Effects of Self-Efficacy Supporting Video Game Elements on Control Beliefs

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Abstract

Self-efficacy—i.e., the perception of one’s ability to accomplish a specific task—is an important factor in developing motivation and showing resilience in facing challenges. This construct, along with perceived competence and dominance, makes up a collection of constructs we refer to as ‘control beliefs’. Control beliefs demonstrably enhance motivation, performance, and wellbeing outcomes. Despite control beliefs’ prominence in sports and personality psychology, the construct has yet to be explored holistically in games scholarship. The goal of this research is to create a theory-driven design framework to enhance player experience and wellbeing. To test the influence of self-efficacy and control beliefs on player experience outcomes, we developed a framework consisting of game elements associated with enhancing self-efficacy (SE) and integrated the elements into a bespoke game artifact, *Space Oddity*. Subsequently, we conducted two studies, with the second study being more comprehensive than the first. In both studies, we implemented two conditions: one where players engaged with our game featuring the SE-supporting framework (SE condition) and the other without the framework (NSE condition). The first study showed that game enjoyment in the SE condition was significantly higher than in the NSE condition but self-efficacy was not different between the groups. In the second study, following exposure to one of two game conditions, 120 participants responded to inventories assessing enjoyment and player control beliefs. In the SE condition, we observed higher levels of perceived competence, dominance, and enjoyment. Additionally, domain self-efficacy was significantly higher in players with high baseline general self-efficacy (baseline GSE) than those with low baseline GSE. Our results also demonstrated increases in general self-efficacy and dominance for all participants, while domain self-efficacy increased among participants with low baseline GSE who were in the SE condition. Our findings illuminate the influence of SE-supporting elements in enhancing player control beliefs and enjoyment, contributing valuable design insight for reducing the perceived difficulty of challenging games.
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Lastly, not saying that tea helped me in my research or write-up, but it definitely filled the ‘now what?’ gaps with a delightful taste, and that’s something worth mentioning in the acknowledgements.
Contributions and Awards

In this thesis, I used ‘we’ to reflect the guidance of my research team throughout the various stages of the project. However, since this thesis details my MSc program of research, it is important to note that this work represents significant individual effort, such that I am largely responsible for the work’s conceptualization, execution, and write-up. To summarize, I conducted a literature review before initiating the study, exploring related work and identifying gaps in the existing research. As a member of the expert group in the game design stage, I contributed to the categorization of game elements under each self-efficacy component and helped compile a list of game elements. I was involved in shortlisting suitable game genres. I developed Space Oddity —our bespoke research game— and took charge of practical aspects such as data collection, participant compensation, and data analysis.

This work has further informed a paper in preparation and has been recognized with two awards at the University of Saskatchewan research events. Firstly, I presented it as a poster at the 7th Symposium on Innovations in Computer Science and Applied Computing (Research Fest 2023). I received the highest points from the judges and was honoured with a Recognition Award, given my role as an executive member of the organizing committee at the time. Secondly, I won the third-place prize at the Graduate Research Elevator Pitch Competition 2023.
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1 Introduction

1.1 Motivation

When engaging in a task, it is important that an individual possesses a favourable perception of their own capacity to meet task demands: that is, they possess a sense of self-efficacy. This perception of self-efficacy represents a motivating factor in undertaking a task, how much effort is put into it, and how much persistence is shown during that task \[12, 4, 7, 69, 48\]. As such, it is a desirable psychological state that influences what tasks people are eager to undertake and progress in. When self-efficacy is not present or cannot be formed, a person’s willingness to engage in the task—and capacity to succeed in said task—are likewise compromised \[12\]. Conversely, when self-efficacy is present or encouraged, we see the inverse: improvements in motivation, performance, and wellbeing outcomes \[5, 21, 62\]. Self-efficacy has four source components (see section 2.3.1 for further detail): Mastery experiences (personal performance accomplishments), Vicarious experiences (seeing peers accomplish the same task), Verbal persuasion (receiving praise), and Physiological states (the physical and emotional states experienced during a task) \[4\]. Mastery experiences serve as the main source of self-efficacy \[4\]. While the most common dimension of self-efficacy involves an individual’s judgment of their own ability in a specific task, the two other dimensions are discussed in the literature as domain-specific self-efficacy \[49\] and general self-efficacy \[24\].

In the context of digital games, self-efficacy is an individual’s belief in their ability to successfully interact with a game and complete in-game tasks \[49\]. For example, relatively high self-efficacy in players drives them to master the game that they are playing—and since mastery experience precedes motivation and enjoyment \[12\], these players are more likely to enjoy the game than those players who have low self-efficacy. Furthermore, players with higher self-efficacy invest greater time and effort into more difficult stages of a game (for example, defeating stronger enemies) than those with lower self-efficacy \[12, 48\].

