After coding each interview, I entered all the codes into the master list. For codes that appeared in multiple interviews, I took note of the frequency of each code. For example, if participant one and participant five both talked about difficulties with the controller, I would record “difficulties with the controller” in the master list after reading through the transcript from participant one and tally a second entry for participant five.

After completing this process with the transcriptions from all the participants, I had 70 different codes. From this initial set of codes, I started an axial coding process, where the data is categorized according to the connections between these codes (Strauss et al., 1990, p. 96). I categorized these codes according to similarities and was left with 47 codes. This became the basis for the formalized coding protocol. This initial hand coding, using a coding schema based on the research questions, created the categories for qualitative data analysis software.

I started a second round of coding using qualitative data analysis software built in the R programming framework called RQDA. I selected RQDA for several reasons: 1. RQDA is open-source, free software; 2. RQDA has a more robust set of qualitative analysis tools than other commercial programs, taking advantage of the R language;
3. RQDA provides flexibility between different platforms.

Using this coding schema, I made an initial pass at all the interviews using RQDA following the practice of axial coding. This further reduced the number of coding categories to 30 codes. Once this was completed, I returned to the interview transcripts and began to structure the codes into a conceptual layer based on the research questions. I followed a selective coding process: 1. I identified core categories; 2. I grouped my axial categories underneath these core categories; 3. I reviewed these categories based on my theoretical framework and research questions; 4. I refined and validated the relationships between the axial coding and the selective coding (Strauss et al., 1990, p. 116).

This coding process resulted in five major categories. First, player reflections which includes what they found too easy, what they found too difficult, what they found frustrating, and what they found rewarding. Second, gameplaying practices or the way a player plays a game to address challenges. Gameplaying practices included visual cues, experimental gameplaying practices, and sense-making. Third, previous gameplay experiences which are instances where players made specific references to their gameplay history. Fourth, challenges are instances that a player needed to find new solutions to a particular problem. Fifth, learning in Portal where players talked about their learning process. These five emergent themes form the analytical framework for this study. I will revisit these themes and the accompanying data in Chapter 5 - Findings.

3.6 Conclusion

This chapter established the methodology for how different adult players encounter Portal for the first time. I use VCM as the basis for this study, which combines
a gameplay session followed by a semi-structured interview based on footage from that gameplay session. As an amendment to VCM, I asked players to review specific instances rather than watching the entirety of the gameplay session. I asked players about their gameplaying practices in specific instances to understand the player's sense-making process in difficult moments for them. *Portal* is an ideal choice for studying first encounters because players interact with unique mechanics. The next chapter will examine the players in more detail.
Chapter 4

The Players

This chapter discusses the players involved in this study. This study involved 14 players who had never played Portal before. There were seven female players and seven male players ranging in age from 24-49. This chapter discusses the players, player groups, criteria used to establish these groups, and revises the research questions moving forward. I also include an overview of the players including their age, gender, expertise, and favorite video game.

4.1 Player demographics

Before starting the gameplay session, players were asked to complete a demographic survey (Appendix G - Demographic Survey). This survey focused on a few key areas: 1. age and gender; 2. previous gameplay experience and expertise; 3. self-perceived experience and confidence with video games; 4. self perceived experience and confidence with first-person perspective games.
4.1.1 Age and gender

Players ranged from age 24-49, with an average age of 33 years old. The average age of female players was 32 and the average age of male players was 34. This is similar to the average age of video game players, which in 2014 was reported at 31 years old and in 2015 and 2016 was reported at 35 years old (Entertainment Software Association, 2016, 2015, 2014). In Canada, the average age of a video game player is 36 (Entertainment Software Association of Canada, 2016). While this study did not attempt to find a representative sample, this was an interesting similarity between the average age of video game players and the players who participated in this study.

4.2 Previous gameplay experience and expertise

Players were asked about their preferred genres, most recently played video game, favorite video game, frequency of playing video games, frequency of playing console video games, and frequency of playing first-person perspective games. These categories show the diversity of the players involved in this study.

4.2.1 Preferred genres

The range of preferred genres was wide and varied. The most common genre players like to play was Adventure games. Table 4.1 shows the frequency of players preferred genres, including the written-in choices for the “other” category.

Players had experience across a wide range of genres. Thirteen of the players selected multiple genres, with two players choosing 10 preferred genres.
Table 4.1: Players preferred genres

<table>
<thead>
<tr>
<th>Genre</th>
<th>Number of players</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adventure</td>
<td>12</td>
</tr>
<tr>
<td>Fighting</td>
<td>3</td>
</tr>
<tr>
<td>First person shooter</td>
<td>6</td>
</tr>
<tr>
<td>Massively multiplayer online game (MMOG)</td>
<td>5</td>
</tr>
<tr>
<td>Puzzle</td>
<td>8</td>
</tr>
<tr>
<td>Real time strategy</td>
<td>4</td>
</tr>
<tr>
<td>Retro/arcade</td>
<td>8</td>
</tr>
<tr>
<td>Simulation</td>
<td>3</td>
</tr>
<tr>
<td>Sports</td>
<td>5</td>
</tr>
<tr>
<td>Tactical shooter</td>
<td>3</td>
</tr>
<tr>
<td>Tower Defence</td>
<td>4</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
</tr>
<tr>
<td>Card game</td>
<td>1</td>
</tr>
<tr>
<td>Platformer</td>
<td>1</td>
</tr>
<tr>
<td>Racing</td>
<td>1</td>
</tr>
<tr>
<td>Turn-based strategy</td>
<td>1</td>
</tr>
</tbody>
</table>

The diversity of the most recently played game was noteworthy, spanning multiple genres. Like preferred genre, players show diversity for their most recently played games. There is no dominant genre or game in this question either. This suggests that the players surveyed in this study represent a diverse population. A full list is available in Appendix M - Most recently played video game.

4.2.3 Favorite video game

Again, the diversity of the favorite video game was noteworthy. The most commonly named games were from the Super Mario series, although there is a difference between *Super Mario Galaxy* and *Super Mario World*. Like the questions in previous gameplay
Experience, the key result from this list is the diversity of selections amongst players. There is a higher representation for adventure games in this list versus the most recently played games, which is consistent with the player's preferred genres.

### 4.2.4 Frequency of playing video games

Players were surveyed about their frequency of playing video games across three categories: 1. video games generally, including mobile games, console games, handheld games, arcade games, etc.; 2. console video games, like Microsoft Xbox, Sony PlayStation, Nintendo WiiU, Nintendo DS, etc.; and 3. first-person perspective video game, that is any video game involving a first-person view. This data appears in Table 4.2.

While the majority of players (11 out of 14) played video games on at least a weekly basis, fewer players (6 out of 14) played console games on at least a weekly basis, and even fewer players played first-person perspective games (2 out of 14) on

<table>
<thead>
<tr>
<th>Player</th>
<th>Any video game</th>
<th>Console game</th>
<th>First-person game</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Everyday</td>
<td>Monthly</td>
<td>Rarely</td>
</tr>
<tr>
<td>02</td>
<td>Everyday</td>
<td>Monthly</td>
<td>Monthly</td>
</tr>
<tr>
<td>03</td>
<td>A few times per week</td>
<td>Weekly</td>
<td>Weekly</td>
</tr>
<tr>
<td>04</td>
<td>Rarely</td>
<td>Never</td>
<td>Never</td>
</tr>
<tr>
<td>05</td>
<td>Everyday</td>
<td>Never</td>
<td>Everyday</td>
</tr>
<tr>
<td>06</td>
<td>Everyday</td>
<td>Rarely</td>
<td>Rarely</td>
</tr>
<tr>
<td>07</td>
<td>Rarely</td>
<td>Never</td>
<td>Never</td>
</tr>
<tr>
<td>08</td>
<td>Weekly</td>
<td>Weekly</td>
<td>Monthly</td>
</tr>
<tr>
<td>09</td>
<td>Weekly</td>
<td>Never</td>
<td>Never</td>
</tr>
<tr>
<td>10</td>
<td>Everyday</td>
<td>Everyday</td>
<td>Rarely</td>
</tr>
<tr>
<td>11</td>
<td>A few times per week</td>
<td>Weekly</td>
<td>Monthly</td>
</tr>
<tr>
<td>12</td>
<td>A few times per week</td>
<td>A few times per week</td>
<td>Monthly</td>
</tr>
<tr>
<td>13</td>
<td>Rarely</td>
<td>Rarely</td>
<td>Rarely</td>
</tr>
<tr>
<td>14</td>
<td>Weekly</td>
<td>Weekly</td>
<td>Monthly</td>
</tr>
</tbody>
</table>

Table 4.2: Frequency of playing video games by type
at least weekly basis. If the range is expanded to at least a monthly basis, half of the players were playing first-person perspective games and half were not.

4.3 Self-perceived experience and confidence

Players were asked to rate their experience and confidence with video games and with first-person perspective games on a Likert scale. Each question used the same scale: 1. no experience; 3. some experience; and 5. significant experience. These categories provided some indication of player expertise in *Portal*. The specific determination of novice and expert players will be discussed more thoroughly in the next section. This section will cover the players as a whole rather than by level of expertise.

4.3.1 Experience playing video games

Players were asked to rate their experience playing video games on a Likert scale (Figure 4.1).

![Experience playing video games](image)

Figure 4.1: Experience playing video games

Seven out of 14 players felt they had significant experience playing video games. One player rated themselves between some experience and significant experience,
three rated themselves at some experience and three rated themselves between no experience and some experience. There were zero players that rated themselves as having no experience playing video games.

### 4.3.2 Confidence playing video games

Players were asked to rate their confidence playing video games on a Likert scale (Figure 4.2) ranging from 1. not confident; 3. some confidence; and 5. significant confidence.

![Confidence playing video games](image)

Figure 4.2: Confidence playing video games

Similar to the previous question, seven out of 14 players felt they had significant confidence playing video games. One player rated themselves between some confidence and significant confidence, one player rated themselves at some confidence, four rated themselves between no confidence and some confidence, and one player rated themselves at not confident. There were two players that responded between some confidence and significant confidence.
4.3.3 Experience playing first-person perspective games

Players were asked to rate their experience playing first-person perspective games on a Likert scale (Figure 4.3) ranging from 1. no experience; 3. some experience; and 5. significant experience.

![Experience playing first-person games](image)

Figure 4.3: Experience playing first-person perspective games

Six out of 14 players felt they had significant experience playing first-person perspective video games. One player rated themselves between some experience and significant experience, two rated themselves at some experience, four rated themselves between no experience and some experience, and one player rated themselves at no experience. Nine out of 14 players rated themselves between some experience to significant experience.

4.3.4 Confidence playing first-person perspective games

Players were asked to rate their confidence playing first-person perspective games on a Likert scale (Figure 4.4) ranging from 1. not confident; 3. some confidence; and 5. significant confidence.

This question presented the widest range of answers from the players. Only four
out of 14 players felt that had significant confidence playing first-person perspective games. Three players ranked themselves between some confidence and significant confidence, one player felt some confidence, four players were between not confidence and some confidence, and two players were not confident.

In summary, these responses show the diversity amongst the players. All players had some experience playing video games and half of the players had significant experience. There is a difference in confidence. While half of the players had significant confidence, the same seven players who rated themselves as having significant experience, the other seven players had a more diversity in their answers. This becomes more diffuse with experience and confidence in first-person perspective games.

### 4.4 Determining player expertise

The results from the demographics suggest that the players are diverse. I was not able to determine player expertise using this data alone. I drew from the gameplay sessions to further understand the different levels of expertise.
4.4.1 Progress in Portal

I conducted additional layers of analysis based on a player's gameplay session, namely their progress and their times to completion. The first layer for analysis was how far a player progressed during the 60 minute gameplay session. Portal becomes increasingly challenging as players progress through the chambers (or levels). Each chamber presents a different challenge, often asking players to combine previously learned skills in novel ways. Expertise can be quickly determined by how many chambers a player completes in 60 minutes.

![Progress in Portal](image)

Figure 4.5: Progress in Portal by participant

Some trends begin to emerge in Figure 4.5: 1. some players progressed much further than other players; 2. players found certain chambers more difficult than others, most notably chamber 3 and chamber 15; 3. player progress varies widely. There is a direct connection here between progress in Portal and expertise - the farther
you progress, the better you are at *Portal*. However, this analysis is not sufficient for determining player expertise.

### 4.4.2 Secondary factors to player progress

There were a number of secondary factors to player progress, namely the increase in difficulty in later chambers, the player's speed in solving chambers, and the player's willingness or ability to complete the full game session. As mentioned earlier, chambers become more difficult as players progress. Chamber 15 is more difficult to solve than chamber 5, and requires more steps to solve the challenge. As players start to progress through each chamber, the average time to complete a chamber increases.

Another factor in player progress is the speed at which a player completes the chambers. Some players were able to progress very quickly through the initial levels but did not complete later levels due to their length. Other players were stuck on particular levels for longer amounts of time but then quickly progressed through subsequent levels once learning the game mechanics of portals.

A third factor is a player's willingness or ability to play for the entire 60 minute gameplay session. Some players were frustrated while trying to solve a particular chamber and decided to stop playing. Other players experienced vertigo and seasickness because of their unfamiliarity with first-person perspective games. Other players wanted to continue playing at the end of the gameplay session.

### 4.4.3 Times to completion

During the gameplay session, I recorded all the player's times to completion for each chamber. These times to completion provided a more effective way to categorize players. Tracking progression was not sufficient for addressing the secondary factors,
Chapter 4. The Players

namely length of the later chambers, the speed at which a player completes the chambers, or the players willingness or ability to play for the 60 minute session. The full data set for time to completion appears as Appendix H - Portal chamber completion times.

4.4.4 Increasing times to completion

As players progress through Portal, the chambers become more challenging. Earlier chambers normally involve one challenge, while later chambers have up to ten different challenges. Chamber 11, chamber 14, and chamber 15 have the largest number of challenges to solve, and require players to combine previous skills in new ways. The average times to completion for these three chambers are notably long, at 6:22, 6:36, and 17:30 respectively. This means that the difference between a player reaching chamber 13 and chamber 15 has a substantial difference in progress through the game.

4.4.5 Difficult chambers

Some chambers are difficult for certain players, particularly those that introduce new skills. Chamber 03 is the most noteworthy example of introducing new skills, which asks the player to interact with both the orange portal and the blue portal for the first time. A group of players emerged that had difficulty with this chamber. These players also did not progress far through the game. Six players spent more than 10 minutes on chamber 03, with four players spending more than 20 minutes on chamber 03.

Out of these four, one player (P03-I) categorized themselves as significantly experienced and significantly confident in both video games and in first-person perspective
games. However, P03-I did not have experience with puzzle games and found it difficult to comprehend the portal mechanic. Despite P03-I's difficulty with chamber 03, they performed better in subsequent chambers. Understanding that some chambers are more difficult than others helps address players who get stuck in particular spots despite a strong performance overall. Their progress may not be as far as other players due to difficulties solving earlier chambers.

4.4.6 Average completion time

Measuring the average time to completion on each chamber allows a clearer understanding of how an individual player performed. In calculating these average times, I only included players who had completed the chamber. If someone was stuck on a particular chamber and did not complete it, they were not included in the average time. This means the average completion time trends towards players who progressed the furthest. This means the average time to completion is not a true reflection of the difficulty of the chamber, but rather a measure of the players who completed each chamber. This addresses the issue of players who stopped playing, particularly one player (P10-E) who had to stop due to motion sickness. P10-E was one of the strongest players, completing all but one chamber under the average time. However, P10-E was not able to play beyond chamber 14.

4.5 Player groups

Determining the player groups required a number of different factors. In my initial assessment of players, I focused on a player's in-game progress and times to completion, which is attached as Appendix H - Portal chamber completion times. I placed more emphasis on average times to completion, since some players were took longer
to complete the initial stages and other players stopped sooner than the 60 minute session. This resulted in a preliminary categories for the players. After establishing these preliminary categories, I compared those findings with three factors: 1. review of player performance in difficult chambers; 2. assessment of player gameplay footage in comparison with other players; 3. responses from individual players during the post-play interview. I watched how players performed in chambers with the most variance in times to completion (chamber 03, chamber 07, chamber 11). I also watched for how players were able to take skills learned in previous chambers and apply those skills to subsequent chambers. Finally, I compared how players talked about their puzzle comprehension during the post-play interview. I used the principle of constant comparison (Strauss et al., 1990, p. 61) throughout this categorization, returning to the demographic survey, gameplay footage, times to completion, progress through Portal, and the post-play interview. This process generated three emergent categories - novice players, intermediate players, and expert players.

4.5.1 Novice players

There were five novice players, four female players and one male player. Novice players all had difficulty with chamber 03, the first chamber that introduced interacting with the static orange portal instead of the player-controlled blue portal. The average time to completion on chamber 03 was 8:27, with novices finishing between 13:15-22:15. Only three novice players completed chamber 03. P06-N was frustrated playing chamber 03 and decided to stop playing after 20:00. P09-N spent 27:00 minutes before deciding to stop. Of the three remaining players, 1 was able to complete chamber 07 and 2 were able to complete chamber 06.

Novice players generally took longer than the average time to completion on all
Chapter 4. The Players

chambers. In particular, chamber 05 was difficult for novice players, averaging more than double the time to completion when compared to all players. Chamber 05 used a similar challenge as chamber 03, requiring players to use the static orange portal as their main problem solving tool rather than the player controlled blue portal. This required a strong understanding of the portal mechanic.

Novice players had a difficult time articulating the relationship between the blue portal and the orange portal, which will be discussed more in Chapter 5 - Findings. During the post-play interviews, novice players were confused about the game mechanic of the portals which explains their difficulty in puzzles that involved interacting with the orange portal. These puzzles, namely chamber 03 and chamber 05, require players to understand the relationship clearly between the blue portal and the orange portal. In the other chambers completed by novices, players are primarily interacting with the blue portal which is under their control.

4.5.2 Intermediate players

There were four intermediate players, two female players and two male players. Intermediate players were closer to the average times to completion on all chambers, aside from a few outliers. P03-I had the longest time to completion for chamber 03 at 29:15, which suggested that he might be categorized as a novice player, but completed the next several chambers below average times to completion.

Intermediate players progressed further than novice players, with 1 player completing chamber 12, 1 player completing chamber 11, and 2 players competing chamber 10. In comparison, no novice progressed further than chamber 07. As the chambers became more difficult, the intermediate players times to completion became longer than average. Chamber 10 introduced a new skill, where players use their momentum
to traverse gaps between different platforms. Intermediate players took longer times to comprehend the puzzles and had more difficulty executing the correct solutions when compared to expert players.

Intermediate players were able to understand the game mechanics and the challenges but the time required to understand those mechanics and challenges was longer than expert players. Also, intermediate players had a more difficult time executing the correct solutions. They lacked the same proficiency with the controller when compared to the expert players. In chambers that required players to make quick or specific reactions, particularly those involving timing when firing portals or placing the avatar in the correct location, intermediate players had more difficulty than expert players.

4.5.3 Expert players

There were five expert players, one female player and four male players. Expert players all progressed to the later chambers, with one player completing chamber 15, three players completing chamber 14, and one player completing chamber 13. P10-E, who did not progress as far, had the third fastest time to reach chamber 14 but due to their unfamiliarity with first-person perspective games had to stop playing due to motion sickness. All but one expert player was able to complete chamber 15, which proved too difficult for all other expert players. The one player who did complete chamber 15 did so using a unique solution, one which reduced their time to completion. This in effect was a short cut, which other players did not identify.

Expert players completed chambers lower than the average time to completion consistently, with no major outliers through chamber 00 to chamber 14. The defining quality of expert players was the speed with which they assessed chambers and reached
the right conclusion. This was consistent amongst all expert players. Many of the experts described the early chambers too easy, only finding difficulty on the later chambers, specifically chamber 14 and chamber 15.

Expert players were able to combine puzzle comprehension with accurate portal placement and avatar control. Later chambers require players to have specific timing with portal placement, and also place their avatar in the correct position while falling, or fire portals while in the air. Expert players were able to both assess and execute these more difficult challenges, particularly when compared with intermediate players. While intermediate players were able to find the solution, they were slower in this assessment and also in the correct execution of the solution.

4.5.4 Moving forward with the player groups

These categories are not strict classifications but attempt to frame the trends that emerged amongst the players. Players in the intermediate category were the most difficult to categorize. Intermediates are best understood as boundary objects, with some intermediate players having gameplaying practices similar to novice players and other gameplaying practices similar to expert players. These categories are helpful for comparing the different gameplaying practices of each group and identifying the trends that emerge between these different groups. These categories are used specifically to compare how previous gameplay experience and player expertise informs gameplaying practices and what different players find challenging.

4.6 Revising the research questions

With the addition of the intermediate category, this requires a minor amendment to the research questions. The new questions are included here, which add the interme-
diate category when discussing the gameplaying practices of players and how different players identify challenges in *Portal*.

### 4.6.1 Research question two

Does previous video game experience and player expertise inform the gameplaying practices of first encounters with Portal?

1. *What are the gameplaying practices of intermediate players?*

### 4.6.2 Research question three

How do different players identify challenges in Portal?

1. *What do intermediate players identify as challenging?*

   This is a minor amendment to the research questions but important for addressing the emerging intermediate player category.
4.7 Overview of the players

<table>
<thead>
<tr>
<th>Player</th>
<th>Expertise</th>
<th>Gender</th>
<th>Age</th>
<th>Favorite video game</th>
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<tr>
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<td>Novice</td>
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<td>30</td>
<td>Assassin’s Creed II</td>
</tr>
<tr>
<td>02</td>
<td>Expert</td>
<td>Male</td>
<td>37</td>
<td>Super Spike Volleyball</td>
</tr>
<tr>
<td>03</td>
<td>Intermediate</td>
<td>Male</td>
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<td>Call of Duty: Black Ops 2</td>
</tr>
<tr>
<td>04</td>
<td>Intermediate</td>
<td>Male</td>
<td>31</td>
<td>Super Mario World</td>
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<td>Intermediate</td>
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<td>14</td>
<td>Expert</td>
<td>Male</td>
<td>26</td>
<td>EA NHL Franchise</td>
</tr>
</tbody>
</table>

Table 4.3: Overview of the players

Table 4.3 provides an overview of the players, their level of expertise with *Portal*, their gender, their age, and their favorite video game. Moving forward, I will refer to players by their numbers and include their level of expertise, such as P01-N (Player 01, novice), P05-I (Player 05, intermediate), and P14-E (Player 14, expert).

4.8 Conclusion

This chapter discussed the players involved in this study and how these players were categorized according to their expertise. I discussed the process to determine the players groups and the criteria used to evaluate the players. A third group emerged when reviewing the player groups, the intermediate group. Two minor additions to the research questions were made to accommodate the emerging intermediate group.
The following chapter further explores the players and their experiences playing *Portal* focusing primarily on the post-play interviews.
Chapter 5

Findings

This chapter discusses the findings from the gameplay sessions and post-play interview. There were five major categories that emerged from data analysis: player experience, gameplaying practices, previous gameplay experience and expertise, challenges, and learning in Portal. This chapter discusses these categories and shares the player’s experiences as they relate to these categories. Each of these areas will have a specific section and subsections, discussing the findings overall and the findings according to novice, intermediate and expert players where applicable.