Video games are widely used arenas where players engage in mastering a set of skills, whether it is defeating a boss enemy, virtually landing an airplane safely, or solving mathematical problems. Given that mastering a skill is a profound source of self-efficacy, we speculate that video games can serve as a source of conveying self-efficacy beliefs if they are designed with this construct in mind. Understanding that possessing self-efficacy can offer benefits and evoke positive feelings in game players, it stands to reason that it could have a significant impact on enhancing or otherwise dictating the tone of the player experience. This motivation led to the initiation of Study One. However, recognizing the possibility of related phenomena being overlooked solely through self-efficacy assessment, we introduced additional constructs, namely ‘perceived competence’
and ‘dominance’ in Study Two. This methodological contribution allowed us to group these constructs under the umbrella term ‘Control Beliefs’.

Perceived competence and dominance are both constructs related to self-efficacy [29, 74]. Perceived competence refers to an individual’s judgment of their skills and capabilities to complete a task. It is closely linked to mastery experiences, as both contribute to a person’s perception of control over actions and outcomes [29, 31, 47]. While self-efficacy and perceived competence share mastery experiences as a primary source, they remain distinct psychological constructs. Dominance is an emotion, reflecting the extent to which a person feels in control of a situation. When combined with self-efficacy and perceived competence, these three constructs provide valuable insights into an individual’s control beliefs.

Borrowing from sports and personality psychology, this work investigates control beliefs: encompassing self-efficacy, competence, and dominance, and describes it as an individual’s perception of their ability to exert influence over their environment [43, 62]. Control beliefs play a critical role in internal regulatory mechanisms that influence behaviour, motivation, and emotional wellbeing—and can be facilitated or thwarted by day-to-day experiences. While self-efficacy, competence, and dominance are strongly related to player experience research, a holistic investigation of these interconnected facets is currently lacking within the broader player experience literature.

1.2 Problem and Solution

Recognizing that self-efficacy can be developed through mastery, vicarious experiences, verbal persuasion, and physiological states, we speculated that video games can be a source for conveying efficacy beliefs, particularly if intentionally designed to cater to self-efficacy source components. We questioned whether specific elements in a game are responsible for instilling self-efficacy and perhaps competence and dominance in players. Through our exploration of self-efficacy in games, we observed that in games user research, certain game elements are linked with self-efficacy and are assumed to enhance self-efficacy without much scrutiny [31]. Relying on elements to boost self-efficacy in games without assessing their actual effectiveness does not contribute to a robust and logically sound design. Furthermore, to the best of our knowledge, existing research does not provide a comprehensive set of game elements to guide the design of games specifically for self-efficacy. Therefore, our problem to solve in this thesis is: Does a curated collection of game elements affect player self-efficacy and the other control belief constructs (perceived competence and dominance)? If so, do they affect player experience in a positive way?

To explore the value of control beliefs in evaluating player experience, this work introduces a design framework of self-efficacy supporting (SE-supporting) game elements within digital games. This framework consolidates elements from the literature associated with self-efficacy into a coherent structure adapted to player experience contexts. Applying this framework, we developed a bespoke research game, Space Oddity, that demonstrates each element of our theoretical framework in action.
To address our problem queries, we have delineated our research questions for exploration through two empirical studies. In Study One, we investigated players’ self-efficacy and enjoyment, addressing research questions S1-RQ1 and S1-RQ2.

**S1-RQ1:** Do SE-supporting game elements influence players’ self-efficacy?
**S1-RQ2:** Do SE-supporting game elements affect game enjoyment for players?

Building upon this foundation, Study Two expanded the scope by incorporating control beliefs alongside enjoyment and perceived game difficulty. Consequently, Study Two provided a comprehensive exploration of S2-RQ1, S2-RQ2, and S2-RQ3.

**S2-RQ1:** Do SE-supporting game elements affect game enjoyment for players?
**S2-RQ2:** Do SE-supporting game elements affect players’ control beliefs?
**S2-RQ3:** Do SE-supporting game elements affect perceived game difficulty?

The *end goal* of our research is to create a theory-driven design framework to enhance player experience and wellbeing. We pursue this goal by focusing on improving players’ control beliefs through an enjoyable video game.

### 1.3 Evaluation

To evaluate the framework, we designed, developed, and evaluated a game comprising two versions: one incorporating SE-supporting elements (SE version), and one without SE-supporting elements (NSE version), allowing for the design of a controlled experiment. Player deaths were objectively recorded as part of the gameplay data. In Study One, participants’ self-efficacy and enjoyment were evaluated through post-gameplay self-report surveys. In Study Two, pre- and post-gameplay assessments were conducted for general self-efficacy, domain self-efficacy, and dominance. Additionally, post-gameplay assessments included enjoyment, task self-efficacy, competence, and perceived game difficulty. Following data collection, comprehensive processing and analysis were conducted to address the research questions.