Novice, intermediate and expert players are not homogenous groups. There was slippage from individual players moving along a spectrum between novice, intermediate, and expert as anticipated by the problems of self-reporting and symbolic interaction theory (Bernard et al., 1984; Freeman et al., 1987; Sudman et al., 1997). However, the trends within the groups were noteworthy for this study. I use the term more likely where appropriate, as in novice players were more likely to struggle with portal mechanics. This is useful as a point of comparison and represents the general trends amongst the player groups rather than strict definitions.
Chapter 5. Findings

5.1 Player reflections

A player’s reflections include what they found too easy, what they found too difficult, what they found frustrating, and what they found rewarding. Each interview session opened by asking players to reflect on their gameplay session. Participants were asked to talk about their general experiences with Portal and what they thought of the game. This open-ended question to start the interview created a number of initial player reflections, but players were encouraged to share their reflections throughout the interview. Player reflections relate to RQ1.

5.1.1 Portal is too easy

All five expert players talked about Portal as being too easy. This may seem like a result of expertise, as in expert players are likely to find early stages of video games too easy. However, this is not an ideal state for any video game. Following the flow channel design principle (Csikszentmihalyi, 1990; Falstein, 2005), video games should provide meaningful challenges to all levels of players as they progress through the game. Players should never feel like the game is too easy or provides no compelling moments. Portal did not meet the needs to expert players. The most common reflection from experts was the ease of the level progression, specifically that the introductory levels were too easy and did not increase in difficulty at the right pace. No intermediate or novice players described Portal as too easy or criticized the progression of difficulty.

It went too slow in the beginning. The first couple of puzzles were like “yes I see what the block is doing I see what the buttons do let's get going”. You could have skipped me right forward to the first one I struggled on, probably, without worrying about it - P02-E
P02-E reflected that *Portal* was too easy in the early chambers and would have preferred to move to the more difficult chambers. Later in the gameplay review, P02-E made the connection between interest and difficulty. The first chamber where P02-E was challenged beyond their skill level (chamber 15) was when P02-E felt the game became interesting. Before chamber 15, P02-E finished all chambers below the average time. P02-E spent more time in chamber 15 than any other player and was not able to complete it.

I feel like it's a pretty simple game. They give you an open space and then want you to solve something algorithmically and I imagine there's a minimum amount of steps you can do in order to solve it, which would be interesting for me - P10-E

P10-E reflected that *Portal* was a simple game, one that could be more interesting with limitations on the number of steps for solving the chamber. This anticipates the challenge modes of *Portal*, designed for more experienced players. These challenge modes require players to solve chambers with less portals, less footsteps, and less time as optional goals.

I want the game to be even harder. Like if you practice it for 100 hours you'll achieve a level of mastery. That's what I'm talking about with *Portal*. I want there to be a higher challenge to get to - P14-E

P14-E reflected that they would prefer *Portal* as a space for mastery. In their interview, P14-E demonstrated a difficult game on their iPhone called *Line Bound* that required high-speed decision making and dexterity. P14-E reflected that adding these elements, like those found in a challenging arcade-style game or rhythm game, would make *Portal* a better experience.
Amongst all expert players, the most common reflection was that the difficulty level of *Portal* increased too slowly. There was a direct connection for expert players between difficulty and a sense of accomplishment. Again, this can be explained with flow theory, where the early chambers of *Portal* did not provide a level of challenge that met the expert player's level of skill. As the game became more difficult, *Portal* was able to meet the expert player's skill level. This meant that expert players were able to enjoy playing and feel a sense of accomplishment in later chambers.

### 5.1.2 *Portal* is too difficult

*Portal* was described as too difficult by six players, four novice players (P06-N, P07-N, P09-N, P13-N) and two intermediate players (P03-I, P05-I). The most common reflection was the severity of the difficulty curve, specifically that the introductory levels were too difficult. In particular, players discussed the difficulty of chamber 03.

There's a long period of time where I don't shoot my gun for a while. I was thinking - number one have I run out of bullets? Does this thing have a number of charges like not an infinite number? And number two - God this is hard! I was pretty sure it couldn't be that hard because it's only level 3 (chamber 03). I was struggling with that too. Why can't I figure this out - P03-I

During the gameplay footage review, P03-I watched a portion of their gameplay footage where they did not take many actions, but walked around and observed the area. This gameplay segment prompted the response above. P03-I was unsure about the rules of the game (how does the portal gun operate) and confused by the sudden increase in difficulty. P03-I rated their experience and confidence with both video games and first-person perspective games as “significant”. However, they were
frustrated with their inability to find the solution. P03-I also used their previous gameplay experience to assess that chamber 03 should be easier based on typical difficulty progression in video games.

The difficulty level spiked too quickly. The game didn't take me with it - P06-N

P06-N describes their perceived level of difficulty, and the inability of *Portal* to provide the appropriate guidance. P06-N decided to stop playing after 33 minutes due to this increase in difficulty.

Maybe there could be different levels [of difficulty]? It got too difficult too fast. Immediately too difficult. Who's going to buy that game unless you're already an experienced gamer - P07-N

P07-N reflected about the perceived audience of the game. They believed that *Portal* was designed for experienced gamers. The difficulty level increased too quickly for this player.

If their target is getting more casual gamers to play then they have to baby us just a little bit more. I don't think anyone reads instructions so they really don't leave much choice - P13-N

P13-N also reflected about the perceived audience of the game. They believe that *Portal* is potentially alienating to casual gamers. The difficulty of *Portal* and the lack of instructions requires the game to introduce concepts more clearly.

There are two major themes that emerge based on reflections that *Portal* is too difficult: 1. the increase in difficulty happens too quickly; 2. *Portal* is intended for experienced gamers. This is in contrast to expert players, who felt that the difficulty
curve increased too slowly. Again, this relates to flow theory where the level of
difficulty and the level of skill are subjective based on the player. What is too easy
for one player is too difficult for another, even in the early stages of an unfamiliar
game. This should not happen in an ideal game design, where all players should find
a sense of meaningful challenge, or what Meier called a series of interesting choices
(Rollings and Morris, 2001, p. 38).

5.1.3 Frustrating experiences

Frustration was a common reflection amongst all player groups, with ten participants
using the term frustration in their interview. There was an equal representation from
all player groups for frustrating experiences. What differed between player groups
was their analysis of their frustration. Novice and intermediate players tended to
attribute their frustration to their own lack of knowledge. Expert players tended to
attribute their frustration to the interface. This is similar to other findings in game
studies (Giddings and Kennedy, 2008; Hamlen, 2011; Jenson et al., 2011) where expert
players associate their frustration with interface design.

Lack of knowledge

Novice and intermediate players attributed their frustrations in Portal to their lack
of knowledge. This was reflected as not knowing how to proceed forward.

It was frustrating for the most part. I didn't know what the objective was
to the game - P01-N

P01-N articulated their frustration in relation to the game as a whole. During
the interview, P01-N was unclear about how the portals worked and expressed their
confusion about the objective of the game. This frustration was common with novice
players in particular who had difficulty evaluating the steps necessary to solve the chambers. This is reminiscent of the “unknown unknowns” conundrum - a player is unaware of what they do not know which makes it difficult for them to conceive of solutions.

[I tried] shooting the wall, which you do first out of frustration and seems like I just want to get out so I’m just going to break the wall. Instead of learning that in this world that is actually the way you build the portal. Instead of destroying the wall you’re actually building a portal - P03-I

P03-I was frustrated specifically with chamber 03. Like P01-N, P03-I was unsure about the mechanics of portals. This was a recurring theme amongst novice players. P03-I initially thought that the portal gun was a destructive device that created physical holes and created doorways. This quote exemplifies the barrier of frustration to learning the mechanics of portals. The frustration to escape the room made it difficult for the player to understand the function of portals. P03-I was able to realize this in retrospect, but was unable to understand this relationship while attempting chamber 03.

[Reviewing their gameplay footage] I just couldn't see the whole thing and I couldn't get my head around how the whole puzzle worked. If I had a map of the rooms I think I could have figured it out. That's why I spent a lot of time looking through the portal wherever it was going to try and figure out what was going on. That was frustrating to me - P05-I

P05-I was frustrated specifically with chamber 11, which the player was not able to solve. Their frustration related to their spatial awareness and puzzle comprehension. Figure 5.1 shows P05-I looking through the portal at their avatar to try and identify
the puzzle elements in chamber 11. P05-I had a difficult time breaking down chamber 11 into discrete steps. Chamber 11 is a difficult chamber, with an average time to completion at 6:22. This chamber requires 3 different phases to find the solution. P05-I's perceived lack of knowledge about the layout of the chamber was the cause of their frustration. They found it difficult to identify the different phases and attributed this to the complexity of the layout.

**Frustrations with the interface**

Expert players attributed their frustrations in *Portal* to problems with the game's interface. This was reflected as design critiques.

This is a frustration of the interface. Sometimes when you change rooms you change orientation. So I felt like if I could get in a predictable pattern
I would be able to shoot in the right spot so I could fall through the portal.
But I wasn’t confident that I could figure out how to do that. Because it
seemed arbitrary to me sometimes how you got reoriented - P02-E

P02-E reflected their frustration as a problem with avatar orientation when moving
trough portals. Their frustration referred to chamber 15, where the player is required
to make a difficult shot while falling. This skill is introduced in this chamber. P02-E
was frustrated with how a player's avatar is repositioned when transitioning between
portals. This contributed to a lack of confidence on avatar orientation required to
make the following shot. This is a problem with the game's design, and one that
remained in Portal 2.

There was definitely a few moments of frustration here where I thought
AH! It was a dual frustration where I was frustrated with my inability to
make that skill shot or inability to put the portal right where I wanted
to. It felt like it was simultaneously like the controls weren't set up for
that and I was having a hard time actually placing the shots. I couldn't
get my reticle down on the ground fast enough. And then when I did I
either placed my shot too soon or too late and it felt like a really nuanced,
ninesse thing to do. When the controls weren't necessarily set up for that
kind of thing - P08-E

Similarly, P08-E identifies their frustration as a problem with the control scheme.
P08-E reflected that the reticle of the portal gun was not agile enough to place
the portal. The controls themselves were the problem, and not designed for finesse
placements. This is partly due to the player's skill but the major factor to their
frustration was the interface itself.
Sometimes what can be frustrating with a game like that is - say I'm shooting across the level and it has to come down onto one of the pellet receptors. Wherever one of the pellet receptors lines up has the orange light so you know exactly where your portal should be. Those kind of guides - when you line things up and you don't quite get it - that can be frustrating. You've already solved the puzzle now it's just the game being finicky. If you know I'm shooting in the right area, just put it in the right spot. Stupid game. If I'm half an inch off just slide it over. Don't make me do it all over again - P11-E

P11-E was frustrated with the slippage between problem solving and the interface. They have found the correct solution to the problem and believe the game should correct for misplaced portals. P11-E specifically blames the game for this issue. They later argue that the purpose of *Portal* is experiencing new things and learning different puzzles rather than placing portals with high accuracy. This was addressed in *Portal 2*, where the hit detection of portal shots was more forgiving and did correct for those minute differences in portal placement.

### 5.1.4 Rewarding experiences

All participants were asked to share their most rewarding experience at the end of the interview session. The most common answer was the sense of accomplishment from solving each chamber. Again, expert players were distinguished from novice and intermediate players. All novice players and all except one intermediate player (P03-I) cited solving chambers as the most rewarding part of playing. Only one expert player (P08-E) mentioned puzzle solving specifically. All experts talked about specific design features and focused explicitly on those features.
Solving chambers

Solving chambers was the most common response to a player's most rewarding experience. In particular novice and intermediate players were most likely to cite solving chambers as their most rewarding experience.

For the first time in my life I could play a game like this and somewhat have fun and progress through the levels - P07-N

P07-N felt empowered playing Portal and reflected that they were able to make progress in the game. This participant previously mentioned their hesitance with playing video games and believed they had a skills gap with typical game players. This sense of accomplishment was clear in the P07-N's response.

I enjoyed the fact that I could get to the exit every time. Just realizing that things were doable. And that the progression and the way the difficulty increased. It was very well paced - P12-I

P12-I found the accomplishment of completing each chamber rewarding, knowing it was possible for them to progress through the game. They specifically mention the pacing and the progression of the chambers as part of their enjoyment.

Solving the puzzles! - P13-N

P13-N summarizes this sentiment clearly. Solving the puzzles and completing the chambers was their most rewarding experience while playing Portal.

Design features

All five expert players and one intermediate player cited specific design features as their most rewarding experience while playing Portal. Design features here account for both the gameplay design and also the interface design.
I think one of the things in particular about this game [that I enjoy] is a feel thing. It's just the way the game feels when you're moving through those momentum puzzles. Normally you move quite slow compared to other FPS's in particular. When you get that feeling, and it's quite an acceleration. I would guess that it's probably 175 or 150 per cent. It feels really good to move that fast. That's enjoyable - P08-E

P08-E specifically identified the change in player acceleration during momentum sequences, where players pick up speed to cross distances that would be otherwise unreachable. The sensation of moving quickly provided the player with a sense of immersion and was their most rewarding experience. P08-E is referring to a confluence of the gameplay design and the interface design. The increase in speed matches the sensation of moving quickly, and the gameplay requirement to move quickly to solve momentum puzzles.

In games I really really like having time to make decisions. The only real time game I play is League of Legends and I only play that because it has so much math that I feel like I can crunch numbers quickly and win no matter what. The ability to solve a puzzle on my own time and terms and then challenge myself to go faster and not have to live up to some kind of side-scrolling jumping time pressure or some other disaster in a certain amount of time. I don't know why that throws me off. Being able to have endless time is nice - P10-E

P10-E found the design feature of letting players progress at their own pace as the most rewarding part of Portal. They also compare this to other games they generally enjoy playing, which also do not have time pressure on the players. P10-E identified
a specific design decision and also compared that design decision to other games they typically play.

The mind bending physics of being able to enter a portal on one axis and then come out on a different axis. And being able to use that to your advantage, like the momentum. That was the best - P14-E

Similar to P08-E, P14-E enjoyed the momentum puzzles. They felt rewarded by using the portal affordances to manoeuvre through the game. Like the other expert players, P08-E was specific in their most rewarding experience and chose a particular game design feature.

5.2 Gameplaying practices

This section will discuss gameplaying practices, the way a player plays a game to address challenges. There are three major areas: observation and visual cues, experimental gameplaying practices, and sense-making.

5.2.1 Observations and visual cues

All players talked about their observations and the visual cues provided by Portal. There were noteworthy differences between the player groups. Novice players were more likely to have difficulty identifying relevant visual information and filtering the important visual cues from the extraneous visual cues. Intermediate players were more likely to identify specific visual cues that helped them complete chambers. Expert players were more likely to express that Portal was deliberate in providing visual cues, and sometimes these cues were too obvious.
Novice

Novices were more likely to have more identifying important visual cues in the environment. In comparison to the other player groups, novice players were more likely to have difficulty filtering information to help them solve each chamber.

Figuring out, filtering the information trying to figure out what was relevant and what wasn't is probably what I struggled with the most. Maybe being a little too suspicious. Like for example thinking - this colour ceiling tile is darker, this colour floor tile is whiter. If I shoot it something different will happen. You could spend hours if you went through the game like that - P06-N

P06-N reflected that filtering out visual information was the most challenging part of Portal. They found it difficult to identify what was critical to solving the puzzle and what was unimportant.

P07-N: Does the game give you more visual clues or less visual clues or does it vary as the levels go by?

Interviewer - I would say less.

P07-N - How could it be less visual clues than this?

This remark from P07-N was related to chamber 03. P07-N was having difficulty finding the solution and reflected that there were no visual cues provided to help the player solve the chamber. Like P06-N, this was a filtering issue. P07-N was not able to identify the appropriate cues to solve the chamber.

Interviewer - You started saying things like “I don't know what to do” and “I'm stuck”. You go down the stairs, and then you look into the pistons
and you start firing into the pistons. You said something like “I think it has something to do with the stairs or with this lift”. Can you tell me about that?

P09-N - [Reviewing their gameplay footage] Yeah. On the stairs - I thought I had something to do with the stairs because it was the thing that was the most different in that space. I felt somehow going into this space that I needed to be in that space where the pistons were, for some reason.

Interviewer - Because it looked different?

P09-N - Yeah. I thought well, going into that space must be...even here the visual of it, the glow, right? I'm in the grey space. I probably need to go to the red space.

P09-N was also having difficulty with chamber 03 - this is their description of their difficulty. P09-N reviewed a particular section of their gameplay video where they identified the wrong visual cues and fired a portal repeatedly into a non-interactive part of the level, the pistons under the stairs. These pistons are visually distinct from the rest of the grey environment. Figure 5.2 shows P09-N attempting to shoot the stairs. Portal provides a visual cue of a blue particle field to communicate that the player cannot place portals on this surface. P09-N believed that because they were visually distinct, they must be related to the solution. P09-N repeatedly fired at these stairs. Like P06-N and P07-N, P09-N had difficulty distinguishing between appropriate and inappropriate visual cues.
Intermediate

Intermediate players were more likely to identify specific visual cues, and used these observations to help them solve chambers.

[Reviewing their gameplay footage] Watch, I aim exactly at the black dot. That's what I was doing. I don't know what I was thinking. I didn't know anything yet. I didn't know that this thing goes to the thing and *makes sound effect* “berro” [referring to the pellet receptor]. I knew that whatever would go through my portal would go through the other portal... The first shot was willy nilly [an accident]. I was just a bit trigger happy. But the second one was bang on the black dot. I guess I know about them from the last level. I saw the orange light on the ceiling. Next level, orange light right on the floor. I am learning from the game - P03-I
Figure 5.3: P03-I in Chamber 07

P03-I was not fully aware of the relationship between puzzle elements but used visual cues as part of their gameplaying practice. Figure 5.3 shows P03-I lining up their reticle with the black mark from the energy pellet. They identified black marks on the wall and orange lights on the ceiling as important visual cues and placed portals on those cues. P03-I attributes this to learning from the game. The observation of visual cues is part of their gameplaying practice. P03-I was also able to anticipate the general location of the pellet before the black mark appeared, firing their first portal in the general vicinity as shown in Figure 5.3.

[Reviewing their gameplay footage] I knew to shoot right at the black dot because the last chamber had taught me that the game is using those markers. The game is doing that on purpose, putting a black mark where they hit the wall. They give you useful information... I knew I was doing
the right thing. I knew I was problem solving the puzzle. But there was also an element of fluke - P04-I

Figure 5.4: P04-I in Chamber 08

P04-I uses a similar practice, learning from previous chambers and placing portals on black marks on the wall. Figure 5.4 shows P04-I lining up the reticle with black marks on the wall after initially placing the blue portal in the wrong location. P04-I remarked that they had difficulty with aiming accuracy, saying that their correct shot was a “fluke”. P04-I identified the visual cues correctly but had difficulty with accurately placing the blue portal. This was a common experience for intermediate players who could identify important visual cues and puzzle elements but had difficulty executing their solutions.

Looking at the world was most helpful. But some of them were helpful, for example I remember the ones in the level where you use momentum.
In that one it was very helpful. The first tile tells you that you can fall from a large distance into a portal and the second tile showed the stick man travelling through the second portal with more speed. It was really helpful to understand that. To understand the steps, and break things down into steps - P12-I

![Figure 5.5: P12-I in Chamber 10](image)

P12-I is referring to floor tiles that give specific clues about the action required to solve a particular challenge. In this case, the momentum placard shows the player falling through a portal and using that momentum to move across gaps. Figure 5.5 shows P12-I stopping and looking at the floor tiles, where they remained for some time assessing the instructions. P12-I used that information as part of their problem solving, taking the visual cue from the floor tiles and following that visual cue. This helped with solving the chamber by understanding the momentum mechanic. P12-I
attributes their success with chamber 10 to breaking things down into steps.

**Expert**

Expert players were more likely to identify visual cues quickly, and in some cases identified them as too obvious. Expert players were more likely to identify visual cues effectively and implement them to help solve the challenges.

It's just signposting. It was obvious. There's so few options within that scenario that something like that just screams “that's what you're going to do”. If there were more options like for instance if the walls on this level weren't black walls they were white walls. If there were cubes. If there was something else for me to play with I might not of done that right away - P08-E

P08-E found the visual cues obvious and straightforward. They used the elements of each chamber to help them devise their strategy. If an element was not present, they would not consider it as part of their solution. This is a different level of filtering in comparison to novice and intermediate players. This also contributed the speed at which expert players were able to solve chambers in comparison to the other groups.

Any kind of focal point or attention point is obviously something you have to interact with in the game. If you assess what tools you have at your disposal - I can shoot a portal, there's a thing on the wall that is a black spot, which looks almost like a bulls eye. *spoken in robot voice* Shoot that gun right there at that bulls eye target. - P10-E

Again, P10-E found the visual cues obvious and straightforward. In this interview, P10-E seemed surprised that I was asking obvious questions about their observation
and assessment. A black mark on the wall is a bulls eye. Like P08-E, P10-E spoke of these visual cues in an abstract way, where the other participants referred to more specific instances. Figure 5.6 shows P10-E assessing the black mark and placed a portal as the energy pellet arrives. P10-E placed their portal with a high level of accuracy and speed after identifying the black mark. The blue trails on the wall in this image are the pre-cursor for the standard portal image. This was a successful shot, and a perfectly timed shot. Gameplay practices with high levels of accuracy and speed were more likely to come from expert players than the other groups.

You see cues, right? There was cues at the start of every level. You start to notice that. You keep your eyes peeled for things like that in games. There's usually some kind of a hint. It's a little bit more obvious in this game where it's more specific. Shoot one up above you and shoot
one below you and move through it [referring to the double jump tile prompts]. Cues like that - P11-E

Figure 5.7: P11-E in Chamber 15

P11-E also identified the visual cues in Portal as obvious; more obvious than other games. In Figure 5.7, P11-E assesses the prompts from the placard. These placards appear at the beginning of every chamber, outlining what elements will appear in that chamber. P11-E refers to these specifically as hints, something a player should watch for when progressing through the game. P11-E was able to identify and assess visual cues as part of their gameplay practice, specifically the double jump icon that appears second from the left on the bottom row. This quick identification of visual cues was common amongst the expert players, and less common amongst novice and intermediate players.
5.2.2 Experimental gameplaying practices

Experimental gameplaying practices are the instances when players talked about experimentation as part of their process to solve chambers. All four intermediate players discussed their experimental gameplaying practices, but neither novice nor expert players specifically mentioned experimental gameplaying practices.

It's just like this quote I heard about the light bulb. None of the precursors to the actual light bulb were mistakes. They were just 10,000 tries on the way to the light bulb. That's what I was playing with here. How does this work, where does this go, where does this shoot, etc. - P03-I

P03-I is specifically discussing the challenges they had solving chamber 03. While working through chamber 03, P03-I spent 20 minutes trying out different ways to solve the chamber including firing portals at cameras, moving back to the beginning of the level, putting the camera in an infinite portal loop, and other gameplaying practices that they believed would trigger some kind of alarm. P03-I described this as exploratory, trying to figure out how the portal works, how the environment works, and how they can interact with the game.

At first it was frustrating because I had no where to shoot other than the places I had shot already. No I was testing. I was doing experiments - P04-I

P04-I is discussing their experimental process. Like P03-I they were stuck on chamber 03 initially and used that time as an opportunity to learn the affordances of portals. This experimental gameplaying practice involved placing portals on different surfaces, sometimes repeatedly, to test how portals behave in the game. P04-I specifically describes this as testing and experiments.
That's why quite a few times I think I would just shoot and see what happens. Like shooting on the metal part, figuring that you can't go through it. Shooting at other things just to see what would happen -

P05-I

P05-I is discussing their exploration with portal affordances. Again, this is in reference to chamber 03. Like P04-I, they are attempting to place portals on a number of different surfaces to see what will happen. P05-I learns from those misplaced portals, testing out which surfaces work and do not work. This helps them progress through chamber 03, exploring the chamber and finding out how to interact effectively with portals.

5.2.3 Sense-making

Sense-making is a theory of how people make sense of their world (Dervin et al., 2003; Naumer et al., 2008; Savolainen, 2007). According to Dervin, people move through space and time until reaching a cognitive gap (Dervin et al., 2003). When reaching this gap, people must address this cognitive gap, or make sense of the situation. This process is called bridging the gap. Sense-making is used in information studies research as a way to understand how people bridge their cognitive gaps, how they make sense of situations. In this study, sense-making refers to how players make sense of Portal.

Sense-making took different forms within each player group. Novice players were more likely to have difficulty bridging their cognitive gaps, often feeling overwhelmed or unsure. Intermediate players were more likely to have specific strategies for bridging the gap, borrowing techniques they have used before. Expert players were more likely to make sense of the situations based on the information provided by the game and
their previous experience.

**Novice players**

Novice players were more likely to have difficulty bridging their cognitive gaps. Their sense-making process did not provide them with effective solutions. Instead, players reflected that they felt overwhelmed, lost, or unsure of their gameplaying practices.

> When I go into the level I don't know where I'm going to make a portal. So I'll just shoot random portals just to see where I go or what I see or where it's going to drop me. And so I think that's where the chance is... when I from the get-go the portal that I'm going to make isn't something that's thought out it's just I walk into a room and then I just blow a hole into the wall anywhere. And from there we'll see what happens - P01-N

P01-N used a random and unstructured approach to sense-making. When starting a new chamber, P01-N placed random portals in an attempt to understand what was happening. They used the language of destruction, thinking that the portal destroys walls instead of creating a short cut between two places. This was a common reflection amongst novice players - just see what happens.

**Interviewer** - I want to go to one of the places were you got stuck. And you had been firing portals in what I thought were very direct places. And then you said “well I'm just going to start blowing holes in things”. What shifted for you from going from a methodical, patient surveying to this approach?

**P06-N** - I guess just frustration that it didn't seem to be paying off, at all, by my methodical approach. Then I started to doubt myself and
thought the methodical approach wasn't going to work, so I might as well just randomly shoot. I felt like I was just missing something, missing whatever it was that was telling me where I should be putting a portal. I thought maybe I'd get lucky if I just shot

P06-N decided to change their sense-making from a methodical approach, which involved taking their time and trying to identify all the possible variables of the puzzle, to a random approach, which involved shooting portals everywhere. P06-N attributed this change to feeling like they were missing something. However, the random approach was not effective either. P06-N was unable to complete chamber 03 and attributed this to missing something that Portal was attempting to communicate. Their sense-making process did not provide them with an effective solution. P06-N felt unsure of their approach, and also that they were missing key information.

Intermediate players

Intermediate players were more likely to have specific sense-making strategies. They borrowed techniques from other video games they played and had a clearer sense of how they were proceeding forward.

Interviewer - There was a point where you said “can I take a screen shot of this please?” The placard pops up, and you stop and look at it and tell me “can I take a screen shot of this?” Can you tell me what you were thinking about here?

P05-I - I have done that before. Sometimes in World of Warcraft when I need to make a decision as to a certain skill that I want to learn when I have some options, I research it as to what other players have done because all skills have some benefits to them but what other people have
found the most useful. I use that for research and I think that because I've done that or because I know I can do that, screen shots. And, I like to reference things. Just in case I was going to step away from this - if I had a copy of it I could review it and compare it to other situations. [makes a gesture of having the screen shot printed out beside the computer]

Figure 5.8: P05-I in Chamber 08

P05-I referred to a specific technique they use when playing World of Warcraft - screen shots. They have used screen shots to help them make decisions in unfamiliar situations. They researched the techniques from other players and use their own screen shots as a reference. While they did not use this tactic specifically while playing Portal, P05-I drew on their previous experience to help bridge the gap. They went on to describe taking mental note of the placard at the beginning of each chamber, which outlines what kinds of obstacles a player will face in a particular chamber. Figure 5.8
is the moment where P05-I asked to take a screenshot of the placard, which outlines that this chamber will include energy pellets, pellet receptors, and deadly water.

Interviewer - So in your style of problem solving, you want to have all of the rules figured out before you take the action.

P12-I - Yes. I feel more comfortable if I have that. I'm used to taking time to understand the new rule set.

P12-I has a similar strategy, taking note of the rules before taking a specific action. Their sense-making process involved learning and understanding the new rule set. In each chamber, P12-I surveyed each element of the puzzle before proceeding forward. They were methodical in assessing the chamber before taking any actions. Their sense-making process involved careful observation and consideration. P12-I also referenced *God of War* and *Tetris* as other video games where this sense-making strategy was effective.

**Expert players**

Expert players were more likely to make sense of the situations based on the information provided by the game and their previous experience. They attributed their sense-making process to understanding the intentions of the developers. Expert players were more likely to attribute sense-making challenges to their own shortcomings. Delays in their sense-making process were do to their own error, like not recognizing a particular element within the chamber.

As an experienced gamer you have some faith in the designer. It's a failure in you and not a failure in the design. So you've missed something that they've tried to give you. Now as the game goes on a good game you'd
gain more faith and a bad game you'd lose faith. But in a game like this you have faith that the game will show you how to do what you need to do - P02-E

Sense-making for P02-E involved following the direction of the developer. They believe that *Portal* is a good game in terms of design, which gives them confidence that the developer will provide them with the necessary information. Sense-making in this scenario involves observing the environment and following the instructions of the game. This is a streamlined sense-making process in comparison to novice and intermediate players. P02-E feels confident they can solve a chamber by identifying the appropriate elements provided by the game.

I know that they are trying to do fancy stuff with onboarding to teach you as you play the game. There were some parts where I thought “what do I do here?” but maybe if I was more observant or looking around a bit more I would have pieced it together...It's a lot like the other types of games that I play where you have to observe your surroundings, make the best decision based on the tools that you're given - P10-E

P10-E had a similar sense-making process to P02-E. By following the direction of the game, P10-E felt confident they can bridge any cognitive gaps. If there are any parts that seem unclear, P10-E attributed that to something they have missed. Observing their surroundings and making the best decision based on the tools provided should result in a completed chamber.
5.3 Previous gameplay experience

Previous gameplay experience are instances where players made specific references to their gameplay history. Players frequently made comparisons with Portal and other games they have previously played, as well as with similar genres. Players also talked about specific gameplay practices, that is skills, techniques, or knowledge from other games that they used in Portal. Players also talked about the shared semiotics between Portal and other games.

5.3.1 Comparisons to other games

Players from all groups compared Portal with other games. The most frequently mentioned game was Myst with four players making direct comparisons. Other comparisons included Diablo (P03-I and P11-E), Fez (P08-E), God of War (P12-I), Monument Valley (P14-E), Perfect Dark (P10-E), Prince of Persia (P12-I), Super Mario World (P04-I, P06-N, and P07-N) Tetris (P09-N), and Tower Madness (P14-E).

Puzzle game similarities

Puzzle games were the most common comparison, with seven players from all player groups comparing Portal to puzzle games. Myst was the most frequently mentioned puzzle game. Out of the four players who discussed Myst, three were novice players (P01-N, P06-N, P09-N) and one was an intermediate player (P12-I).

It reminded me a little of Myst. How old is that game? 15 years old? I played it when I was a kid. In terms of feeling like you could just walk around in circles all day, touch everything in the room and still not be able to figure it out. And having no idea what's going on - P06-N
P06-N made comparisons to *Myst* and the difficulty of the puzzles. In both games, P06-N found it difficult to understand what to do. They felt like they were walking around in circles. This alludes to the sense of confusion in *Myst*, being unable to identify what was and what was not relevant to the solution.

I played *Myst*. It's exactly that. You have to look in the book or do that one thing so something would happen. I tried that. Shooting certain things like the cameras, thinking maybe that's the switch or that's what breaks the code. Or shoot the window of the control room - P09-N

Similar to P06-N, P09-N made comparisons to *Myst* and the difficulty in identifying what was and what was not relevant to the solution. P09-N spent 10 minutes in chamber 03 attempting to find a hidden solution. They attempted to place portals on cameras, windows, and pistons thinking they would unlock a hidden door. This hidden solution is a common mechanic in *Myst*, but does not appear in *Portal*.

*Monument Valley*, it's a game of geometric impossibilities. It has similar ways of modifying a puzzle to come out a door in a mind bending geometrical way. You've seen that triangle that's an impossibility, you could walk around on it kind of thing. There's a lot of instances where you need to slide blocks and use those impossibilities to your advantage. So you need to think 2 or 3 steps ahead in that way - P14-E

P14-E made reference to *Monument Valley*, a spatial awareness puzzle game for designed for mobile devices. This was the only comparison to puzzle games with a positive connotation. *Monument Valley* helped P14-E to think ahead when planning their portal placements. The comparisons to *Myst* emphasized a high level of difficulty and confusion. P14-E credited *Monument Valley* with helping them understand spatial puzzles.
Platform games and adventure games

The other genres mentioned were platform games and adventure games. Five players representing all player groups compared *Portal* with these two genres (P04-I, P06-N, P08-E, P12-I, P13-N).

There are similarities that I see even with *Super Mario World*. In the basic sense of one level gets harder. The levels just get harder. You have to figure out from level to level what the parameters of the tools that you get, and the parameters of the enemies that you get. Because my database of games is not that deep in my brain that's all I really have to compare it to - P04-I

P04-I draws comparisons between *Portal* and *Super Mario World* based on their difficulty curve. As a player progresses through each game, the difficulty increases and the player is required to learn and implement new skills. Chambers and levels become more complex and require different approaches.

I played *Fez* a few years ago or other games where there's a solution, typically it's one solution, and you just have to experiment with the objects you can interact with enough until you find that solution - P08-E

Similar to P04-I, P08-E compares *Portal* and *Fez* at a meta-level. *Fez* similarly has complex puzzles that require specific solutions. Players must experiment with the objects provided in each instance to find that solution, not unlike completing a chamber.

*Prince of Persia* and *God of War*. All those adventure games that make you learn about the space that you're in but also make some decisions that would open the world for you - P12-I
P12-I continues this trend of meta-level analysis by comparing games based on spatial awareness and decision making. In all three games, players must learn about a particular space in order to identify the correct solution. This is another meta-level analysis, identifying the broad similarities between the two genres.

First-person shooter games

While some players did talk about *Portal* as a first person shooter, only one player made direct comparisons to specific first-person shooter games. The absence of comparisons with other first-person shooter is noteworthy.

Everyone's had this where they go to a friend's house and they play *Perfect Dark* or *Goldeneye 007* on Nintendo 64 and then they say “how do I turn a different direction or travel a different direction” or have the camera aligned somewhere strange and start walking sideways. Those kind of things always throw me off - P10-E

P10-E draws comparisons with other first-person shooters as sites of confusion or disorientation. They do not make comparisons based on the mechanics but rather the challenge of interacting with the first-person perspective. The camera and the dual joysticks are the points of comparison. P10-E also compares *Portal* to the first-person shooter *Borderlands* which will be discussed in the next section on gameplaying practices from other games.

5.3.2 Gameplaying practices from first-person shooters

Gameplaying practices from other games are specific techniques, skills, or knowledge that players report having acquired from other games. Players discussed specific gameplaying practices from first-person shooter games. While first-person shooters
were notably absent from specific comparisons, several players talked about the similarities with first-person shooters as a whole. All five players who made connections between first-person shooters and *Portal* were from the expert group.

> It's a tremendous advantage for me to be comfortable with the controller, to be comfortable in general with pointing and shooting at things. I think the mechanics of falling through and gaining speed is new and so I struggled with that as you saw. But beyond that anything that required just pointing and shooting, which is the majority of the games that I play, it was a huge advantage to have - P02-E

P02-E has significant experience playing first-person shooter games based on their demographic profile, where they rated their experience and confidence with first-person shooters as “significant experience” and “significant confidence”. They cited their experience with first-person shooter controls and mechanics as a tremendous advantage. P02-E contrasts this comfort with standard first-person shooter mechanics with their discomfort with the new momentum mechanics introduced in *Portal*. This points towards a larger trend of players being uncomfortable with unfamiliar mechanics.

> It's a lot like the other types of games that I play where you have to observe your surroundings, make the best decision based on the tools that you're given, etc etc. Strategy. First person perspective just throws me off because I never playing first person games. I think the only first person perspective game I've ever played is *Borderlands* because I like the art style - P10-E

Continuing with the trend of discomfort with unfamiliar mechanics, P10-E does
not normally play first-person shooter games. The familiar first-person shooter conventions were a hinderance to P10-E. There were similar visual elements where players observe their surroundings to make the best decision. The controls and the camera perspective were a barrier in this instance, despite P10-E's familiarity with Borderlands.

It feels the same. The control system and all that. Moving around. It's still a first person shooter - P11-E

P11-E rated their experience and confidence with first-person shooters as “significant experience” and “significant confidence”. The similar feel from the standard first-person shooter mechanics made it easier for P11-E to move in the game. P11-E classified Portal as a first-person shooter.

5.3.3 Semiotics of games

Returning to the concept of affinity groups, Gee argues that affinity groups share a semiotic core. Words, symbols, images, and artifacts take on a situated meaning based on the shared semiotic core of an affinity group. Learning in any domain involves how people build meaning from that semiotic core and how that core relates back to the domain. For video games, this semiotic core is the language of a particular game or a particular genre. This section will discuss the language of Portal as interpreted by the players.

Comprehending the semiotics of Portal

Three players discussed their successes with the semiotics of Portal. Two of these players were categorized as experts, one player was categorized as intermediate.
How did I know to hit the orange thing? It's the same answer to when I'm playing adventure games with someone who isn't good at games. How did you know to click on that thing? You just know. It looks different. It looks like something that you should do something with. And in a visual medium like video games you need to be really on on your visual language. And when people mess with the visual language it's really annoying. It's the same with controls like when the controls are sloppy, the control is not doing what I'm telling it to do. It's betraying my confidence in the whole game - P02-E

P02-E was asked how they were able to distinguish visual cues in Portal, specifically the orange light from the pellet receptors. They responded that they just know. It looks different. They attribute this knowledge to their experience with the visual language of video games. They also expressed frustration when developers alter this visual language. Their experience within the semiotic domain is invalidated when developers change the visual language, in the same way a developer might change the control scheme. P02-E makes the connection between the semiotic domain and enjoyment, and games that follow the standard video game language are more enjoyable than those that do not.

Like I said about game design and game designers, nothing is arbitrary. Because at that stage in the game my options are so limited. I only have the only portal to use. There's nothing else in the room for me to do. I could maybe try to shoot the receptacle for the energy ball but I already know from a few levels that the walls are the only interactive part for the portal gun - P08-E

P08-E draws a connection between the semiotic domain and the design process.
They reflected that nothing is arbitrary in a video game. All objects have a purpose, and this purpose is clearer in *Portal* because the options are limited. In this instance, P08-E was discussing chamber 06, where the player directs an energy pellet into a pellet receptor using the blue portal. The orange portal is still static at this point in the game. P08-E has understood the semiotic domain of *Portal* at this stage, understanding how the portal works and using the visual cues in each level to their advantage.

Figuring out the cues or clues on how to proceed was also learning to read the game's language. The instructions in the game. Like the icons that you see in each level...You discover everything so that you're not being told. That's really cool - P12-I

P12-I has a similar reflection to P09-N: the semiotic domain of *Portal* is a learning process. Learning to read the language of *Portal* provides the instructions to play effectively. This is a discovery learning process. *Portal* does not explicitly tell you how to solve a particular chamber but provides the appropriate semiotic clues to help the player. For P12-I, this contributed to their sense of fun.

**Trying to understand the semiotics of *Portal***

Some players discussed their struggles with understanding the semiotics of *Portal*. They found it difficult to understand what *Portal* was trying to communicate. Two of these players were novices and one was intermediate (P04-I, P06-N, P09-N).

Looking at this in hindsight, I see the ceiling has this jutted bit. If I was a master gamer, this is all in hindsight, but if I was a master gamer I would have just looked at that and seen my first shot should be at the jutted part - P04-I
P04-I made this comment while reviewing their gameplay footage. They were commenting on a specific instance in chamber 12 where Portal introduces momentum jumping. In this instance, the player is provided with a visual cue to place a portal on a specific tile above them. In Figure 5.9, P04-I recognizes this in hindsight as a “jutted bit” indicated by their reticle. They reflected that if they were a master gamer, that is if they understood the semiotics of the puzzle, they would place a portal on that particular tile. P04-I was able to recognize this semiotic cue while reviewing the gameplay footage but did not understand this cue for several minutes during their gameplay session.

I don't feel confident that I'm able to quickly pick out what matters and what doesn't especially in a new game, I don't have the eye for that, so I sort of feel like I have to look at everything. Because I'm not good at
filtering the information - P06-N

P06-N had difficulty understanding the semiotics of Portal, and reflected that they generally find it difficult to understand the semiotics of video games. They did not feel confident that they can identify the important information from unimportant information, particularly in new games. P06-N specifically identifies the visual semiotic domain as their most substantial barrier, where their eye is not able to distinguish clues. In this particular instance, referring to their experience in chamber 03, this made it difficult for the player to understand the complexity of the puzzle. They were looking for a hidden solution, trying to knock cameras off the wall, identify different coloured tiles, and access the pistons under the raised platform.

It came to me much more slowly than it probably should have. You feel that way later, like I could have got through those levels better if I knew what that meant...Even if there aren't a ton of clues, as you go from level to level you accumulate things so I think you read the space much more quickly at the higher levels. That's part of the process, you're learning about the clues - P09-N

P09-N identifies their difficulty with comprehension as understanding the language of clues. Learning how to play Portal is learning how to identify important information. P09-N uses the term “read the space”. The inability to read the space and comprehend the clues makes Portal more difficult for P09-N, who uses the phrase “it came to me much more slowly than it probably should have”.
5.4 Challenges in Portal

Challenges are instances in the game that a player found difficult. What a player finds challenging is subjective. This section discusses different players and what they found challenging, and how they describe these challenges.

5.4.1 Different players, different challenges

Players were asked what part of Portal they found most challenging. Different players found different parts of the game challenging. Within the player groups, some trends did emerge. Novice players found it difficult to understand the portal mechanics. Players expressed their confusion, particularly with learning how the portal operates. Novice players were more likely to talk about being unsure, unclear, or uncertain about how to play. Intermediate players were more varied in what they found most challenging. The responses included spatial awareness, portal mechanics, and puzzle comprehension. Expert players were similarly disparate but the most common theme was time pressure, where the game required players to make quick decisions. Other expert players talked about the interface as the site of challenge.

Novice players

Novice players found portal mechanics the most challenging. They had difficulty understanding how portals work, specifically how portals create pathways for players. This is clearest in chamber 03, the first instance where a player is required to apply their conceptual knowledge of portal as game mechanic. All the comments from novice players in this section refer specifically to chamber 03.

I think [chamber 03] where I didn't quite figure out all of the mechanics.

So that took probably the longest. Where I figured out you could shoot
to the other side that one was the most challenging because I was still trying to figure out what I was supposed to do - P01-N

P01-N found it challenging to understand the mechanics of portals. In particular, P01-N did not understand that portals could be placed from long distances, which they describe as shooting to the other side. In these early levels, the mechanics of portals and the steps to complete the chamber are closely connected. These early levels are designed to help players learn about the function of portals and simplify the challenges to help players grasp these concepts. This means the mechanics of the portal and the path the player must take are nearly identical.

Understanding what this game wanted from me in chamber 03. Understanding that I physically didn't have to get over there and that I could create with my gun. It did tell me in the audio what this thing was, a portal maker thing, that I could make a portal - P07-N

Similarly, P07-N found the purpose of chamber 03 challenging. They did not understand what the game wanted them to accomplish. P07-N also made particular note of the audio clues provided by the game, but the concept of the portal gun was unclear. P07-N did not understand how to create portals effectively. Again, the mechanics of the portal and the path the player must take are nearly identical, but this does not ensure that the player will understand either.

The beginning was the hardest part. Just figuring out the portal concept - P13-N

P13-N is referring to chamber 03 and the challenge of understanding portals conceptually. Portals present a new paradigm for players, one they were not likely to
encounter in previous gameplay experiences. For novice players, this is the most challenging aspect of the game. The portal metaphor and portal mechanics were a challenge for novice players.

**Intermediate players**

Intermediate players found puzzle comprehension most challenging, specifically as the level of difficulty increased. Intermediate players referred to the furthest chamber they reached as their most challenging instance.

Interviewer - What do you think was the most challenging part of the game for you?

P04-I - The last challenge, the last level...It was difficult for me.

P04-I did not go into detail about what they found challenging about their last chamber. Based on the observations of their gameplay footage, P04-I found it difficult to isolate the specific steps required to proceed. They were repeating the same steps in the sequence without proceeding forward. I would conclude that P04-I was confused by the number of elements in this particular chamber. The number of steps required to solve this chamber made puzzle comprehension difficult.

I think when the puzzles got more complex because you have to put it all together. The first few steps obviously were very challenging because you didn't know what to expect, but at the same time they were simple and fairly easy to figure out. When it got more complex it was too many things to juggle...But at the same time that's what makes these kind of puzzles very fun to do, because once you figure it out you feel like a genius.

- P05-I
P05-I found puzzle comprehension in their last chamber most challenging. Specifically, P05-I refers to the increasing complexity of later chambers and identifying the appropriate steps. Earlier chambers presented new concepts but the combination of these concepts into a more complex arrangement was the most challenging part.

Interviewer - What was the most challenging part of the game for you?

P12-I - The last levels that I played. There were different types of momentum that I could grab. That was really hard for me. Just realizing that you can use different momentum. Also discovering surfaces for momentum. And realizing that you could do different instances to go higher.

Climbing levels using momentum

P12-I similarly struggled with puzzle comprehension. They found it difficult to distinguish between the different momentum jumps required to solve the chamber. This particular chamber was difficult for all intermediate players, who all took longer than average to complete.

Expert players

Expert players had more diverse opinions on what was most challenging. The most common theme was time pressure, where the game required players to make quick decisions. Other expert players talked about the interface as the site of challenge, which will be discussed more in the following section - Learning in Portal. This section will focus on the time pressure.

I felt like I was getting my dexterity with the controller and figuring out the mechanics of the game. Things were getting more challenging. You had to make quick decisions as you stepped out of the portal. Instead of
being able to set up your shot there was pressure and this and that. OK you've got half a second to shoot another portal in the right spot. You're working on your precision - P11-E

P11-E describes the instances requiring quick thinking and precision as the most challenging part of Portal. Once they grasped the mechanics and the controller, they were required to make quick decisions and accurate shots. The majority of Portal allows the player to take their time and assess a situation if they choose to. These later chambers require quick decisions, which is reminiscent of other first-person shooter games.

Any time that I was put under [time] pressure. The platform moving, the turrets at the end...Most of the game you weren't under pressure - P14-E

P14-E also talked about time pressure when asked about their most challenging instance. They refer to any instance involving quick decisions. Because P14-E progressed the furthest, they were the only player to encounter turrets in chamber 16. These turrets require quick decisions and accurate portal placement, or they will kill the player. P14-E also reflects that these time pressures are not present in the rest of the game. If novice players were to encounter these later chambers, they may have similar reflections.

5.4.2 Description of challenges

Similar to how different players found different challenges, players described challenges in diverse ways. Two major themes emerged for players describing challenges: 1. time to make decisions; 2. no punishment for mistakes. While many players found Portal difficult or frustrating, their description of challenges in Portal was generally
positive. Players praised the freedom in *Portal* to take their time and to fail without consequences.

**Time to make decisions**

Players from all groups commented on the lack of time pressure in the early levels of *Portal*. In the majority of chambers, players have as much time as they need to make decisions. Only in later levels does *Portal* introduce quick decisions. These levels were only reached by expert players. When talking about challenges, players commented that the lack of time pressure was preferable to other games, particularly faster-paced games like first-person shooters.

I liked that it's just you in a room until you figure it out. It's not a lot of other external factors. Either beyond your control or pressuring you. It's almost a feeling of anxiety where you're playing a game with a time either because it's because like a shooter game because someone's going to kill you or it's like a timed part of it or whatever and you have to get it done before the time runs out. It's nice to have it open ended and be able to play with it as much as you want at your own pace - P06-N

P06-N compared the rules of *Portal* with other first-person shooter games. They preferred the player-determined pace and the emphasis on the puzzle. While P06-N found *Portal* challenging, they preferred this type of challenge versus an anxious type of challenge.

If the game allows it then I'll take my time. It's a puzzle so you think about it...I'm not in a rush and there's no benefit to rushing. Just pick your spots - P11-E
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P11-E similarly reflects that Portal allows the player to take their time. There is no reason to rush through the puzzle. The player is allowed to assess the situation and choose the appropriate way forward. This quote is noteworthy for recognizing the affordances of the game itself. Because Portal allows for a slower approach, the player uses that to their advantage.

I was going to walk into a game that was more like 3-2-1! You're in a zone! You're time pressured! I didn't know. That's how it feels at the beginning. But portal has less of that pressure...I think most games have a lot more pressure...This one I didn't feel as much pressure - P13-N

P13-N uses the term pressure. They compare Portal to other games based on this sense of pressure. They were expecting something similar to an arcade game where players have to make quick decisions and complete a specific task within a small time frame. Like P06-N, P13-N found portions of their gameplay session challenging, but the challenge was in puzzle comprehension.

No punishments for mistakes

Players from all player groups talked about how Portal does not punish players for making mistakes. There are several ways that games punish players: 1. returning them to the beginning of a particular section or level; 2. taking away player resources such as in-game currency, or lives, or special abilities; 3. taking away points or achievements; 4. ending the game (Juul, 2009). Portal does not use any of these forms of punishment. Player progress is saved with each step solved, players do not have in-game currency or lives, players do not have in-game points or achievements, and players always remain in the game. While the puzzles can be difficult, players are never punished in their attempts to solve the puzzles.
I think it's one of those things like “grind it 'til you find it”. It wouldn't have so many obstacles if you weren't expected to die a couple of times.

There's no punishment for death - P10-E

P10-E recognized the freedom to die without punishment. Borrowing from role playing game language, they use the term “grind it 'til you find it”, or keep playing until you get there. P10-E makes an interesting connection between the difficulty level of Portal and the lack of punishment. Because the puzzles are hard to solve, Portal does not punish players for making mistakes.

P12-I - In general, I love the fact that it's very evident that you're being tested. Every game is a test, in a way. At least for the player. I think you're testing yourself. To put the attention of being tested in the game. You're in a lab. It takes the off burden, a little bit, of you doing the right thing.

Interviewer - There's something I really like that you said during your gameplay session - “being in the testing environment gave me more license to let me do what I wanted to do.”

P12-I - Yeah! And to make mistakes.

Interviewer - So you felt that the game world was encouraging you to make mistakes and to explore?

P12-I - Yes.

P12-I had a unique observation about the Aperture Labs environment as a safe environment. Because Portal thematizes testing and testing environments, P12-I felt a freedom to explore. They felt encouraged to make mistakes without negative consequences.
It's a very fluid environment. There's no penalty for executing what you're thinking. So I just tried this and tried that. You work through your own hypothesis of what it is very quickly and then you just execute it - P14-E

P14-E used this freedom to make mistakes as a gameplaying practice. They created hypotheses of what they thought would work and tried those different hypotheses. This also allowed P14-E to progress the furthest of all the players. They were willing to try new approaches when faced with unfamiliar obstacles.

### 5.5 Learning in Portal

Learning in Portal covers instances where players talked about their learning process. This discusses both the successes and shortcomings of Portal as a learning environment. Players talked about their experiences with tutorials, scaffolding, learning the portal mechanic, and experience with the interface.

#### 5.5.1 Tutorials

Most modern first-person perspective video games have introductory sections called tutorials that teach players how to play a game. These are usually incremental, taking players through the range of actions they can perform in the game and showing players how to perform those actions sequentially. Portal is different from this model. There is no specific tutorial level in Portal. Players are asked immediately to solve puzzles. There are some minor on-screen prompts to help players identify the appropriate buttons but this is minimal when compared to other modern first-person perspective video games. Some players felt that there was not a specific tutorial, or that the tutorial did not provide sufficient instruction. Other players felt that the minimalist
tutorial was effective.

**Tutorial was ineffective**

P01-N - There's no hand holding in this game. Tower Madness doesn't allow you to be confused because it explains what every step is. So if there's a new weapon that's unlocked it explains exactly what it does.

Interviewer - So you think *Portal* doesn't explain or did a bad job of explaining?

P01-N - I think doesn't explain.

Interviewer - What didn't *Portal* explain to you?

P01-N - I think - how to get to the objective. The voiceover did say you have to go through the doors, or whatever. In a more what I call “hand holdy” game I would say that there would be almost like a tutorial level where it's “you shoot this portal and you walk through the portal and this portal takes you here and you can shoot through this portal and that portal will drop you in through the ceiling” that kind of thing. While this one is just - I'm in the room.

P01-N draws a specific comparison with Tower Madness, a tower defence game with a detailed tutorial. They refer to games with more detailed tutorials as “hand holdy” games, where the game methodically instructs the player. P01-N outlines what they believe would be a methodical tutorial for portal, instructing the player on how the portal works, where the portal can be placed, or how the portal can be used. In contrast, P01-N classifies *Portal* as not having a tutorial. The player is simply in the room.
P03-I - I understand the concept of a portal so that part made sense. But obviously it doesn't instruct you or walk you through it. Most games now a days hold your hand and tell you what to do.

Interviewer - So you don't think there's a tutorial for this game?

P03-I - I didn't find it held your hand like a lot of games would. Navi didn't pop up

P03-I also uses the term “hold your hand” in reference to tutorials in other games. They make a specific reference to *The Legend of Zelda: Ocarina of Time* and the character Navi. While these games are from different eras and different genres, Navi is an iconic character for player assistance. If a player is stuck, they can ask Navi for a clue. P03-I makes a specific comparison between *Portal* and “a lot of other games”, contrasting the instructions provided by *Portal* to other video games.

Maybe if it gave you the option at least to have a hint. If you are the person who just wants to figure it out no matter how long it takes you could. But if you're a person who spent 25 minutes in there and you're in danger of quitting the game you had the option to say “hey give me a hint why I can't figure this out” - P06-N

P06-N was asked if there was anything they would like to change about the game. They responded that an option for hints would be helpful, particularly if a player was stuck. P06-N was stuck on chamber 03 because they were unclear about portal mechanics. If they were provided with a hint, specifically around how the blue and orange portals operated, they would have been able to proceed. P06-N is suggesting that an improved tutorial structure, like a hint system, would have helped in this instance.
Two other participants provided succinct answers regarding tutorials and instruction. When asked if the game made it clear what you were supposed to do, intermediate player P05-I replied “I had no clue what I was supposed to do” and novice P07-N replied “Never. Not once. That was the worst part. It was confusing”.

Tutorial was effective

Other players from the intermediate and expert groups thought that Portal provided an effective tutorial. These players reflected that the minimalist tutorial was appropriate for Portal.

I think that was the appropriate amount of tutorial. I suppose having an option to skip ahead would be nice but you also need to know things like what the weighted cubes were for. There may be a middle ground there and maybe your first puzzle contains four of those elements of those elements you need to learn rather than one at a time but overall I think it's pretty good - P02-E

P02-E said that this minimalist tutorial was appropriate, even suggesting an option to skip ahead or combine multiple elements in the initial chambers.

I had to figure that out myself, which I love. I feel that the only reason that it became intrinsically motivating is because I wasn't told how to think. When I figured out that first one and I got excited to onto the next one, it's because I did that. Fully. The video game wasn't telling me something that I could then resent it's rules. That sounds really too much or something. Because you're just put there without any instructions - they don't tell you - P04-I
P04-I said that the minimalist tutorial required them to figure out the game themselves. This provided intrinsic motivation for P04-I. They reflected that no instructions were provided, the player was required to find out on their own.

I didn't realize I was playing the game right off the bat. When I got in there I was looking around and I was expecting an intro or a tutorial or something and then you realize you're stuck in a room, better start poking around and figuring things out. But it's cool. Once you got out. It was pretty interesting because you could see how they built in the layers, so to speak - P11-E

P11-E said that they were expecting a tutorial or introduction. They were not expecting the game to start immediately. P11-E thought that the game progressed effectively, providing layers for the player to learn and use those layers as they proceed forward.

5.5.2 Scaffolding

Scaffolding, or support in key areas, allows learners to go beyond what they would be able to achieve on their own with the help of a more knowledgeable other, such as a teacher or skilled peer (Vygotsky, 1978). This metaphor has been extended to include technological artifacts, particularly those found in software (Sherin et al., 2004). The same principle applies to Portal. By teaching players portal-related skills in an incremental process, Portal scaffolds the complex skills needed to complete the game. Players from all groups talked about the scaffolding in Portal. Players reflected that concepts build on each other, with skills from the previous chamber being applied in subsequent chambers.
Interviewer - When you fall into this hole you said “we took the lesson we just learned!”

P04-I - I think at that point, once I knew that I could just put myself where I needed to be, create the portal where I wanted to come out, as from learning from the previous challenge, that's how I solve a challenge, or how I won. I realized that they taught me that and now I can just do it

P04-I reflected positively when falling into the hole and said “we took the lesson we just learned!” emphatically. They talked about how the skills learned in previous challenges provided them with all the necessary skills to succeed.

Interviewer - At one point you said “we will teach you this one concept. Now use this concept. Now here's another concept.” You were very quickly picking up the concepts and then putting them all together. Is that something you're generally good at in games or was Portal really good at showing the concepts?

P10-E - I think this is actually a computing science thing. They do it a lot in games but it's not done very well in games. Portal is one of the first games that actually harnesses the concept and uses it in it's full way. From my experience anyway, with a lot of games that I play

P10-E provided a meta-level answer, attributing their understanding of scaffolding to their background in computing science. They said that other games do not effectively provide scaffolding for players, but Portal uses this technique effectively. In a previous answer, P10-E talked about the onboarding and how Portal was providing instruction to players in novel and structured ways.
Every level challenges you a little bit more. As soon as you learned one trick it was almost a given that that wasn't going to work on the next one. Or you were going to used that but you were also going to have to learn something new. Every level presented a new challenge and you learned a new technique, so to speak. Which is nice for evolution. You don't want a game where you're doing the same thing over and over in a different level or a different spot. You have to do things differently each time - P11-E

P11-E attributes part of the enjoyment of their gameplay session to this scaffolding. As the chambers progress, the game becomes more difficult and asks players to apply previously learned concepts in novel ways.

P01-N, 05, and 07 had similar reflections (listed respectively): “forcing me to do tasks made things clearer”, “it definitely grows on itself. I like that kind of stuff because it feels like you’ve learned something useful” and “it makes you feel like you’re building on previous concepts”.

### 5.5.3 Learning the portal mechanic

Half of the players in this study had difficulty understanding the portal mechanic. They found it difficult to understand the relationship between the blue portal and the orange portal, specifically entering one portal allows the player to exit the other portal. All of the novice players struggled with the portal mechanic, along with two intermediate players. There were no expert players who were confused with the portal mechanic. Understanding the portal mechanic is essential for completing chambers.

Interviewer - At what point did it become clear to you that you had to walk through the orange portal instead of the blue portal to get to the other side?
P01-N - I still did not know that I had to do that

When watching the gameplay footage from chamber 03, P01-N was still unclear about the portal mechanic. They were unable to understand the relationship between the blue portal and orange portal.

I suppose that's what I didn't know was how to make the portal work for me. I could see that it was staying open but I couldn't tell how that was helping me - P06-N

P06-N was also confused by the blue and orange relationship when reviewing gameplay footage from chamber 03. The portal that was staying open in this instance is the orange portal. P06-N was not aware that they controlled the other side of the portal and walking through the orange portal would move them through the blue portal.

Interviewer - Was there anything specifically unclear to you?

P09-N - The portal thing, that was really hard

When asked about what was unclear in their gameplay session, P09-N was confused by the portal itself. They also found it difficult to articulate the relationship between the blue and orange portal.

Interviewer - Was there anything that was unclear to you in the game?

P13-N - Well now as I talk more about the name of the game, it should have been more clear, I think...just kidding. No I think that was about it - the blue/orange relationship
P13-N provided a similar answer when asked what was unclear in their gameplay session. The relationship between the blue and orange portal was not made clear.

The noteworthy takeaway from these reflections on the portal mechanic is required for completing chambers. *Portal* attempts to teach players about the relationship between these two portals but does not explicitly state the relationship between the blue and orange portals. This could be seen as a limitation in level design, particularly design for accommodating novice players.

### 5.5.4 Struggling with the interface

Players from all groups were critical of the interface. In other video games, the interface can be helpful for teaching players. The interface can provide prompts, suggestions, or details on how to solve particular challenges. In *Portal*, the interface is nearly invisible. There is no pause menu, no inventory, no heads-up display for ammunition or health, no mini-map, and few on-screen prompts. Several players commented that the interface interfered with their gameplaying practices. There were no players that spoke positively about the interface. There were three major trends: 1. difficulty with the controller; 2. difficulty with the avatar; 3. missing features.

**Difficulty with the controller**

Players from all groups were critical of the controller. Some players critiqued the controls of *Portal* specifically, other players were unfamiliar with game controllers generally, and some players preferred mouse and keyboard over the game controller.

I think the controls were the most challenging. I felt like I couldn't make the shots that I wanted to make so there was a disconnect between my
intentions and the actions I was taking... The controls could be fine tuned  
- P08-E

P08-E was critical of the controls of Portal in comparison to other first person perspective games. They expressed that the controls were the most challenging part of their gameplay session. They were specifically critical of the responsiveness of the controls and their ability to place portals effectively. P08-E commented that the controls could be fined tuned for a better experience when placing portals.

I could see having more experience with the controller then you understand the world faster. I'm sure it took me a lot longer to figure out what was going on in that space then it would have otherwise because I can't look properly and I can't move around - P09-N

P09-N was unfamiliar with game controllers. They found this unfamiliarity as an impediment to their puzzle solving, but also their puzzle comprehension. P09-N makes an interesting connection between controller proficiency and figuring out a particular space. They spent time struggling with orienting themselves with chambers, feeling unsure about their surroundings because they had difficulty looking around and moving around. This impacts both puzzle solving and puzzle comprehension.

I'm used to using a keyboard and mouse. I usually have that precision. Some of those times I was struggling a little bit because the controller doesn't have the same accuracy - P11-E

P11-E is primarily a PC gamer and normally uses a keyboard and mouse in first-person perspective games. They made a direct connection between their familiar interface and precision / accuracy. P11-E did not feel that they had the same prevision
and accuracy using a game controller. In this instance, the unfamiliar interface created an unnecessary challenge for the player.

**Difficulty with the avatar**

Players from all groups talked about their difficulty with the avatar, specifically moving through portals. This is an interface problem where players will collide with edges of the portals or have difficulty manoeuvring specifically while in the air. This is primarily a programming limitation, where the game does not effectively recognize the collisions between the avatar and the environment. Players were not pleased with these difficulties moving their avatar through portals.

> The puzzles are pretty simple, it's getting yourself to do it that's hard... I know what I have to do I just can't do it. That annoys me - P02-E

P02-E was annoyed with the control they had over their avatar. The difficulty for P02-E was not puzzle comprehension or puzzle solving, the difficulty was executing the solutions. P02-E had these annoyances happen several times during their play through, where their avatar would be caught on edges and interfere with their path.

> Interviewer - It seemed to me like this was not a problem with you knowing what to do, the challenge was getting yourself to fall through the portal. Is that accurate?

> P05-I - Yeah. Absolutely. I knew I had to do that and I knew that's what it was telling me to do. I just couldn't quite do it - P05-I

Similarly, P05-I found it difficult to execute their solutions. They knew what they had to do and were able to comprehend the puzzle correctly. In this specific instance, P05-I was referring to the momentum puzzles that require players to fall
from long distances and line themselves up with a portal below. Several players expressed frustrations about these momentum puzzles and the inability of the game to place them in the correct space.

I found it difficult to line up my character to the portals. And like most first-person shooter jump puzzles are always a bit of a crapshoot. Because you have no proprioceptive awareness you just have to assume your avatar is going to hit the spot. Unless you're looking down at your feet as the avatar but then you don't real know, you can't gauge the distance - P08-E

P08-E is also talking about the momentum puzzles. They found it difficult to correctly place their avatar to move through the portals. P08-E draws a comparison between Portal and other first-person games were jump puzzles are often difficult due to the camera's perspective. They specifically use the term proprioceptive awareness, or the awareness of where your body is in space. In this case, the body translates to the avatar.

**Missing features**

Players from all groups made specific mentions of missing interface features. They discussed these missing features as ways to improve the game, or ways they wanted to interact with the game.

It was strange that there wasn't a traditional menu. It could be more fun if it had more of a “oh I want to read more about my story so far” or even as to what they let on. I couldn't really understand the audio - P07-N

P07-N commented on the absence of a standard pause menu or inventory. For P07-N, this menu would ideally have a summary of the story. In other moments,
P07-N felt that having more context or more narrative could help with puzzle solving and puzzle comprehension. They found it difficult to understand the clues provided by GLaDOS's audio clips.

I'm used to playing games like *Dragon Age: Origins* or *Dragon Age: Inquisition* where you go up to it and the mouseover interacts and the object is outlined and you know which are interactable and which are not - P10-E

P10-E was specifically interested in a mouseover feature. This feature has been used in other view games to provide a distinct outline on objects intended to be picked up or used by the player. Often, this takes the form of a glowing border or distinct colour around an object. They wanted to know what objects were interactable and what objects were not. This feature was helpful in their previous gameplay experiences.

If you know I'm shooting in the right area, just put it in the right spot.
Stupid game. If I'm half an inch off just slide it over. Don't make me do it all over again - P11-E

P11-E commented on the lack of aim-assist in *Portal*. Aim-assist corrects a player's reticle or player's shots and drags them towards the correct location. This is a common feature in first-person shooter games, especially those designed for controllers and consoles. P11-E makes the connection between their gameplaying practices and the interface - by including aim-assist, the interface would recognize the portal placement correctly and reward the player's correct gameplaying practice.
5.6 Conclusion

This chapter reviewed the findings from the gameplay sessions and post-play interviews. Players discussed five major categories: 1. player experience; 2. gameplaying practices; 3. previous gameplay experience; 4. challenges; and 5. learning in *Portal*. There was diversity in the experience of all players, but some noteworthy trends within the player groups. This will be examined more thoroughly in Chapter 6 - Discussion to contextualize the player's experiences and provide answers to the research questions.
Chapter 6

Discussion

In this previous chapter, I presented the findings from the gameplay session and post-play interview. This chapter will provide context to the findings and examine the trends that have emerged from the study. This chapter also revisits the assumptions from Chapter 2 - Literature review and theoretical framework. I will discuss first encounters, gameplaying practices, previous gameplay experience, challenges, learning in Portal, and gender as it relates to expertise. This discussion explores consistencies and variations between the player groups and provides context for their diverse experiences in Portal.

6.1 First encounters

RQ1 asks how do different players encounter Portal for the first time? First encounters with Portal were divergent when comparing responses across all players. A spectrum of players emerged between novice and expert. There were few consistencies and continuities in first encounters amongst all players. There were more divergences and variations. For example, some players found it difficult to understand how portals
work and thought the difficulty level increased too quickly (P01-N, P06-N, P07-N, P09-N). Other players quickly grasped the portal mechanics and described the game as “too easy” (P02-E, P10-E, P14-E). This was not an unexpected finding because players were recruited from diverse group.

6.1.1 Consistencies and continuities

There was only one major consistency amongst all players. All players talked about their search for visual cues in the post-play interview. Players carefully observed the environments of each chamber and searched for visual cues to inform their gameplaying practices. The ways in which players interpreted these visual cues varied but players all searched for visual cues to help them solve challenges. Players most frequently talked about specific cues like placards, wall markings from energy pellets, and orange lights from pellet receptors as clear indicators for what to do next.

There were also consistencies in the groups for how players talked about these cues. Novice players talked about how it was difficult to identify relevant information. They could distinguish that something was different but found it difficult to distinguish what was relevant and irrelevant for a particular problem. For example, novice players were more likely to fire portals repeatedly at non-interactive objects like stairs because the stairs are red (P01-N, P06-N, P07-N, P09-N). These red stairs were visually distinct but were not part of the solution.

Intermediate players were more likely to identify specific visual cues and use those cues to help them solve challenges. They made specific connections between unique visual cues like black marks on the wall from energy pellets and portal placements. Intermediate players knew that these cues were meaningful, citing that Portal had taught them to recognize those marks. One player said “the game is doing that
on purpose, putting a black mark where they hit the wall. They give you useful information” (P04-I). Another player made similar remarks about tiles, saying that the tiles provided step-by-step instructions (P12-I).

Expert players were more likely to describe these visual cues as too obvious. They said things like “it's just signposting. It was obvious” (P08-E), "I can shoot a portal, there's a thing on the wall that is a black spot...like a bullseye” (P10-E), and “[in most games] there's usually some kind of hint. It's a little more obvious in this game” (P11-E). These expert players have experience with visual cues, even identifying them as “signposting” (P08-E) and “assets” (P10-E) which are terms used by game developers. Expert’s previous gameplay experience and expertise allows them to understand the developer's intentions and follow the path provided by the visual cues.

Again, while all players identified visual cues as part of their gameplay session, the ways that different player groups used these visual cues was divergent.

6.1.2 Divergences and variations

There were many divergences and variations in the gameplaying practices of different players encountering Portal for the first time. Some players were frustrated with their lack of knowledge (P01-N, P03-I, P05-I) other players were frustrated with the interface (P02-E, P08-E, P11-E). Some players found visual cues easy to identify (P08-E, P10-E, P11-E), other players found it difficult to filter relevant and irrelevant visual cues (P01-N, P06-N, P07-N, P09-N). Player's sense-making strategies varied, with some players using random, unstructured gameplaying practices (P03-I, P06-N, P07-N, P09-N). Other players were able to understand the developer's intentions quickly, describing their sense-making strategies as paying attention to the environment and reading the clues, often described as obvious (P02-E, P08-E, P10-E). Some players
had difficulty with the conceptual understanding of portals - how they operate, how to place them effectively, and how to use them to navigate to different places (P01-N, P03-I, P06-N, P07-N, P09-N, P13-N). Other players wanted the game to introduce concepts more quickly, increasing the pace of the early levels and providing them with more challenge earlier in their gameplay session (P02-E, P10-E, P14-E). The divergences in the gameplaying practices amongst all players was a noteworthy finding in this study. Players did show more commonalities to players with similar expertise, but across all players the divergences outnumbered the consistencies. Again, this is not an unexpected finding considering the diversity of the players in the study. This will be discussed in the subsequent sections which explore the distinctions between the player groups.

6.2 Gameplaying practices

Gameplaying practices are strategies players use to make sense of a new game. Related studies have examined first encounters with games (Hamlen, 2011, 2012; Orvis et al., 2008; Squire, 2005) or how players use tutorials (Bartle, 2005; Cox et al., 2012; Ellis et al., 2008; Schrader and McCreery, 2008; White, 2012). Gameplaying practices look both the act of play and a player's reflection on their experience. This section will review specific gameplaying practices including how players identified relevant information, how players used sense-making strategies, and how players understood the semiotic domain. Each of these categories will be explored according to novice, intermediate, and expert players.
6.2.1 Novice players

Novice players found it difficult to distinguish between relevant and irrelevant visual information. All novice players attempted to interact with non-interactive portions of the game. Novices would attempt to place a portal on a non-interactive segment, like the pistons under the stairs in chamber 03 or observation windows. The noteworthy difference between novices and other players was their repetition of these ineffective strategies (P01-N, P06-N, P07-N, P09-N, P13-N). Novices would return to the same gameplaying practices despite this plan not working earlier. They would repeat actions that had not worked, like firing portals at visually distinct areas like windows or placards over and over, despite seeing no results.

Novices also had difficulty identifying important visual cues in the environment. Several novice players talked about searching for hidden elements like secret doors or switches that would activate additional elements (P01-N, P06-N, P07-N, P09-N). They returned to visually distinct areas thinking that these would open a secret door or provide them with additional information. However, these visually distinct areas, like the pistons under the stairs or observation windows, were aesthetic features rather than part of the challenge. Novice players visually misidentified the challenges and used incorrect gameplay practices, like searching for secret doors.

Novices found it difficult to bridge their cognitive gaps correctly, which are the missing pieces of information required to solve a problem (Dervin, 1992, p. 67). Their sense-making strategies, which are the strategies used to find those missing pieces of information, did not provide them with effective solutions. Novices expressed feeling lost and overwhelmed. The most common sense-making strategy, or method to bridge the cognitive gap, was using a random or unstructured approach (P01-N, P06-N, P07-N, P09-N, P13-N). Novice players appeared to wander through the chambers, without
a clear solution for overcoming the challenges. Players often shot portals randomly, or repeated similar paths like walking in circles or returning to the same area multiple times, or attempted to interact with non-interactive portions of the game repeatedly. All novice players fired 10 or more portals at non-interactive elements like stairs or windows, left the area to find another solution, then returned to the non-interactive element and continue firing portals (P01-N, P06-N, P08-E, P09-N, P13-N).

Overall, novices found it difficult to comprehend the semiotics of Portal. Players expressed that they were unsure of how to proceed, or unclear about what the game wanted them to do, or missed something they needed to help them play. This can be characterized as difficulties understanding the language of Portal. This is best described as an unknown unknowns situation - players did not know what to do, and they did not know how to assess what was important and what was not important. Novice players were often unable to understand the solution conceptually.

6.2.2 Intermediate players

Intermediate players were better able to distinguish between relevant and irrelevant visual information. They were able to identify specific visual cues and used these observations to help them solve challenges. Intermediate players were able to make connections between the puzzle elements and the environment. The defining feature of intermediate players was their ability to identify important puzzle elements without necessarily understanding the function of a puzzle. Intermediate players were able to recognize puzzle elements and interact with those elements sequentially. They may have been confused about the solution overall but solved challenges systematically. For example, P03-I and P05-I both found it difficult to comprehend the multiple steps required to solve chamber 11, but they were able to identify specific elements and solve
portions of the chamber. They both identified the energy pellet black marks on the walls and interacted with those black marks. The correct solution emerged through this sequential process. P03-I and P05-I recognized a puzzle element, but they were unable to comprehend how those elements fit with the remainder of the chamber. P04-I and P12-I used this same tactic in chamber 12 and chamber 13 respectively. In contrast, novice players found it difficult to identify those specific elements, and often identified the wrong elements. Expert players were more likely to have a working model of the chamber as a whole, rather than identify one element at a time.

Intermediate players were the only group to talk about experimental gameplaying practices in their interviews. What is noteworthy is all four intermediate players specifically addressed their experimental gameplaying practices during the post-play interview. The most common form was testing the affordances of portals or puzzle elements as part of their gameplaying practice. This could include placing portals in different areas, testing the relationship between blue and orange portals, or interacting with elements like energy pellets. This is notably different from the more unstructured approach of novice players, and from the confidence in puzzle comprehension of expert players.

Why were intermediate players the only players to discuss their experimental gameplaying practices? One possible answer is that intermediate players learned through this experimentation process. Novice players found it difficult to understand how portals worked and without these concept it is difficult to use portals in novel or experimental ways. Expert players quickly grasped how portals worked and did not require an experimental phase to use them effectively. Intermediate players used these experimental gameplay practices to understand the portal affordances and mechanics. All intermediate players appeared to use chamber 03 as a space to learn the affordances of portal, what they can and cannot do with portals, how to interact with
the environment, and how to best utilize portals for solving chambers. P03-I and P04-I specifically referred to their experimentation in chamber 03.

Intermediate players had clearly defined sense-making strategies. They talked about techniques they borrowed from video games they had played before. P05-I referred to their mental note-taking process learned from *World of Warcraft*. At the beginning of each level, P05-I referred to the placards and took note of the elements that would be in each level. Similarly, P12-I assessed puzzle elements before making a specific decision. They describe this process as “taking time to understand the new rule set” which is something they also used in *God of War*.

Intermediate players were able to recognize the semiotics of *Portal* and use that language to their advantage. All four intermediate players talked about learning to read the game, from the icons to the level design elements. While they did not recognize these cues as quickly as expert players, intermediate players were able to understand the relationships and use those relationships to help solve challenges. P04-I in particular was able to apply their new semiotic understanding while watching their gameplay footage, recognizing places where they could have improved and anticipating what expert players may have noticed in particular instances.

### 6.2.3 Expert players

Expert players effectively distinguished between relevant and irrelevant visual information. They described the relevant information clearly in the post-play interview and talked about how their observations helped them solve challenges. In some cases, expert players identified this information as too obvious. The defining feature of expert players was the speed and accuracy in identifying important puzzle elements. When asking expert players about their identification of certain elements, like black
marks left from pellets, they were often surprised. The visual cues were obvious to expert players that they were surprised why I would ask how they identified these cues. They used terms like “bulls-eye” (P02-E, P08-E, P10-E) and remarked sarcastically “what else could that mean?” (P10-E).

Expert players did not encounter the same type of cognitive gaps as other players. They responded that it was easy for them to make sense of challenges based on the information provided by the game and their previous gameplaying experience. Expert players attributed their sense-making process to understanding the intentions of the developers. When encountering a challenge that required them to bridge the gap, all expert players talked about observing the environment for clues. Expert players were also more likely to quickly recognize their mistakes and correct them when compared to novice and intermediate players. These moments were often accompanied with comments like “duh” (P02-E), "I was just stupid" (P10-E). Overall, expert players were confident in their gameplaying practices, feeling that they could address any particular issues that might arise.

Expert players appeared to find it easy to understand the semiotics of Portal. They attributed that understanding to their previous gameplay experience and expertise. Expert players talked about the challenges of game design. They reflected that games are difficult to create so all assets have a purpose (P02-E, P08-E, P10-E, P12-I). Experts said that once they learned the function of those assets, like weighted cubes or portals, they understood the mechanics of a particular game. Expert players made specific connections between the semiotic domain and the design process. They reflected that nothing in a video game is arbitrary (P02-E, P08-E, P10-E, P11-E).
6.3 Previous gameplaying experience and player expertise

All players made connections to video games they had previously played in the post-play interview. The connections included puzzle games, platform games, adventure games, and first-person shooter games. Players also talked about a variety of different platforms, from console video games to PC video games to mobile video games. The most frequently mentioned video game was *Myst*, an adventure / puzzle game released in 1993 for Macintosh and later PC. Players talked about the similarities in the puzzles and the difficulty of the puzzles. *Myst* is notorious for being difficult to understand, with players often returning to similar areas trying to figure out what to do next. This connection about the difficulty of puzzle comprehension was most frequent amongst novice players (P06-N, P09-N, P13-N). Players also made connections to platform games and adventure games, providing broad allusions to the difficulty curve (P04-I, P06-N, P07-N, P08-E, P11-E, P14-E), spatial awareness (P01-N, P02-E, P04-I, P06-N, P09-N, P10-E, P12-I, P13-N), and decision making (P02-E, P03-I, P05-I, P06-N, P08-E, P14-E). The most interesting result from these connections was the absence of specific first-person shooter comparisons. Only one player made direct connections between *Portal* and first-person shooters during the post-play interview (P10-E).

Returning to Suchman's canoe metaphor, players undergo a plan and action process as they assess new challenges. A player will draw on their expertise to create a plan, and then execute that plan using their embodied skills. This process of plan and action is a reciprocal process, where players have to adjust their plan on the fly and may face unexpected results. Both planning and action are situated in a player's expertise. The effectiveness of this plan and action relationship is related to a player's expertise.
One explanation for why players talked about a wide range of genres is that *Portal* does not have a definitive genre. *Portal* is a boundary object that shares similarities with puzzle games, platform games, adventure games, and first-person perspective games. Another explanation is that the expertise of other players varied widely. Players may be drawing on limited previous experience, like those novice players who compared their experience to *Myst* which released in 1993.

### 6.3.1 Previous experience and first encounters

RQ2 asks if previous video game experience and player expertise informs the gameplaying practices of first encounters with *Portal*. Situated cognition proposes that knowledge of a particular domain is connected to lived situations and experiences, where knowledge is part of the activity and context in which it is developed and used (Brown et al., 1989; Chaiklin et al., 1993; Dede et al., 2004; Lave, 1988; Suchman, 2007). People undergo a process of plan and action, and these plans and actions are products of a person's previous experience. This creates a dialectic relationship between experience and expertise that is reconstituted in the ongoing practice. In other words, the more you do something, the more knowledgable you become. The more video games a person has played, the more knowledgable they will be at future video games.

This was also true for a video game with unfamiliar mechanics. In *Portal*, players showed the most similarities in their gameplaying practices to other players from their group. While there were still key divergences, an expert player was more similar to another expert player than a novice or intermediate player. This was most obvious in puzzle comprehension, where expert players quickly grasped how portals worked and novice players could not understand the game mechanic.
6.3.2 Semiotic domain of Portal

Gee's concept of the semiotic domain provides a framework for previous gameplay experience and player expertise. He argues that learning in any semiotic domain involves how to build meaning in that domain and then apply that meaning to the sorts of situations related to that domain (Gee, 2003, p. 26). In other words, learning how to play video games involves building meaning from those games and then applying that meaning to other video games. This concept can be extended for first encounters. A player’s previous gameplay experience and expertise creates their semiotic domain which they draw on to make sense of first encounters.

Players who did not report as having “significant previous gameplay experience” found it difficult to understand the semiotic domain of Portal. Two novice players (P06-N, P09-N) and one intermediate player (P04-I) talked about their experience trying to understand what Portal was communicating. While reviewing gameplay footage, P04-I reflected that it difficult to recognize the visual cues in their last level, chamber 12. P04-I selected their final few minutes to watch and identified the puzzle element needed to progress further, the “jutted bit”, an interactive tile that emerges from the wall. P04-I commented that if they were a “master gamer” they would have been able to identify it immediately. P04-I is anticipating their progression in the semiotic domain, and recognized new visual cues in the gameplay footage. As P04-I acquired gameplay experience, even during the one hour gameplay session, they were able to apply that experience as knowledge (Orlikowski, 2002; Savolainen, 1995).

P06-N and P09-N also commented that it was difficulty understanding what Portal was communicating. P06-N said “I don't feel confident that I'm able to quickly pick out what matters and what doesn't . . . I'm not good at filtering information” and P09-N said that “I could have got through those levels better if I knew what that meant.”
While P04-I was able to recognize what they missed, P06-N and P09-N did not feel that they understood what *Portal* was communicating. This is indicative of the differences in gameplaying practices between novice and intermediate players. Novice players tended to have difficulty identifying relevant visual cues from irrelevant visual cues while intermediate players were able to identify key puzzle elements sequentially.

Players who reported as having “significant previous gameplay experience” were able to understand the semiotic domain of *Portal*. Two expert players (P02-E, P08-E) and one intermediate player (P12-I) talked about their successes, and even their enjoyment of *Portal*'s semiotics. P02-E made clear connections between their previous gameplay experience and *Portal*'s semiotics. “How did I know to hit the orange thing? It's the same answer to when I'm playing adventure games with someone who isn't good at game. dow did you know to click on that thing? You just know.” P02-E makes a specific reference to playing video games with novice players, and how they are able to distinguish what is and what is not important based on their previous experience. When reviewing the gameplay footage, I asked P02-E to talk about locating the orange light and placing a portal quickly and accurately. P02-E did not notice the orange light before I asked them specifically about it, they identified it as a visually distinct element unknowingly. P08-E articulates this visual distinction more clearly, saying that “nothing in a arbitrary...There's nothing else in the room for me to do”. P08-E talked about video game assets, how making something visually distinct indicates something in video games, based on their previous experience. P12-I talks about these visually distinct clues as “learning to read the game's language”. Each of these players drew on their previous gameplay experience and expertise to understand *Portal*'s language.
6.4 Challenges

Returning to Dervin’s theory of sense-making (Dervin et al., 2003) and the metaphor of bridging the gap, I argued earlier that players encounter challenges during their gameplay session where they are unable to proceed forward. Players assess these challenges, create solutions, and then execute those solutions. These moments were sites of inquiry during the post-play interview. In reference to RQ3, I asked players how they identified particular challenges and how they form their strategies to overcome challenges.

6.4.1 Challenges for novice players

Novice players found portal mechanics the most challenging. All novice players found it difficult to understand how portals work, specifically the relationship between the blue portal and the orange portal. Chamber 03 is the first instance that requires a player to explicitly understand the relationship between the blue and orange portal. Players control the blue portal and must place that blue portal on the opposite ledge. Players then must move through the static orange portal to complete the level. This relationship between blue and orange portal is the foundational game mechanic of Portal, and without knowledge of this portal mechanic a player cannot succeed. Novice players struggled with the relationship between the blue and the orange portal and therefore struggled the most with chamber 03. P06-N and P07-N were unable to complete chamber 03.

When asked about their most frustrating experience, novice players talked about their lack of knowledge. P01-N, P06-N, P07-N, and P13-N said they did not understand the objective of the game. Without working knowledge of the portal mechanic, novice players could not create effective plans to complete the challenges. This is the
equivalent of being unsure about how to make pairs in a game of Go Fish. If a player
does not understand the concept of pairs, they will not be able to succeed playing
Go Fish. This is directly reflected in the longer completion times for Chamber 03 for
novice players, as shown in Table 6.1.

<table>
<thead>
<tr>
<th></th>
<th>Average time</th>
<th>Longest time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Novice</td>
<td>19:30</td>
<td>27:00</td>
</tr>
<tr>
<td>Intermediate</td>
<td>11:10</td>
<td>29:15</td>
</tr>
<tr>
<td>Expert</td>
<td>1:30</td>
<td>2:15</td>
</tr>
<tr>
<td>All players</td>
<td>8:27</td>
<td>29:15</td>
</tr>
</tbody>
</table>

Table 6.1: Average time and longest time for chamber 03

Applying flow theory, the level of difficulty did not meet the novice player's level of
skill. Portal was not effective at bridging the gap for novice players. The level of diffi-
culty increased too quickly for novice players, resulting in frustration and disinterest.
P06-N and P07-N stopped playing at this point as they saw no way forward.

6.4.2 Challenges for intermediate players

Intermediate players found puzzle comprehension most challenging. P04-I, P05-I and
P12-I discussed their last chamber as their most challenging experience. Intermediate
players were able to understand the relationship between the blue and orange
portal more effectively than novice players. Their challenge was understanding the
complexity of later chambers.

Intermediate players talked about the challenge of juggling multiple skills. Later
chambers require players to apply previously learned skills in novel ways. These
later chambers also require sequential puzzle solving, where one step unlocks the next
step. Players must identify the order of operations and execute these steps in the
appropriate order. P04-I, P05-I and P12-I reflected that this complexity and this
puzzle comprehension was most difficult.

This is distinct from novice players. Intermediate players were able to understand the portal mechanics. Their challenge was identifying the correct path in the more difficult chambers. Similar to novice players, the frustrations expressed by intermediate players was their lack of knowledge. However, this is not a lack of knowledge about portal mechanics but rather a lack of knowledge about the puzzle design.

Based on this finding, intermediate players found it challenging to comprehend complex puzzles. This made it difficult for intermediate players to identify the correct paths in later chambers that required sequential problem solving. Intermediate players were able to understand the mechanics and rules of *Portal* but required more time to solve puzzles as the game became increasingly complex.

### 6.4.3 Challenges for expert players

Expert players were more likely to talk about the interface. P02-E, P08-E, P10-E, and P11-E talked about the interface as a barrier. P02-E talked about avatar orientation as they passed through portals, specifically how to they were unable to predict their direction. This made it difficult for P02-E to make creative decisions while moving at high speeds. P08-E talked about the precision of the controller as an impediment to their success and specifically mentioned that the controls could be fine tuned. They felt that there was a gap between their intentions and their in-game actions due to this lack of tuning. P10-E would have preferred to use a mouse and keyboard, saying that the accuracy and precision from a controller was a challenge. P11-E described portal placement as frustrating, describing a slippage between problem solving and the interface. P11-E said that *Portal* is a game applying novel mechanics like creative portal placement rather than shooting accuracy.
Expert players made clear distinctions between interface and gameplay. Like Juul’s definition, expert players separated the interface (the software and hardware tools, in particular the controller) from the game itself. They saw the interface as a layer that separated them from gameplaying practices. Expert players felt that their decision making was restricted by the interface. Returning to the possibility space, ideally a player explores a video game through the interface and experiences the myriad configurations of the game in their own unique way (Bogost, 2007, p. 42-43). This permits players to make “a series of interesting choices” (Rollings and Morris, 2001, p. 38) and experience the game on their own terms. Expert players were frustrated by the limitations of the interface from making these interesting choices.

One potential explanation for this frustration is the illusion of freedom in *Portal*. Players are given the illusion that *Portal* is a sandbox that provides freedom of choice and unique ways to interact with the chambers. This creates an expectation for players, particularly expert players, that they will have the freedom to solve the chambers in whatever way they see fit. In reality, all video games are tightly controlled experiences that are bound by the rules of the game and the rules of code (Bogost, 2007). All interactions between the player and the game must be anticipated by the developer. Expert players were able to articulate this limitation more clearly than the other players but expressed this as a challenge.

### 6.4.4 Description of challenges

The descriptions of challenges was similar within the player groups. Novice players talked about their lack of knowledge. They found it difficult to understand how portals worked, and how to use portals effectively. Intermediate players talked about their difficulty comprehending the puzzles. They found it difficult to break down the
complex chambers into discrete steps as they progressed. Expert players talked about their struggles with the interface. They found it difficult to interact with the avatar and the controller.

Players from all groups described the relationship between the challenges of Portal and the rules of Portal. While many players found Portal difficult or frustrating, these same players described the relationship between rules and challenges as positive (P01-N, P08-E, P10-E, P14-E). Players talked about the lack of time pressure and the lack of punishments for failure (P07-N, P08-E, P10-E, P12-I, P14-E). In nearly all chambers, players have as much time as they need to make decisions. Time pressure only appears in later chambers, and those chambers were only reached by expert players. Players said that the lack of time pressure was a welcomed change from other first-person shooter games, which often have a frenetic pace (P07-N, P12-I, P14-E). Even players frustrated by the puzzles themselves enjoyed the lack of pressure and talked about the focus on the puzzle itself rather than external factors (P01-N, P03-I, P04-I, P06-N, P07-N, P13-N).

In all chambers, there is no punishment for mistakes. If a player dies, they respawn immediately at the same point in the chamber. Players are not punished with “GAME OVER” screens, progress resets, loss points, loss lives, or any other measurable penalties. Players are able to return to solving the chamber from the same point where they stopped. Players felt encouraged to fail, to explore, and to make mistakes (P10-E, P12-I, P14-E). They talked positively about the relationship between the puzzles and the lack of punishment, expressing that the rules of Portal provided a freedom despite the difficult challenges (P02-E, P04-I, P06-N, P07-N, P12-I, P14-E).
6.4.5 Conceptualizing challenges

Challenges are the subjective experience of difficulty. Furthering the concept of affinity groups, I argue that a player's identification of challenge will be influenced by their previous gameplay experience and expertise. What a player finds challenging will be an ongoing and negotiated balance between the subjective difficulty of a particular challenge and a player's skill (Csikszentmihalyi, 1990). This means that different players will identify different parts of Portal as challenging. What is difficult for one player will not be difficult for another player. As players move through Portal they will encounter sections where their skill level meets the level of challenge, and others where their skill either exceeds or does not meet the level of challenge. Players oscillate between these different states, with some puzzles being too easy and others being too hard. Different players identify different challenges based on their skills and their expertise.

Because previous gameplay experience and player expertise varies amongst players, there is variance in what different players identify as challenging. Some players had difficulty identifying the parameters of the challenges themselves. Novice players were more likely to struggle with framing the challenges because they did not understand the mechanics of portals. Intermediate players were more likely to struggle with later chambers, as the puzzle complexity was too difficult. Expert players were more likely to talk about their challenges with the interface.

6.5 Learning in Portal

Learning in Portal covers the tutorials, scaffolding, and portal mechanic. I asked players about the effectiveness of Portal as a learning environment. There is a wide
variance between the learning process for different players. Players talked about their experiences with tutorials, scaffolding, the portal mechanic, and how to improve their experience with *Portal*.

### 6.5.1 Tutorials

Players had different opinions on the effectiveness of the tutorials. In *Portal*, players are asked to solve puzzles and learn concepts experientially. This is a departure from modern video games which typically instruct players in an introductory level. *Portal* could be described as an ongoing tutorial - players are asked to learn new skills and combine skills in new ways for almost every chamber. Some novice and intermediate players said there was no tutorial in *Portal* (P01-N, P03-I, P05-I, P06-N, P07-N). Other players from the intermediate and expert groups felt that the tutorial was effective at teaching them how to play (P02-E, P04-I, P11-E).

P01-N and P03-I used the terms “hand holding” and “hold your hand” respectively to talk about tutorials in other video games. In these games, there is a specific tutorial segment to outline the actions a player can take. P01-N created an analogy between their previous video game tutorial experience. P01 said that if *Portal* had a standard tutorial, it would be as follows: “you shoot this portal and you walk through the portal and this portal takes you here and you can shoot through this portal and that portal will drop you in through the ceiling”. This kind of tutorial would outline the properties of portals, how to use them, when to use them, and provide working examples or exercises as proof of concept. When asked if *Portal* has an ineffective tutorial or no tutorial at all, P01-N said there was no tutorial: “*Portal* is just...I'm in the room. I shoot the portal open and then it's almost trial and error from there”. P03-I made a similar observation, saying “it obviously doesn't instruct you or walk
you through it. Most games now a days hold your hand and tell you want to do”.

P02-E and P04-I found the “minimalist” tutorial effective. Expert player P02-E talked about the pace of the tutorial: “I suppose having an option to skip ahead would be nice... There may be a middle ground there and maybe your first puzzle contains four of those elements and those elements you need to learn rather than one at a time”. Later, P02-E remarked that the pace of the early levels was too slow and wanted to progress to more difficult challenges sooner. Returning to flow theory, the level of difficulty for P02-E was too low during the first chambers, which resulted in feelings of boredom. Intermediate player P04-I had a different experience: “I had to figure that out myself, which I love. I feel that the only reason that it became intrinsically motivating is because I wasn't told how to think”. P04-I later talked about their frustration with video games as controlled environments that provided too much guidance and took away the fun of exploration and discovery. They identified themselves as a non-gamer and cited this lack of freedom as their primary reason for not playing. P04-I found this “minimalist” tutorial motivating and let them discover Portal on their own terms.

6.5.2 Scaffolding

Portal uses scaffolding to teach players different skills required to solve challenges. Players learn different skills in each chamber. As players progress through the game, they learn new skills that help them solve the next set of challenges. Players follow a progression through the chambers that scaffolds game concepts in a timely manner (Fernández et al., 2001; Sherin et al., 2004; Wass et al., 2011). This is intended to guide players to use certain methods to solve challenges. Seven players representing all three groups talked about scaffolding, and these players said that the scaffolding
was effective.

Novice players (P01-N, P07-N) reflected that scaffolding made things clearer, and made them feel like they were building on previous concepts. Intermediate players (P04-I, P05-I) reflected that they learned from the previous challenge and that Portal grows on itself. Expert players (P10-E, P11-E) reflected that Portal was good at showing concepts sequentially and that every level presented a new challenge and required players to learn a new skill. The reflections from all player groups were similar - Portal teaches you concepts in a specific order and asks you to apply those concepts as you progress through the game.

The relationship between tutorials and scaffolding is notably absent from the post-play interviews. Some players who felt that the tutorial was ineffective or non-existent (P01-N, P05-I, P07-N) spoke positively about the scaffolding. This is a noteworthy finding, where players felt that Portal was teaching them new concepts through scaffolding despite their criticisms of the tutorial. One potential explanation is that “tutorial” invokes a specific kind of experience in video games. Tutorials imply explicit instructions, step-by-step processes, and often involves pop-up menus, voice-overs, or some other distinction from the standard game.

6.5.3 Portal mechanic

Half of the players had difficulty understanding the portal mechanic, that is the relationship between the blue and orange portal. All novice players along with two intermediate players (P03-I, P05-I) found the portal mechanic confusing at some point during the gameplay session. No expert players found it difficult to understand the portal mechanic. Following the gameplay session, I asked players to tell me about their struggles with the portal mechanic. Four novice players (P01-N, P06-N, P07-
N, P09-N) found it difficult to explain this relationship. I attempted to explain the relationship during the post-play interview but the portal mechanic was still unclear to these players.

Understanding the portal mechanic is a requirement for succeeding in *Portal*. All challenges are based portal placement and using those placements to access inaccessible areas and objects. *Portal* attempts to teach players about this foundational portal mechanic but the effectiveness of this scaffolded learning approach does not work for novice players. This approach was effective for expert players. This suggests there is a gap between the intended learning outcomes for novice and expert players.

### 6.5.4 Improving first encounters

A majority of players in this study (13 out of 14, all except P14-E) had some difficulty understanding *Portal*. This includes the entirety of both novice and intermediate groups. The reasons for this difficulty were varied. The most common answers were the portal mechanics and the complexity of later chambers. Players used terms like unsure, unclear, confused, and frustrated. They talked about being unable to figure out what to do, not able to understand what the game wanted from them, and not feeling confident at picking out what matters. Some players thought that a specific tutorial would have helped them learn more effectively. Other players were satisfied with the level of instruction provided. There was no singular reason that players found it difficult to understand *Portal*. Several players had specific recommendations for how to improve their *Portal* experience. Some of the suggestions included interface improvements like being able to tell which objects were interactive by placing a highlighted frame around that object (P10-E). Another player wanted a summative text option that provided an overview for all GLaDOS commentary (P07-N). Other
players wanted changes to the game engine, like improved collision physics where objects would collide with other objects more consistently (P02-E, P08-E).

The most common request was a hint system (P01-N, P03-I, P05-I, P06-N, P07-N, P09-N, P12-I). This hint system would provide clues on how to solve a particular challenge at the player's request. Players would actively choose to receive a hint, perhaps with a sequential button combination to prevent accidental hints. I believe that first encounters with *Portal* would be improved by including an optional hint system.

This was not a case where these players made incorrect assessments on the puzzles, or lacked the controller skills to make difficult shots, or required faster decision making. These players did not understand what they were supposed to do next in a specific instance during their gameplay session. A simple solution for this knowledge gap is a player-controlled hint system. Players could request a hint from the game to help them find the next objective or understand an unfamiliar segment. For players who wanted additional an additional challenge, there could be an achievement for their first successful completion without using hints.

6.6 Revisiting the assumptions

In the theoretical framework chapter, I presented five assumptions. This section will review these assumptions based on the findings and discussion. These assumptions have been paraphrased. The original assumptions appear in 2.4 - Assumptions. I will discuss the overall findings for each player group in this section.
Assumption one

“More experienced players will perform better than less experienced players. More experienced players will progress further through the game than less experienced players, complete chambers more quickly, and solve puzzles more accurately using fewer portals”

More experienced players performed better than less experienced players. More experienced players progressed further, completed chambers more quickly, and solved puzzles more accurately using fewer portals. Also, more experienced players found it easier to understand the semiotics of Portal. Less experienced players found it difficult to learn portal mechanics and how to use portals effectively. The relationship between the blue and orange portals was still unclear for some less experienced players during the post-play interview. In contrast, more experienced players quickly grasped the portal concept and utilized portal mechanics to solve early chambers efficiently.

Another potential factor for the proficiency of more experienced players is their ability to assess challenges from previous gameplay experience and expertise. Less experienced players frequently mentioned being overwhelmed by the chambers, specifically chamber 03. They found it difficult to distinguish between relevant and irrelevant visual information. They often looked for hidden solutions, thinking they needed to find a secret passage. More experienced players talked about how same chamber was too easy. They may have understood that early levels in video games are generally easier, trying to teach players foundational concepts. This also impacts the level of confidence of more experienced players - they know what to expect in the early stages of video games. Less experienced players had lower confidence, thinking that they were unable to solve challenges effectively. Without the previous gameplay experience and expertise, less experienced players searched for solutions that were too
complex. They believed they had missed something or lacked the necessary skill to assess the challenge. The difference in skills between more experienced and less experienced players were clearest in the later chambers, where less experienced players talked about their difficulty comprehending complex challenges. More experienced players were able to understand these complex challenges and progress further.

**Assumption two**

“Experts will show similarities with other experts while novices will have more divergence with other novices”

Experts did show similarities with other experts, but novices did not have more divergences with other novices. Experts used similar gameplaying practices and were better at understanding the semiotics of *Portal*, but this did not contribute to less divergent gameplaying practices. Novice players did have a more difficult time finding optimal paths through the game, but they shared similar gameplaying practices when compared to other novices. Intermediate players also shared similar gameplaying practices with other intermediate players, particularly exploratory practices.

This relationship between gameplaying practices and expertise provides insight into first encounters for players from different backgrounds. Novice players shared several distinguishing gameplaying practices: 1. random and unstructured approaches to solve challenges; 2. searching for hidden solutions; 3. attempting similar solutions repeatedly. Intermediate players also shared distinguishing gameplaying practices: 1. exploratory and experimental approaches to learn new skills; 2. sequential problem solving and identifying smaller solvable elements; 3. difficulty comprehending complex challenges involving multiple steps. Expert players shared several distinguishing gameplaying practices: 1. accurate identification of visual cues; 2. methodical assessment of chambers; 3. efficient use of portal mechanics. Novices, intermediates,
and experts had more in common with each other than with other players, and the amount of variance within these groups was similar. This means players with similar previous gameplay expertise can be grouped together effectively.

**Assumption three**

“Experts will articulate their gameplaying practices more clearly than novices. Experts will have previous understanding of video games and familiarity with the kind of language used to describe video games. Novices will have a more difficult time than experts when articulating their gameplay practices”

Experts did articulate their gameplaying practices more clearly than novices. Experts were able to identify design features like scaffolding and onboarding that made it easier for them to solve chambers. In general, experts drew on their knowledge and used language specific to video games and allusions to similar video games. Expert players were more likely to talk about specific gameplaying practices they borrowed from other games. Intermediate players were similar to expert players. They talked about their previous gameplay experience and made allusions to practices they borrowed from games they played before. They did not have the same clarity explaining the design features, but were able to talk about their own problem solving process. Novice players were able to articulate their gameplaying practices, but the practices themselves were often unclear. Novice players did not know the best way to proceed, but they were able to describe their lack of knowledge. In this instance, the potential lack of language or lack of knowledge would impact their gameplaying practices but not their ability to describe those gameplaying practices. Novice players did have feelings of uncertainty when describing their gameplay session, but again this is related to their inexperience rather than their inability to talk about their experience.

However, this working assumption does have a flaw. It conflates the gameplay
session with the post-play interview. This assumption suggests that experts will be better at describing their gameplay session. This was not consistent with the results. Novice, intermediate, and expert players all clearly described their experience. Expertise is not an important factor for a player's reflection on their experience. All players in the study provided noteworthy insights and contributions. While some players performed better than others during the gameplay session, all players provided rich data during the post-play interview. This is an important finding for future user-focused video game research involving players from different backgrounds.

**Assumption four**

“Novices will be discouraged more easily while playing”

Overall, novice players appeared to be discouraged more easily while playing. Novice players were more likely to report feeling frustrated during their gameplaying session. Two novice players ended their gameplay sessions before the allotted one hour due to frustration. Only one other player ended their gameplay session early, an expert player who was experiencing motion sickness. Novices were more likely to express feeling lost or unsure of what to do.

Intermediate players appeared engaged, where the level of difficulty matched their level of skill. Intermediate players were more likely to talk about having fun, feeling lost in the moment, having control over their actions, and working towards clear goals, which are characteristics of flow citecsikszentmihalyi1990flow. The level of difficulty in the early levels of *Portal* matched the intermediate players' level of skill.

Expert players were not discouraged when playing *Portal*, and some commented that *Portal* was too easy. They were able to identify solutions quickly. This was not a case where expert players were able to find more elegant solutions or implement new skills in a particular situation. Expert players were better equipped at understanding
the semiotics of *Portal*. Their ability to read the game's language and correctly assess the developer's intentions contributed to their success.

The difference in novice, intermediate and expert players was video game literacy - an ability to read a developer's intentions, understand portal mechanics, and comprehend complex challenges.

**Assumption five**

“A third player-type category will emerge on the continuum between novice and expert”

This assumption suggests that the three player categories are static, but there was diversity when comparing all players. I referred to players as novice, intermediate, and expert because they shared characteristics in their progress, times to completion, and gameplaying practices when compared to the other groups. This was useful as a site of analysis rather than a static classification.

Intermediate players had the most diversity in times to completion in key chambers, most notably chamber 03 and chamber 09. The times for chamber 03 were 29:15 (P03-I), 7:00 (P04-I), 7:00 (P05-I), and 2:15 (P12-I) with an average time to completion of 8:27 amongst all players. Expert players ranged from 0:45 to 2:00 in chamber 03. The times for chamber 09 were 5:00 (P03-I), 2:10 (P04-I), 2:05 (P05-I) and 4:35 (P12-I) with an average time to completion of 2:38 amongst all players. Expert players ranged from 1:45 to 2:45 in chamber 09. The key difference between novice and intermediate players was their progression. No novice player made it past chamber 08 while all intermediate players reached chamber 11. When compared to experts, all expert players reached at least chamber 14, and 4 experts reached chamber 15. This diversity amongst intermediate players reflects the range of players who participated in this study.
6.7 Gender and expertise

There was a disparity in expertise between female and male players. Out of the seven female players, there were four novice players, two intermediate players, and one expert player. Out of the seven male players, there was one novice player, two intermediate players, and four expert players. This result suggests that there are more expert male players than expert female players. However, this is influenced by the exclusion criteria and recruitment rather than a representative sample of video game player expertise by gender.

Exclusion criteria for the study was: 1. have not played Portal or Portal 2; 2. between the ages of 18-49. It was difficult to find female expert players who had not previously played Portal. During the snowball sampling phase, I asked female players if they had any friends who had not played Portal before. Several female players said they had female friends with previous video game experience who would be eager to participate in a gameplay session. I was hopeful to find more female players who self-identified as experts but these potential players all had played Portal. When recruiting for this study, I encountered seven self-described expert female players who were not eligible compared to one male expert player who was not eligible. This is not surprising - Portal is a popular game amongst self-identified gamers and one of the few games released during the mid to late 2000s with a female protagonist.

In this exploratory study of Portal, expertise was not dependent on gender (Gee, 2003, 2004; Jenson et al., 2011). This finding is similar to Jenson's work about expertise, which challenges the standard notions of gender and gaming through an interventionist research design (Jenson et al., 2011). However, this does not suggest that there are not significant differences in broader video game culture. Returning to Jenson, she suggests that the standard stereotypes must be challenged but remain
in the area of gender and gameplay, players need not conform to those stereotypes...When the balance of power for the gaming club is shifted to technologically-competent female gamers, the girls in the club respond: they play more, take up more space, police who is allowed in or not, and generally display technological and political competence, interest in games, and knowledge of them. They also acknowledge the dominance of boys and begin to vocalize their presumed entitlement and work to change it (Jenson et al., 2011, p. 164)

Expertise in video games can be described as an affinity group, where people orient towards a common set of social practices to succeed in those social practices (Gee, 2003, p. 183). The standard boundaries of a community, specifically race, gender, age, and class, can be challenged and reshaped within an affinity group. In Jenson's project, this took the form of challenging the existing notion that “video games are for boys” by recreating the boundaries of the affinity group. Jenson empowered the girls in the club to take leadership roles and challenge the existing gender assumptions.

Jenson's challenge of gamer culture on a local scale speaks to a broader issue of “gamer capital”. Consalvo defines gamer capital as “how individuals interact with games, information about games and the game industry, and other game players. The term is useful because it suggests a currency that is by necessity dynamic - changing over time, and across types of players or games” (Consalvo, 2007, p. 4). In video game genres such as competitive first person shooter games (Counter-Strike series, Call of Duty series, Battlefield series) gamer capital is primarily the domain of male players. The barriers to exclusion are significant for new players, and particularly for female players who face discrimination from hardcore gamer communities (Consalvo,
Female players are often excluded from these hardcore gamer communities based on existing gendered practices, in particular the kind of bullying that occurs between competitive first-person shooter players (Consalvo, 2012; Fox and Tang, 2016; Jenkins, 1998; Williams et al., 2009). Fortunately, Game Studies scholars are challenging these barriers and these stereotypes and attempting to reform the exclusionary practices. There is still significant progress to be made, but within Game Studies scholarship these gendered structures are being challenged and reconfigured.

6.8 Conclusion

This chapter discussed the findings from the gameplay session and the post-play interview as they relate to the research questions. I discussed the categories that emerged from data analysis and examined the trends from the player's experiences. There was a noteworthy amount of differences and variations amongst the players. The next chapter concludes this dissertation and highlights the contributions from this study.
Chapter 7

Conclusion

This study asked how adult video game players encounter an unfamiliar game for the first time. I examined the gameplaying practices of adult players to see what differences, if any, exist between the players, how previous video game experience and expertise informed the gameplaying practices, and how different players used sense-making to overcome challenges.

In regards to RQ1, first encounters were divergent amongst all players. Some players found *Portal* too easy, others found it too difficult. Some players felt that *Portal* provided effective tutorials, others found it confusing. Some players understood the portal metaphor, other players were unsure how portals worked in the post-play interview. Some players were frustrated with their lack of knowledge, others players were frustrated with the interface. Player’s sense-making strategies varied substantially. Some players had random, unstructured approaches to challenges. Other players quickly understood the intention of a puzzle and described their ability to read the semiotics of the developer. The divergences amongst all players was noteworthy. All aspects of gameplaying practices were divergent amongst all players.

For the purposes of comparing the different groups of player, I established three
categories based on several factors: how far a player progressed during their gameplay session, time to completion in difficult chambers, assessment of gameplay footage in comparison with other players, and responses from players during their post-play interview. These three groups are novice players, intermediate players, and expert players. Novice players were those players who did not advance past chamber 08 and had longer than average times to completion on chamber 03 and chamber 07. Intermediate players were those who did not progress further than chamber 13 and had longer than average completion times on chamber 11. Expert players were those who did not progress further than chamber 16 and had faster than average completion times on chamber 00 to chamber 14.

In regards to RQ2, previous video game experience and expertise did inform the gameplaying practices of players' first encounters with Portal. There were noteworthy trends that emerged based on a player's expertise. Novices found it difficult to identify relevant information. They attempted to interact with non-interactive parts of the game and would often repeat unsuccessful strategies several times. Overall, novices found it difficult to comprehend the semiotics of Portal. Intermediate players found it easier to identify relevant information. They were able to identify important puzzle elements without necessarily understanding the overall solution to a puzzle. Intermediate players were able to overcome challenges through a sequential process, solving elements they did understand before trying to decipher the entire puzzle. Overall, intermediate players understood the semiotics of Portal but found it difficult to combine puzzle solving strategies in more complex problems. Expert players found it easy, and sometimes too easy, to understand the relevant information in Portal. They were able to comprehend and analyze chambers quickly and accurately. Expert players clearly articulated the semiotics of Portal and often used language to describe their experience that could be compared to a video game developer such as
“on-boarding”, “assets”, or “sign posting”.

In regards to RQ3, I explored moments when players faced challenges using Dervin’s sense-making methodology. This methodology uses an instance based interview protocol to examine specific moments when a player reached a cognitive gap; an instance where they needed to overcome a challenge and “bridge the gap”. These challenging moments were divergent when comparing all players but trends did emerge that reflected a player’s level of expertise. Novice players found portal mechanics the most challenging. All novice players reported that it was difficult to understand the relationship between the blue and orange portal. This was a source of frustration for novice players who talked about how their lack of knowledge made it difficult to understand the objective of *Portal*. Intermediate players found puzzle comprehension most challenging. They talked about the challenge of managing multiple skills, particularly in later chambers that ask players to use a combination of previously learned skills. Intermediate players were able to understand how portals work but could not identify how to use those portals as puzzles became more difficult. Expert players were more likely to talk about the interface as the site of their challenges. They talked about how the interface was a barrier to their decision making. Expert players were more likely to criticize the interface.

Overall, *Portal* was an effective choice for this study. The unique portal mechanics were important for examining first encounters. For all players in the study, this was their first experience using the portal mechanic. The unfamiliarity with the mechanic ensured that the gameplay session was new and unfamiliar. While novice players had difficulty understanding how portals worked, they were able to articulate what they did not understand or what was missing for them. However, *Portal* does have some shortcomings. There were issues with the collision physics in the game, with many players finding it frustrating to interact with objects passing through portals. Players
would often clip the side of the portal, which made it difficult for them to execute their solutions effectively. This also impacts how players interact with objects as they move through portals, such as the weighted cube. Players would identify the correct solution but the interface and game mechanics would sometimes be uncooperative and require several attempts from players.

Methodologically, the revised video commentary model provided thorough reflections from players. I was pleased with this method and was able to reach saturation on player feedback. All players felt that we were able to cover their experience effectively. Having players control video playback and isolating specific moments also allowed further exploration of specific issues. This has two advantages: 1. players determine what they find meaningful which adds an additional layer for analysis; 2. players can describe their experiences thoroughly with the aid of the video. In future studies involving users interacting with video games, video commentary model is an effective approach.

### 7.1 Revisiting Canada's digital society

Video games are an important part of Canada's digital society, with more than half of Canadians playing video game on a regular basis (Entertainment Software Association of Canada, 2016). Video games have been championed as ideal learning spaces where people can learn skills for an emerging economy (Dubé and Keenan, 2016; Gee, 2004, 2003; Jenson et al., 2011; Schrader and McCreery, 2008). Related research argues that video games provide engaging learning opportunities and motivate people in ways that improve on traditional learning like critical thinking, risk taking, embodied experiences, and reducing fear of failure (Gee, 2003, 2004; McGonigal, 2011; Steinkuehler, 2006). In some ways, video games seem like a remedy to
several major issues of education and learning, most notably learner engagement and skill development (Gee, 2003; McGonigal, 2011; Steinkuehler, 2006).

The results of this study show that comprehension in an unfamiliar video game is related to previous gameplay experience and player expertise. Players who had less expertise found it difficult to comprehend the basic interactive metaphor of portals. It is hard for players to understand how to play a new video game if they do not have previous video game experience. There were more barriers to entry for novice players. They had more difficulty with the controls and the interface, but most noteworthy was their difficulty with understanding game mechanics. In comparison, expert players found the initial levels of the game too easy. These expert players talked about they did not have a sense of accomplishment in completing the early chambers. This illustrates a disconnect between player expertise and learning outcomes. Learning the unfamiliar portal mechanic proved too difficult for novice players and too easy for expert players.

Opinions varied widely when asked players were asked to evaluate Portal as a learning environment. Players had different opinions on the effectiveness of tutorials in Portal. Several novice and intermediate players said there was no tutorial (P01-N, P03-I, P05-I, P06-N, P07-N) with some making direct comparisons to tutorials in other games. P01-N and P03-I talked about games that “hold your hand” in contrast to Portal. They reflected that Portal did not effectively teach them how to play. Other intermediate and expert groups said the tutorial was effective (P02-E, P04-I, P11-E). P02-E and P04-I talked about how the exploratory nature of Portal was effective at teaching them how to play. Some players who criticized the tutorials of Portal felt that the scaffolding was effective (P01-N, P05-I, P07-N) and made them feel like they were building on previous concepts. The variance in responses was noteworthy. Despite the variance on Portal as a learning environment, a majority of
players (13 out of 14, all except P14-E who progressed the furthest) expressed some difficulty understanding Portal. The most common response to improving Portal is the inclusion of an optional hint system (P01-N, P03-I, P05-I, P06-N, P07-N, P09-N, P12-I). This hint system would let players ask for a clue to help them with their current challenge. Players wanted this hint system to be an opt-in system.

Although video games are championed as learning environments (Gee, 2003, 2004; McGonigal, 2011; Steinkuehler, 2006), we must assess the effectiveness of specific video games for different types of players (Dubé and Keenan, 2016). In particular, it is important to assess the game mechanics and how those impact different player's gameplaying practices. Returning to situated action, difficulties with a complex photocopier were not due to “any lack of general technological sophistication on the part of its users but rather of their lack of familiarity with this particular machine” (Suchman, 2007, p. 9). The more experience a person has with a particular machine, or the semiotics related to that machine, the better they will understand that machine. Similarly, the more experience a person has with a certain video games, or the semiotics related to that video game, the better they will understand a certain video game. This means people who are regular video game players will have an advantage in video game learning environments. Video games are not a universal solution for revitalizing learner engagement and skill development. Instead, video games can engage existing video game players who may find traditional learning methods less interesting.

7.2 Contributions

This research makes contributions to several areas: 1. scholarship on information practice; 2. the fields of Information Studies and Game Studies; 3. video game developers and game design; 4. gamers from diverse backgrounds.
Contribution to scholarship on information practice

The information practices of video game players are an underrepresented segment of the larger body of information practice scholarship. In the few studies that involve information practices of video game players, the approach has been examining information practices that are supplementary to gameplay (Adams, 2009; Harviainen and Savolainen, 2014; Storie, 2008). These supplementary information practices include browsing game-related forums, consulting wikis, reading guides and manuals, watching videos or talking with fellow players. These studies are summative and ask players to share their information practices that have developed over their career with a specific game.

This study contributes a new approach to information practice scholarship. I focus on a specific instance of information practice, which I call episodic information practice. This instance-based information practice is intended to examine the first encounter and only the first encounter with a video game. Focusing on this first encounter emphasizes the way a player makes sense of an unfamiliar game rather than the information practices they have developed during their career with the game. This is a new approach for information practice scholarship, both in terms of study design and domain.

This approach can be used for other information practice scholarship that examines how people interact with digital artifacts. Drawing from user-focused Game Studies and human-computer interaction, this project emphasizes a first-encounter in a specific video game. In other contexts, this could include a classic case like a user interacting with a library catalog. Information practice provides a way to understand how a person makes sense of an unfamiliar situation. This could provide a potential direction for information practices with digital artifacts conducted as user studies.
Chapter 7. Conclusion

Contribution to Information Studies and Game Studies

This study makes a methodological contribution to the fields of Information Studies and Game Studies. Using a modified approach to the video commentary model, I collected data that combined a gameplay session and post-play interview. The gameplay session was recorded and reviewed during the post-play interview. Players controlled the video playback and commented on their gameplay session. This allowed players to talk more specifically about their gameplaying practices. Players reviewed instances that they found meaningful and provided detailed commentary on those instances. The retroactive talk aloud approach and player participation in data collection provided a rich data set that was unique to this methodology. Video commentary model has potential application for future studies involving human participants and digital objects. Researchers can record the interactive session and review that session with the participants, having the participants identify what they found meaningful. This may yield unanticipated results from current research approaches in Information Studies involving video games.

Also, this study provides a theoretical contribution to Game Studies research by connecting Information Studies theory and methodology with user-focused Game Studies scholarship. I draw on the traditions of player-focused studies and connect an similar epistemological emphasis on lived experience. This study introduces the term gameplaying practices, a combination of information practice, knowledge-in-practice, and gameplay. The emphasis of gameplaying practices is how players address challenges in their gameplay sessions. This is a player-focused research approach, emphasizing the subjective player experience in a particular game. I draw on information practice theory, which similarly emphasizes the lived experience of a person in a particular domain. This player-focused draws from a similar body of scholarship in Game
Studies while providing connections with information practice theory.

**Contribution to video game developers and game design**

Video game players are diverse in their previous experience and their expertise. Designing a compelling video game for a diverse audience is a difficult challenge for game developers. This study provides a methodological foundation for developers to play test their games with a diverse audience. Particularly in early builds of games, this approach would provide insights into what is unclear for particular groups of players. This is potentially rich data on how to improve a game in early development stages. This contrasts the usual quality assurance process, which primarily involves bug testing with in-house staff. Studying first encounters with video games in development could create more inclusive games. By studying a diverse player group, developers could identify gaps in their game logic or game mechanics, or identify missing features or interface improvements.

For video game design more generally, this study identifies a number of areas where players criticized particular design choices. This included interface design, clarity of game mechanics, variable difficulty, and portal precision. Players would prefer that the challenge in *Portal* comes from the puzzles rather than precise portal placement. The most common suggestion was the inclusion of a hint system, where a player can choose to receive a hint. This is applicable for nearly all first encounters with video games, where players may be confused about how to play effectively. An early hint system may provide the information necessary for players to bridge the gap. This could be the difference between frustration and engagement for a particular game.
**Contribution to gamers from diverse backgrounds**

Novice gamers are underrepresented in video game culture. Often rejected as “n00bs” or “filthy casuals”, the novice gamer faces substantial barriers. For a novice player who wants to participate in video games, the learning curve can be difficult. A novice player may be enthusiastic to play but feel alienated by the skill barrier. This does not even begin to address the standard factors of race, class, gender, and accessibility. This is a complex issue. The purpose of this study was to focus on the characteristics of first encounters for all kinds of players. What I discovered is that the skill gap for novice players is most prominent barrier to playing video games.

This research and methodology provides a direction for improving first encounters. By studying the gameplaying practices of novice players, developers could create more inclusive design features that address the needs of these players. A hint system is one possible direction but this kind of research could result in innovative design practices that attempt to meet players of different expertise within the same game or genre.

**7.3 Future work**

I plan to expand on this study with different parameters for the gameplay session. I want to allow players more freedom. The plan for this study was how a player uses the game itself as a learning environment without additional resources. I asked players not to use their phones or other devices to look for information about the game during their gameplay session. The plan with this study was to assess how the design of *Portal* may or may not have been effective for different players. For the next version of this project, I want to tell players they have freedom to do whatever they would normally do. This may include watching gameplay videos on their phone.
to help them when they find an instance too difficult or unclear. To further the situated context of these supplementary information practices, I would also prefer to conduct the gameplay sessions in the player's normal play space. The issue for this study was that situated play space as research site involved a significant amount of setup and tear-down which was not time effective for a lone-researcher approach. Ideally a funded project could include a research assistant to help with this setup and tear-down.

Also, I plan to include eye-tracking as an additional data collection component. Eye-tracking maps where players look on the screen during their gameplay session. This may provide interesting results about how different players identify relevant information. Similar to video commentary model, I plan to review the eye-tracking data with participants following the gameplay session. I believe that players can provide valuable reflections on their process, specifically how they identified and used relevant visual information. This would be a strong supplement to their comments on their gameplay footage. I plan to combine their eye-tracking data with the gameplay footage in key instances and ask players to describe their thought process as well as their eye-movement.

As a theoretical contribution, I plan to continue this research on player diversity and contribute more findings on how different players experience video games. I was not anticipating the variety of experience amongst different adult players. The most surprising finding from this study from my perspective was that novice players did not understand the portal metaphor, even following an explanation during the post-play interview. The relationship between the blue portal and the orange portal was still unclear to the majority of novice players. Understanding these foundational interactive metaphors and game mechanics is necessary for progressing through *Portal*. If this game mechanic is unclear in a game like *Portal*, it is likely unclear for many
players during their first encounter with a new video game. This is a problem for
game developers and for anyone planning on using a video game as a site of public
engagement. Information Studies and Game Studies should continue to explore this
problem and recognize who is left out. As video games become more pervasive in
education, health care, government, and other public services, we must emphasize
the digital divide between gamers and non-gamers.

Additionally, I want to further explore the relationship between Csikszentmihalyi's
flow theory and subjective experiences of challenge in video games. Flow theory was
an important theoretical framework for understanding subjectivity and challenge in
video games but was incorporated as a component of Dervin's sense-making theory.
This formed the basis for gameplaying practices but was not explicitly compared. I
revisited flow theory in the challenges subsection of the discussion chapter but I would
like to explore flow theory more explicitly in future work. In particular, I believe a
theoretical comparison between flow theory and sense-making is a valuable area of
exploration particularly as it relates to information practice research on video games.

Finally, this approach has potential applications for education games. Any video
game used for education purposes, particularly involving assessment, should meet the
skill level of a diverse audience. Play-testing with a diverse audience is necessary for
any education game. Video commentary model provides a framework for that play-
testing and may offer suggestions for features that reduce the digital divide between
gamers and non-gamers.
Bibliography


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Appendices
Appendix A

Consent letter
CONSENT TO PARTICIPATE IN RESEARCH

Gameplay in an unfamiliar environment: Novice and expert adult players encountering Portal for the first time

Andy Keenan, PhD Candidate, andy.keenan@mail.utoronto.ca

PURPOSE OF THE STUDY
The rationale for doing this study is to examine how different players encounter Portal for the first time and how the self-reported descriptions of those encounters vary between different players. It also seeks to gain an understanding of how players form strategies to overcome challenges in video games, and the individualized processes of those strategies.

PROCEDURES
If you volunteer to participate in this study, I would ask you to do the following things:

1. Please respond, by email or phone, as to your availability for an in-person game play session and interview. The session will last a maximum of 2 hours and will be recorded.
2. Please indicate how you would like to be contacted.

POTENTIAL RISKS AND DISCOMFORTS
There should be no potential risks or discomforts arising due to your participation in this study.

POTENTIAL BENEFITS TO PARTICIPANTS AND SOCIETY
This project will contribute a better understanding of how video game players encounter challenges and could lead to guidelines to design more inclusive video games. This research attempts to address how different players solve challenges in games.

CONFIDENTIALITY
Every effort will be made to ensure confidentiality of any identifying information that is obtained in connection with this study. All participant identities will be anonymized in written works, reports, or presentation of findings. All data will be encrypted and stored on a secure database maintained by, and available only to, the researcher. All records will be retained securely for seven (7) years.

PARTICIPATION AND WITHDRAWL
Your participation in this study is at your own discretion. You may withdraw at any time without consequences of any kind. You may exercise the option of removing your data from the study. You may also refuse to answer any questions you don’t want to answer and still remain in the study. You will be required to notify the investigator by email or phone if you wish to withdraw. The investigator may withdraw you from this research if circumstances arise that warrant doing so.
RIGHTS OF RESEARCH PARTICIPANTS
You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study.

If you have any questions or concerns about this research, please feel free to contact the researcher’s supervisor, Dr. Sara Grimes, Assistant Professor in the Faculty of Information, at sara.grimes@utoronto.ca

This study has been reviewed and received ethics clearance through the University of Toronto Social Sciences, Humanities and Education Research Ethics Board. If you have questions regarding your rights as a research participant, contact:

Office of Research Ethics
University of Toronto
McMurrich Building, 2nd floor
12 Queen’s Park Crescent West
Toronto, ON M5S 1S8
Telephone: (416) 946-3273
Fax: (416) 946-5763

SIGNATURE OF RESEARCH PARTICIPANT

I have read the information provided for the study “Gameplay in an unfamiliar environment: Novice and expert adult players encountering Portal for the first time” as described herein. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

____________________________________
Name of Participant (please print)

____________________________________
Signature of Participant

____________________________________
Date

SIGNATURE OF WITNESS

____________________________________
Name of Witness (please print)

____________________________________
Signature of Witness

____________________________________
Date
Appendix B

Email query to participants
Email Query to Potential Participants
To Potential Participant
Bcc Sara Grimes

Hi __________,

I’m wondering if you’d be willing to participate in a video game play session and short interview that would benefit my doctoral thesis research. I am currently working on a thesis at the University of Toronto’s Faculty of Information where I’m exploring how people play a video game for the first time. I am looking for people who have never played Portal. The session will last approximately 2 hours. In return for your time, I will be providing a $10 Starbucks gift card.

The game play session and short interview will take place on the University of Alberta campus in Edmonton.

Attached is a consent form outlining the research project. If you are interested in participating, please respond with a preferred means of contact, as well as a suitable time and date range for me to contact you.

Thank you for your consideration,
Andy Keenan

Doctoral Candidate
Faculty of Information
University of Toronto
p. [redacted]
e. andy.keenan@mail.utoronto.ca
Appendix C

Interview questions
Interview Questions
First Impressions of Portal
1. Tell me about your general experiences with Portal. What did you think of the game?

2. Were there similarities with other games that you've played before?
   b) Did you use anything you’ve learned in other games to help you play Portal?

3. Was anything unclear in the game?
   b) Did the game make it clear to you what you were supposed to do?

Specific Instances in Portal
1. What were you trying to figure out?

2. What conclusion did you come to?

3. What led you to that solution?

4. Let’s way you could have done whatever you want, without the restrictions of the game. What would you have done instead?

5. What stood in the way of that ideal situation?

Closing Thoughts on Portal
1. What was the most challenging part of the game for you?

2. What did you enjoy the most about the game?

3. Anything you would want to change about the game?

4. Any closing thoughts on your experience? Anything we didn’t get to talk about that you would like to share?
Appendix D

Snowball sample recruitment letter
SNOWBALL SAMPLE RECRUITMENT LETTER
Dear [Mr. / Ms. LAST NAME],

Thank you for your interest in Gameplay in an unfamiliar environment: Novice and expert adult players encountering Portal for the first time.

I am writing to ask whether you would be willing to pass along the enclosed information to friends and/or family members who may also be interested in learning about this research study. You are under no obligation to share this information and whether or not you share this information will not affect your relationship with the researcher or the University of Toronto.

Thank you for your time and consideration.

Sincerely,

Andy Keenan
Doctoral Candidate
Faculty of Information
University of Toronto
p. 780-604-5050
e. andy.keenan@mail.utoronto.ca

[Attached will be Appendix E – Recruitment Brochure]
Appendix E

Recruitment brochure
VIDEO GAME RESEARCH PARTICIPANTS NEEDED

Are you a video game player who has never played Portal or Portal 2?

I am conducting a research study for people who have never played Portal or Portal 2 (first-person puzzle games). The study involves playing Portal and talking about your experiences with the game.

Participants must be between the ages of 18-49. Players of all levels of experience are welcome.

The study takes approximately 2 hours.

To volunteer for this study, please contact me at andy.keenan@mail.utoronto.ca or 780-604-5050

Contact:
Andy Keenan
Doctoral Candidate
University of Toronto
andy.keenan@mail.utoronto.ca

Your personal information will be treated with complete confidence. All data is anonymized.
Appendix F

Portal map
1. Clock counts down until the first portals open.

2. Walk through the first portal, then around the Relaxation Vault and through the door.

3. Place the Cube on the Heavy Duty Super Colliding Super Button (herein referred to as the Button).

4. Walk through the door and in to the Chamberlock.
1. Walk into the pit.

2. Wait until the portal shows the Cube. Walk through the portal and pick up the Cube.

3. Wait until the portal shows the Button. Walk through the portal and place the Cube on the button. Return to the first room.

4. Wait until the portal shows the exit door. Walk through the portal and move through the door and in to the Chamberlock.
Chamber 2

1. Walk through the door, down the stairs, and stand near to the small opening on the wall.
2. Wait for the portal on the wall, walk through, and acquire the Portal gun.
3. Fire a portal, walk through it, and proceed in to the Chamberlock.
1. Place a portal on a nearby wall and walk through it.

2. Look to the right to see the Chamberlock, fire a portal at one of the walls near it. Walk back through the portal.

3. Proceed in to the Chamberlock.
1. Activate the Cube dispenser.
2. Fire a portal under the Cube in the pit.
3. Pick up the cube and place it on the button.
4. Proceed in to the Chamberlock.
Chamber 5

Cube order does not matter on this chamber.

1. Cube 1: Approach the pit at the back of the room. Fire a portal underneath the Cube in the pit.
2. Fire a portal on the wall or floor and pick up the cube.
3. Alternative: jump into the pit, fire a portal, and collect the cube. Walk through the portal with the cube.
4. Place the cube on either of the buttons.
5. Cube 2: Fire a portal and stand on the platform.
6. Fire a portal behind the adjacent raised platform. Go through the orange portal and pick up the cube.
7. Place the Cube on the remaining button. Proceed through the door.
8. In the radio room, look up and see an orange portal on the ceiling. Fire a portal on the wall and walk through the portal.
9. Proceed in to the Chamberlock.
1. Fire a portal above the Energy Pellet Collector, close to the orange light beam.
2. Walk to the lift, and proceed in to the chamberlock.
1. Fire a portal where the Energy Pellet hits the wall. This is indicated by the black scorch mark.

2. Fire a portal above the Scaffold. Walk through the portal on the floor when the Scaffold is visible through the portal.

3. Ride the scaffold to the other side and proceed into the Chamberlock.
1. Fire a portal where Energy Pellet strikes the wall, indicated by the black scorch mark.

2. Fire a portal in front of the Energy Pellet Collector (marked by an orange light) after the Energy Pellet passes through the first portal. This starts the Scaffold.

3. Fire a portal on a closeby wall and walk through it to the next platform.

4. While standing on the platform, fire a portal above the Scaffold. Wait for the scaffold to come into view through the orange portal and walk through the orange portal.

5. Ride the Scaffold to the other side and walk on to the platform.

6. Proceed in to the Chamberlock.
1. Fire a portal near the Cube. Pick up the cube and proceed through the portal onto the platform.

2. Standing on the platform, fire a portal through the small opening on the dividing wall. Walk through the orange portal with the Cube.

3. Place the Cube on the button.

4. Proceed in to the Chamberlock.
1. Fire a portal on a nearby wall or on the floor. Walk through the portal on to the platform and up the stairs.

2. Walk towards the ledge. Fire a portal on the floor below and jump through.

3. Move into the next section.

4. Fire a portal on the piece of wall that extends outwards. Jump through the orange portal.

5. Again, fire a portal on the new piece of wall that extends outwards. Jump through the orange portal.

6. Proceed in to the Chamberlock.
1. Walk up the stairs and fire a portal on the floor or wall.
2. Wait for the orange portal to be generated near the Switch. Walk through and activate
the Switch.

3. Fire a portal on the wall behind the door that opens from the Switch. Wait for the orange portal to generate behind you. Walk through the orange portal.

4. Fire a portal on the wall marked with the black scorch marks to collect the Energy Pellet. Wait for the orange portal to generate opposite of the Energy Pellet Catcher.

5. Walk through the blue portal on to the Scaffold.


7. Activate the Switch that emerges. Fire a portal on the wall behind the door that opens with the emerged Switch.

8. Fire a second portal on the other side of the Scaffold. Get on the Scaffold to reach the portal and move through it.

9. Proceed in to the Chamberlock.
1. Walk over to the ledge. Fire a portal on the floor below and a second portal on the wall above.

2. Jump through the portal on the floor and land on the other side. Fire a portal on the next wall, above the previous wall.

3. Jump through the portal on the floor and land on the other side. Fire a portal on the tilted wall and jump through the portal on the floor.

4. Pick up the Cube. Place the Cube on the button below the exit.

5. Jump through the portal on the floor for the final time.

6. Proceed in to the Chamberlock.
Chamber 13

1. Fire a portal on the wall and a second portal behind the Cube. Pick up the Cube and place it on the button.

2. Go through the door and enter the main room of the chamber.

3. Alternate - Stand on the button and shoot a portal into the main room of the chamber.


5. Fire a portal on the ceiling over the Scaffolding.

6. Fire a second portal on a nearby surface. Wait for the Scaffolding to be underneath the portal.

7. Walk through the portal. Pick up the Cube.

8. Fire a portal on the ceiling over one of buttons. Pick up the cube and walk through the portal. Place the Cube on the button.

9. Fire another portal on the ceiling over the other button. Stand on the button.

10. Fire a portal through the door that just opened. Fire a second portal on any surface.

11. Proceed in to the Chamberlock.

Alternative: take the first Weighted Storage Cube from the upper level of the area to activate one of the two buttons. Instead of shooting a portal through the Chamberlock door, shoot a portal through the button-activated door in the upper-level area.
Chamber 14

1. Walk to the left of the hall and proceed up the stairs.

2. Look to the left. Fire a portal on the wall near the ceiling across from the Cube.

3. Walk over to the ledge and look down onto the floor that used to be the stairs. Fire a portal on the floor and jump through.

4. Pick up the Cube and place it on the button.

5. Proceed to the next room with the platforms. Fire a portal on the other side of the room and one on the wall near you. Alternatively, jump across.


7. Move to the other side using the platforms, or follow the Energy Pellet through the portal.

8. Fire a second portal on the ceiling in the first area indicated by the orange light over the Energy Pellet Collector.

9. Use the platform and proceed in to the Chamberlock.
1. Walk forward to the glass partition. Turn around and look up. Fire a portal on the extended wall.

2. Fire a portal on the floor tiles that allows you to fall through the first portal and then through the second portal consecutively. If this works, you will reach the other side of the room.

3. Proceed through the hallway. Fire a first portal on the wall scorched by the Energy Pellet.

4. Fire a second portal above the lift parallel to the first portal.

5. When the Energy Pellet enters the portal go through the Emancipation Field.

6. Fire a first portal on the wall where the Energy Pellet hits and a second portal on the ceiling over the Energy Pellet Collector marked by the orange light. Proceed to the lift.

7. Proceed through the hallway. Fire a portal on the extended wall above the door.

8. Walk to the small room, climb the small stairs, and fire a second portal below. Jump through the portal.

9. Fire the first portal as you are about to land and create a daisy chain of portals to fly to the far side of the room.


11. Move through the daisy chain portal.

12. Fire a first portal on one of the angled wallpanels and a second portal on the other wall panel. Wait for the Energy Pellet to find the Energy Pellet Collector.

13. Fire a portal behind the angled wallpanels and fire a second portal on the floor in front of the other portal.

14. Go through the portal and fire the first portal on the floor in a daisychain.

15. Stand in front of the door and fire a portal at the end of the hall.

17. Proceed through the portal and look to the left. Fire a portal to the end of the hallway.

18. Wait for the platform and stand in front of the portal.

19. Repeat this process.

20. Board one of the lifts and reach the top.


22. Push the switch and proceed through the portal. Press the second switch. Shoot one portal on the extended wall facing the Collector and a second portal on the wall opposite of the Energy Pellet.

23. Take the lift. Proceed in to the Chamberlock.
1. Walk down the hall. Go through the door. Knock over the turret.

2. Walk to the end of the hall. Stay to the right, shoot a portal behind the portal. Shoot a second portal nearby. Knock over the turret.

3. Walk up the stairs. Move slowly around the wall and fire a portal behind the turret. Fire a second turret nearby. Knock over the turret.

4. Fire a portal above the turret and another portal nearby. Drop a Storage Cube on top of the turret.

5. Find the Red X above the other turret. Fire a portal above. Drop a Storage Cube through the portal. Use the storage cube as a shield and knock over the turret while holding the cube.

6. Keep carrying the Storage Cube and knock over the other nearby turret.

7. Repeat this strategy with the next turret indicated by the Red X.

8. Fire a portal on the wall behind the turret.

9. Take a Storage Cube and place it on the button.

10. Fire a portal through the opened door. Fire a second portal on a nearby wall.

11. Knock over the turret.

12. Repeat this procedure.

13. Proceed in to the Chamberlock.

   Alternative - Most turrets can be approached and knocked over using a Storage Cube.
Chamber 17

1. Proceed down the hallway. Pick up the Companion Cube, and use the Cube to climb up the ledges.

2. Use the cube to block the first Energy Pellet when walking down the hallway.

3. Move to the second hallway. Wait for the pellet to move past and move quickly to the oterside. Turn left and proceed through the door.

4. Jump down the ledge and into the room with three lifts, still carrying the Companion Cube.

5. Note: The order of these next steps does not matter. All three lifts must be activated before proceeding forward.

6. In the first area, fire a portal on the angled panel parallel to the Pellet Collector.

7. Fire a second portal in the nearest hallway on the black scorch mark on the near wall. This will activate one of the three lifts.

8. Pick up the companion cube and head to the door facing the lifts. Use the cube to deflect the Energy Pellet into the Pellet Collector. This will activate a second lift.

9. Carrying the cube, head to the room with the buttons. Place the cube on the elevated button on the ledge.

10. Fire a portal on the opposite wall outside the button room. Fire a second portal in the first hallway on the black scorch mark on the wall.
11. Proceed carefully through the portal, being careful to avoid the Energy Pellet. Stand on
the other button.

12. The Energy Pellet will land in the Pellet Collector after passing through the two doors.

13. Take the Companion Cube across the three activated lifts.

14. Place the Companion Cube on the button. Activate the switch in the opened room. Drop
the Companion Cube into the incinerator.

15. Proceed in to the Chamberlock.
1. Walk to the end of the hallway. Turn around and fire a portal on the third panel above the hallway.

2. Go back in the hall and shoot a portal on the floor at the end of the hallway. Drop down through the portal.

3. You should automatically drop through for the second time and then land on the other side of the Goo.

4. Turn right and place a portal on the ceiling. Put the other portal on the wall above the goo and jump through it.

5. Turn to face the platform above. Shoot a portal on the ceiling above it and the other one under yourself.

6. Turn towards the door. Fire a portal on the same wall and put the other one near yourself and go through.

7. Place a portal on the extended wall panels near the ceiling. Shoot the other one on a platform below and jump through it.

8. Walk to the switch and push it. Crouch and get to the second part of the chamber. Go to the left.

9. Follow the aiming beam of the turret on the platform near you. Shoot a portal on the wall where the beam ends and the other one where the High Energy Pellet emitter is going to shoot next. Wait for the Pellet to knock the turret over.
10. Do the same again for the turret aiming at the same wall and to the turret near you.

11. At the back of the chamber there are extended walls facing the last turret. Put a portal there and the other one where the emitter is going to shoot next.

12. You should have deactivated all of the four turrets. Go stand next to the switch and fire a portal on the extended walls on the other side of the chamber.

13. Shoot a portal on the wall where the emitter is about to fire the next Pellet and wait for the Pellet to go through the portal.

14. Quickly fire a portal on the wallpanels facing the switch and the other one on the wall near you. Enter through the portal and press the switch.

15. Wait for the Pellet to reach the catcher and walk to the Unstationary Scaffolding.

16. Get on the platform and wait for it to stop at the other end. Then drop down behind the switch.

17. Shoot a portal above the glass on the other side and the other one on the wall next to you.

18. Push the switch and go through the portal. When the panels are in the correct angle, put a portal on the panels and then turn left and go to the ledge.

19. Shoot the other portal on the floor below and drop down through the portal.

20. Pick up the cube and wait for the Unstationary Scaffold to get near you. Then jump on the platform with the cube.

21. Place the cube in front of the glass and place a portal above the glass. Turn around and go on the platform.

22. Jump behind the switch again and put a portal on the wall.

23. Push the switch and go through the portal. Pick up the cube and walk over to the first part of the chamber.

24. Place the cube on the button and fire a portal on the wall with the open door.

25. Drop down on one of the platforms and fire a portal on the floor. Go through the portal.

26. Go through the open door behind you and walk to the other end of the corridor and drop down.

27. Shoot a portal on the platform further away. Turn to the left and fire the other portal on the floor there and drop down.

28. When you have gone through the portal and are about to fall down again, place a portal on the platform beside you and go through the portal again.

29. Do this two more times. You should then see angled panels somewhere. Shoot the portal there and you will reach the elevator.
Appendix G

Demographic survey
Portal play through questionnaire

1. Participant Number

2. Age

3. Gender
   Male, Female, Transgender, Other

4. What is the most recent video game you have played?

5. What genres of game do you like to play?
   Select all that apply
   Check all that apply.
   - Adventure
   - Fighting
   - First Person Shooter
   - Massively Multiplayer Online Game (MMOG)
   - Puzzle
   - Real Time Strategy
   - Retro/Arcade
   - Role Playing Game
   - Simulation
   - Sports
   - Tactical Shooter
   - Tower Defence
   - Other: .................................................................

6. What is your favorite video game?

.................................................................
7. **How often do you play video games?**
   Can include mobile games (iPhone, Android), console (Playstation, XBox, Nintendo), PC (Steam, solitaire), or any other form.
   *Mark only one oval.*
   - [ ] Everyday
   - [ ] A few times per week
   - [ ] Weekly
   - [ ] Monthly
   - [ ] Rarely
   - [ ] Other: .................................................................

8. **How often do you play console video games?**
   This includes XBox, Playstation, and Nintendo or multiple console PC games most commonly found on Steam.
   *Mark only one oval.*
   - [ ] Everyday
   - [ ] A few times per week
   - [ ] Weekly
   - [ ] Monthly
   - [ ] Rarely
   - [ ] Other: .................................................................

9. **How often do you play first-person perspective games?**
   First-person perspective games include first-person shooters (Call of Duty, Half Life, or Doom) and first person role playing games (Fallout, Skyrim, or Myst).
   *Mark only one oval.*
   - [ ] Everyday
   - [ ] A few times per week
   - [ ] Weekly
   - [ ] Monthly
   - [ ] Rarely
   - [ ] Other: .................................................................

10. **How would you rate your experience with video games?**
    *Mark only one oval.*
    
    | 1 | 2 | 3 | 4 | 5 |
    |---------------------------------|
    | I do not have experience playing video games | [ ] [ ] [ ] [ ] [ ] |
    | I have significant experience playing video games | [ ] [ ] [ ] [ ] [ ] |
11. How would you rate your confidence with video games?  
*Mark only one oval.*

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12. How would you rate your experience with first-person-perspective video games?  
First-person perspective games include first-person shooters (Call of Duty, Half Life, or Doom) and first person role playing games (Fallout, Skyrim, or Myst).  
*Mark only one oval.*

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13. How would you rate your confidence with first-person perspective video games?  
*Mark only one oval.*

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14. What do you know about the game Portal?

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Appendix H

Portal chamber completion times
Portal chamber completion times

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Numbers in red indicate when the player did not complete the chamber. These have been excluded from the average time to completion.
Appendix I

Developing Portal
Appendix I - Developing Portal

The origins of *Portal* account for the unique qualities of the game. Originally a student design project, *Portal* is more of an experiment or tech demo than a fully realized game. *Portal* was too short to release as a stand-alone title sold at full retail cost. Instead, developer Valve included *Portal* as part of a bundle of games known as *The Orange Box*.

**Valve**

*Portal* is developed by Valve Corporation, a video game development and distribution company based in Bellevue, Washington. Founded by Gabe Newell in 1996, Valve is famous for two major products: 1. the Half-Life series and its Source engine; 2. Steam, a digital distribution platform for computer video games. Valve’s initial success was based on its innovative game design and critically acclaimed released. The recent growth of Valve is based primarily on the Steam platform. Steam is the iTunes of video games, providing players with a portal for their computer gaming experience. This includes purchasing, cloud storage, multiplayer, social interaction, meta-game achievements, and distribution for independent and commercial developers.

Valve operates with a flat hierarchy. There is no direct management structure. There are no bosses at Valve. This encourages employees to take risks, try new ideas, and critique decisions in the development process. Valve’s games are high quality releases, generally receiving the highest possible reviews for games released in that year. However, this also creates major delays in the release process. These delays are known as “valve time”, the significant gap between a reported release date and an actual release date. A running joke within the online gaming community is the imminent release of *Half-Life 3*, rumoured to be in
development since 2010. This gap between development and release date is a common theme for Valve.

**Narbacular Drop**

Valve often breaks standard conventions and uses unique gameplay features. This is the case with *Portal*. *Portal* is based on a student game design project called *Narbacular Drop* a first-person perspective puzzle game where players must escape rooms using gateways, or portals. Developed in 2005, *Narbacular Drop* was the senior game project for a group of students at the DigiPen Institute of Technology in Redmond, Washington. The main character in *Narbacular Drop* is Princess No-Knees, whose name reflects her inability to jump. She is trapped in a dungeon and imprisoned by a demon. With the help of an elemental creature named Wally, the Princess attempts to escape the dungeon using Wally’s portal ability.

Because of the unique mechanic of portals, *Narbacular Drop* won a number of awards from various outlets during the 2006 award year. In nearly all first-person shooter games, the player has the ability to jump. Often jump is mapped to one of the primary buttons and becomes a key mechanic in proceeding through the game. By taking away the jump feature *Narbacular Drop* asked players to conceive of solving puzzles in a novel way. Portals replace jumping, forcing players to interact with the environment in an unfamiliar way. The portals allow players to reach places in a level that would normally be reached through jumps. The final version of *Portal* allows players to jump, although jumping is not required to solve any of the puzzles. Even Valve succumbed to the standard conventions of first-person perspective games that almost always include jumping.
Narbacular Drop is a relatively short game with only 6 puzzles for players to solve. The game is considered more of a tech demo than a fully realized game. However, it provides the core for Portal including the portals themselves, the restriction to only shoot portals on certain kinds of surfaces, switches activated by boxes, and environmental objects that can kill the player (in Narbacular Drop these are boulders, in Portal these are energy pellets). Valve hired the entire development team for Narbacular Drop. This group became team who developed Portal. They kept several of the same conventions from Narbacular Drop including the female protagonist, the blue and orange portals, the mechanics and function of the portals, and the omnipresent antagonist.

The Orange Box

Portal was first released with The Orange Box, a compilation of Valve games including Half-Life 2 and its related episodes, and Team Fortress 2. The Orange Box was a major success, receiving rave reviews from critics and selling well on all three major platforms (PC, Playstation 3, Xbox 360). The Orange Box won numerous game of the year awards for 2007 including The Academy of Interactive Arts and Sciences, BAFTA Video Game Awards, and Spike Video Game Awards, amongst others. Portal was praised as the breakthrough title from The Orange Box.

Based on this success, a standalone version of Portal entitled Portal: Still Alive was released the following year. Portal: Still Alive contained additional maps and single player modes that added optional game modes with more difficulty to the standard game. This included a speed run mode (how quickly you could complete a level) and two strategic modes (1. use fewer portals; 2. take fewer steps), along with an advanced set of chambers.
Appendix J

Portal 2
Appendix J - Portal 2

Examining the differences between Portal and Portal 2 provides an interesting site for critique. I argue that this provides a glimpse into what worked and what did not work in the original Portal. The major changes between the games were the redesigned levels in the initial chambers and the inclusion of a zoom feature. Overall, Portal 2 provides clearer instructions on the mechanics of portals. The re-designed early levels suggest that the core portal metaphor were not as clear as the developers had intended. Players may have found it difficult to understand these new game mechanics.

Zoom

Portal 2 includes a zoom feature. Using a shoulder button on a standard controller, players can zoom in and magnify an area. Players are also permitted to fire portals while zoomed in. This allows players to make more difficult long range portal shots. There are two major consequences to this zoom feature: 1. players are able to survey areas of the chamber at a distance; 2. players can fire portals more accurately at longer distances. I argue that Valve’s development team included the zoom feature to improve a player’s experience in the game by reducing the complexity of the firing portals. Zoom further alleviates the potential misconception that success in Portal 2 is related to firing portals and therefore requires accurate aiming. Zoom allows players with less familiarity with aiming to make more difficult shots.

Viewing this through procedural rhetoric, the Portal 2 developers have decided to simplify the process of firing portals accurately. This conveys to the player that succeeding in Portal 2 is not an issue of accurate shooting, like other first-person shooters. Succeeding in Portal 2 requires players to assess puzzle
elements and make correct decisions about the order of operations within the puzzle. Zoom allows players get closer to the puzzle solving by reducing the complexity of the interface. This also relates to Juul’s concept of the relationship between interface and gameplay. By making shooting easier through an interface improvement, that is using the zoom feature, the developers are foregrounding puzzle elements. Players are required to make correct puzzle decisions rather than make accurate shots.

Portal 2 level design

Portal 2 uses an integrated tutorial approach. Instructions on how to play the game are embedded into the first levels of the game. Using increasingly difficult chambers, Portal 2 teaches players the required skills to progress through the game in a specific order. The difference with Portal 2 is the process is more explicit. While Portal is more exploratory, Portal 2 provides more specific direction.

Because each game takes place in the same space, the Aperture Science Computer-Aided Enrichment Center, players encounter the same levels in the beginning of each game. These levels are designed to help the player learn the basic concepts of portals and how to solve puzzles with portals. Portal 2 changes the design of some of these early levels. I argue that this can be read as an improvement in the design process. The developers realized which concepts may be unclear or may cause a player to get stuck and clarified these concepts.

Chamber 01 of Portal 2 attempts to teach players the same relationship between the blue portal and the orange portal as Chamber 01 of Portal. Portal places a player in a chamber with 4 separate rooms - one room has the orange portal, which remains static, one room has a weighted cube, one room has a
weighted cube button, and the last room has the exit door. The blue portal moves between the three rooms (cube, button, exit) intermittently, outside of the player’s control. The player must use the static orange portal to navigate the three rooms and complete the simple puzzle. However, the player does not yet have the portal gun in Chamber 01 of Portal. The blue portal is generated on an intermittent loop, with each iteration lasting 5 seconds. The relationship between the two portals may be challenging to decipher in this scenario. This is only one of two instances that the player does not control over the location of the blue portal, and the only instance where the blue portal appears without a specific source (that is, the portal gun).

Chamber 01 of Portal 2 changes this relationship between the blue portal and the orange portal. Again, the player does not yet have control of the portal gun and the orange portal remains static in the first room of the chamber. However, the player controls the location of the blue portal using buttons that are adjacent to the weighted cube room and the weighted cube button room required to solve the puzzle. The relationship between the orange portal and the blue portal is explicit through the player’s control over the location of the blue portal via buttons.

This suggests that players in Portal had a difficult time understanding the relationship between the orange portal and the blue portal in early chambers. This also means there was potential confusion for players with the blue portal randomly generating in Chamber 01 of Portal. This change to the level design in Portal 2 indicates this was a concern for the developers, otherwise the level would have remained the same.

Similarly, Chamber 02 in Portal 2 combines Chamber 02 and Chamber 03 from Portal with some design changes. In Portal, players enter into a gap
between two ledges and must navigate out of that gap using a blue portal to exit the static orange portal on the far ledge. *Portal 2* makes those ledges much higher than in *Portal* to reinforce to players that they are not able to jump out of the gap. They must use a portal to exit the gap. In Portal, players are able to see over the ledge, which may indicate they need to find some way to jump out. *Portal 2* makes the ledge much higher, taking away any possibility that a player could exit with a jump.

*Portal* uses an aesthetic feature of pistons underneath the ledges, which were not an interactive feature, but were visually distinct from the rest of the room. Instead of the normal grey walls, the pistons were surrounded by red walls. This piston feature and red wall is completely removed from *Portal 2*, suggesting that players have found those features distracting and may have been overly focused on the visual difference instead of utilizing the gameplay mechanic of the portals themselves.

Overall, *Portal 2* highlights the relationship between the blue portal and the orange portal more clearly than *Portal*. *Portal 2* provides clearer instructions on the mechanics of portals. This suggests that the level design in *Portal* was not as clear as the developers had intended on showing players these new game mechanics.
Appendix K

Aperture Science
Appendix K - Aperture Science

*Portal* takes places in the Aperture Science Computer Aided Enrichment Center, a research facility run by Aperture Science. The lore of Aperture Science is not revealed in the first Portal game but *Portal 2* provides an interesting narrative for Aperture Science. Aperture Science is part of the *Half-Life* universe as a direct rival to Black Mesa, a research corporation that is apparently held by the US Government. Aperture Science is the number two contractor behind Black Mesa. Aperture Science founder Cave Johnson despises Black Mesa. The original *Half-Life* game takes place at the Black Mesa Research Facility.

Founded in the early 1940s by Cave Johnson, Aperture Science was originally known as Aperture Fixtures. Aperture Fixtures was a shower curtain manufacturing and distribution company, which Cave Johnson refers to as a low-tech portal between the outside world and the shower. Aperture Fixtures received a US Government award in 1943 for Best Shower Curtain Contractor, supplying shower curtains to the military efforts during World War 2. From there, Aperture Fixtures transitioned into Aperture Science. Borrowing from the inspiration of the low-tech portal, Aperture Science began development on an inter-dimensional portal gun. Testing for this gun took place in an abandoned salt mine in Upper Michigan that eventually became the Aperture Science Computer Aided Enrichment Center.

**Aperture Science Computer Aided Enrichment Center**

The Aperture Science Computer Aided Enrichment Center is a sterile environment. The test chambers consist primarily of grey walls, with a few surveillance cameras and overlooking office spaces. This clinical environment was an intentional decision, according to developer Kim Swift:
We were working with complex environments way back when, but that was the wrong idea for Portal. Because we’re introducing a new concept, it was best to keep it bare bones. In one section, all you were supposed to do was put a box on a button and open a door. One player literally spent 30 minutes trying to push a shelf onto the button, meanwhile, the box was sitting right there. That’s how the clinical test-chamber environment came to be (Elliott, 2008)

The austerity of the game was intended to provide fewer distractions for players as they learned new game mechanics. In a similar direction to Kim Swift, I choose Portal for its austerity.

The simplicity of the environment ideally allows players to focus on the challenges. This was an intentional choice to have players interact more directly with their gameplaying practices. Fewer distractions from those gameplaying practices would ideally illicit richer responses from participants. They would be able to better articulate their experience with solving challenges rather than be distracted by the game’s environment.

The other reason for choosing a game that takes place in a sinister testing centre was irony, and ideally reflexive irony on the part of the player. I wanted players to laugh at Portal. I also wanted them to recognize the playful nature of this user study. I was not evaluating them on their gameplay and I wanted an ironic way to remind them about the experiential nature of the study.
Appendix L

Characters of Portal
Appendix L - Characters of Portal

Aside from the player, Portal only has one character - an omnipresent operating system intent on killing the player. While some hints are provided about the player's identity, the sparse details of Portal provide a space for the player to place themselves into the narrative.

GLaDOS

GLaDOS, the Genetic Lifeform and Disk Operation System, is an artificial intelligence system designed to control and oversee the Aperature Science Computer-aided Enrichment Center (Hodgson and Stratton, 2007). GLaDOS is omnipresent in Portal, guiding the player through the testing chambers and providing commentary as the player progresses through the game. As Portal begins, the player wakes up in the Relaxation Vault and first encounters the voice of GLaDOS. The voice is robotic and seems automated, functioning like a recording to guide the player. GLaDOS represents Aperture Science's research program, and initially seems helpful and encouraging. According to developer Kim Swift, Portal was initially too dry. The easiest way to solve that problem was with a disembodied voice:

With only a handful of people on the project, creating a whole new character with animations and the like would’ve been a lot of work. What’s the path of least resistance? Disembodied voice! (Elliott, 2008)

As the player progresses through the game, GLaDOS becomes sarcastic and confrontational. The arc of GLaDOS is similar to other computer adversaries,
most notably HAL 9000 from 2001: A Space Odyssey. Like HAL, GLaDOS gradually transitions from a friendly and helpful companion to an undermining critic and finally to a murderous enemy. In the final level, GLaDOS is revealed as the enemy. Using a neurotoxin, GLaDOS has killed all of the scientists and presumably all other test subjects at the Aperture Science Computer-aided Enrichment Center before the events of Portal. She attempts to kill the player twice, first with an incineration masquerading as a party with cake (a long-promised reward for completing the game) and finally with neurotoxin during a final battle.

GLaDOS is the only character that players encounter in Portal. There is no interaction with GLaDOS, just a disembodied voice as players reach particular waypoints in the game. Players cannot respond to GLaDOS. The only time players visually encounter GLaDOS is during the game’s boss battle.

The appeal of GLaDOS as a villain comes from a strange confluence of wit, sarcasm, instruction, and conflict. GLaDOS is celebrated by critics and gamers as a great video game character. In 2010, GLaDOS was ranked as the number one video game villain of all time by entertainment website IGN. GLaDOS represents a unique approach to storytelling, serving as a simultaneous narrator, companion, and enemy. The player is provided with small details about her history through GLaDOS, but these are only glimpses. Players can make assumptions based on the comments from GLaDOS, but there is never a clear answer.

In the game play session for this study, players do not progress far enough in the game to encounter the fully-realized adversarial GLaDOS. While GLaDOS does make some vague illusions to the eventual demise of the player, GLaDOS is primarily comic relief in the first hour of the game. GLaDOS makes a few
disparaging comments about the player, but mostly provides positive feedback. The tone of that feedback as sarcastic and undermining does not become clear until the true corrupted nature of GLaDOS is revealed in the final level of *Portal*.

**Chell**

Chell, or Test Subject Number 1, is the playable character in *Portal*. She is a silent protagonist with a mysterious identity (Hodgson and Stratton, 2007). GLaDOS provides only one clue about Chell’s origin. GLaDOS refers to the - “Aperature Science bring your daughter to work day” as “the perfect time to have her tested”. This suggests that Chell, now a grown woman, may have been in the Enrichment Center for some time, first brought by a parent employed by Aperture Science. Chell does have one unique feature, cybernetic knee attachments. This allows Chell to fall from any height without taking any damage.

This silence of Chell and lack of details about her origin provides a space for the player to inhabit the character. This creates the illusion GLaDOS is speaking directly to the player. There are no other characters in *Portal*. The only visual encounter with something other than the testing facility is the moments when a player sees reflections of Chell through the portals. The first-person perspective furthers the sense of immersion for players. I often found myself forgetting that I was playing as Chell. I felt that GLaDOS was providing feedback to me, rather than feedback to Chell. This could also explain the popularity of GLaDOS as a villain - players feel as though they are directly facing GLaDOS, rather than facing GLaDOS as Chell.
Appendix M

Most recently played video game
Appendix M - Most recently played video game, genre in parentheses

- Battlefield 4 (First-person shooter)
- Candy Crush (Puzzle)
- Diablo III (Role playing game)
- Hearthstone (Card game)
- Marvel: Agents of Shield (Adventure)
- Mount & Blade Warband (Adventure, Role playing game)
- Movie theatre racing game (Racing)
- NHL 13 (Sports)
- NHL 15 (Sports)
- Snake (Retro/arcade)
- Super Smash Brothers (Fighting)
- Tetris (Puzzle)
- Tower Madness (Tower defence)
- World of Warcraft (MMOG)
Appendix N

Favorite video game
Appendix N - Favorite video game, genre in parentheses

· Assassin's Creed 3 (Action, Adventure)

· Call of Duty: Black Ops 2 (First-person shooter)

· Civilization V (Turn-based strategy)

· Doom (First-person shooter)

· EA Sports NHL franchise (Sports)

· Fire Emblem (Role playing game)

· Katamari Damacy (Puzzle)

· Super Spike Volleyball (Sports, Retro/Arcade)

· Super Mario Galaxy (Adventure)

· Super Mario Galaxy 2 (Adventure)

· Super Mario World (Adventure)

· World of Warcraft (MMOG)
Appendix O

Summary of the theories
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<th>Application</th>
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<td>Reality is constructed rather than objectively measurable</td>
<td>Ontological framework</td>
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<tr>
<td>Situated cognition</td>
<td>Knowledge is situated in an activity, context, and culture</td>
<td>Playing a video game is a dynamic interaction between the player and the game</td>
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<td>Situated action</td>
<td>The relationship between plan and action, canoe metaphor</td>
<td>Analyzing player experiences by examining their plans and actions</td>
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<td>Zone of proximal development</td>
<td>Learning through a more knowledgeable other</td>
<td>Evaluating the learning artifacts in Portal</td>
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<td>Affinity groups</td>
<td>People with domain knowledge share a semiotic core</td>
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<td>Gameplay</td>
<td>The interaction between the player and the game</td>
<td>Site of analysis from the user study</td>
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<td>Lusory attitude</td>
<td>Voluntary attempt to overcome unnecessary obstacles, the peculiar state of mind during gameplay</td>
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<td>Possibility space</td>
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<td>Flow theory</td>
<td>Right balance between player skill and game difficulty provides engaging experiences for players</td>
<td>How players of different skill levels approach Portal, subjective experience of difficulty</td>
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<td>Information practice</td>
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<td>How people make sense of challenging moments using information practices</td>
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<tr>
<td>Gameplay practice</td>
<td>Subjective experience of difficulty in a game</td>
<td>How players attempt to overcome challenges based on their previous gameplay experience</td>
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Table 1: Summary of theories