### 1.3.1 Technological Framework

We chose the Unity game engine to develop our game due to its widespread popularity and robust capabilities. Additionally, we used the Bride of Frankensystem (BoF) online platform, a tool developed by the Interaction Lab, to deploy the study. Using this platform, we were able to seamlessly include a consent form, game builds, a video player, and all our surveys. BoF facilitated the integration of gameplay data and participant data, offering a smooth and cohesive experience for participants. This eliminated the need for participants to transition between different platforms for game hosting (e.g., itch.io) and survey platforms (e.g., SurveyMonkey). Finally, we hosted both of the studies on the *hci-mturk server*, ensuring that participant data was securely stored on university servers.


1.4 Contributions

This thesis reports two studies, namely Study One and Study Two. Recognizing the limitations encountered during Study One after the experimental phase, our focus on Study One was relatively limited. Subsequently, we shifted our attention to Study Two, which can be regarded as a comprehensive and robust iteration of Study One. Study Two takes the central focus within this thesis.

This work situates control beliefs within the player experience literature, creates a theory-driven framework of self-efficacy supporting elements, demonstrates this framework through our research game (*Space Oddity*), and provides empirical evidence that SE-supporting elements can increase players’ competence, dominance, enjoyment, and situationally increase domain self-efficacy. The key findings include:

- We show SE-supporting game elements lead to significantly higher enjoyment, competence and dominance.
- There is an observed increase in domain self-efficacy following the experience of SE-supporting game elements.
- SE-supporting game elements lead to higher domain self-efficacy, particularly in players with high general self-efficacy.
- The presence of SE game elements creates a perception of the game being easier in difficulty.

1.5 Thesis Outline

In Chapter 1, we give an overview of the research problem, the process of solving the problem and the important contributions of the present work.

Chapter 2 provides an overview of the current state of the existing literature and related research concerning the psychological constructs of control beliefs and their exploration in games literature.

In Chapter 3, we present our SE-supporting framework, the design process of our digital game and how we integrated this framework into our bespoke game. We outline the challenges in balancing the difficulty level of the two versions of the game.

In Chapter 4, we present Study One, wherein we explore the influence of our framework on player self-efficacy dimensions: general self-efficacy (confidence), domain self-efficacy (in video games), and task self-efficacy (related to playing *Space Oddity*).

In Chapter 5, we detail the modifications made to the research game following Study One and preceding the initiation of Study Two.

1 Throughout the manuscript, the identifier ‘we’ is used to reflect the guidance of my research team. However, it is important to note that this work represents significant individual effort, such that—as this thesis details my MSc program of research—I am largely responsible for the work’s conceptualization, execution, and write-up.
Chapter 6 centers on Study Two, the primary focus of this thesis. Study Two investigates the effects of our self-efficacy supporting framework on control beliefs, encompassing self-efficacy, perceived competence, and dominance in players. Additionally, we explore how our designed framework influences perceived game difficulty and player experience, specifically enjoyment.

Finally, Chapter 7 concludes the thesis by summarizing the research and its findings.
2 Related Work

2.1 Control Beliefs

Control beliefs centre around the notion of personal agency: an individual’s belief in their ability to exert influence over their environment and outcomes [43, 62]. Control beliefs have been found to exert a significant influence on individuals’ emotional states, wellbeing, and performance [63, 5, 21, 62, 11]. With control beliefs shaping how people interact with external challenges and internal cognitive processes, they are especially important to consider in fields that have high challenge and skill demands. Because of this, control beliefs have garnered significant attention within the domain of sports psychology, with a particular emphasis on their impact on athlete performance. In competitive sports, where performance outcomes are paramount, researchers have studied the influence of control beliefs on athletic performance—focusing on the related constructs of self-efficacy and perceived competence. Empirical studies have consistently demonstrated the positive impact of self-efficacy on athlete performance across various physical activities [27, 37, 72, 22]. Research affirms that athletes who possess a heightened sense of self-efficacy tend to exhibit superior performance outcomes and heightened satisfaction [27]. For instance, sport-confident runners with high self-efficacy beliefs are reported to have consistently achieved faster running times compared to their counterparts [37]. The literature also demonstrates that both high baseline self-efficacy and manipulated self-efficacy beliefs lead to improved competitive motor performance [72]. Separately, perceived competence, a construct with links to control beliefs, has seen widespread investigation. For instance, a strong association is found between perceived competence and athletes’ relative autonomous motivation in sports such as soccer, ice hockey, and basketball [54]. Specifically, players reporting higher perceived competence display greater levels of intrinsic motivation. Some studies have also suggested that positive feedback to players leads to higher intrinsic motivation and perceived competence [70].

2.2 Related Constructs

While control beliefs offer a useful theoretical lens, they lack a universal standard of measurement and are instead explored through a variety of interrelated constructs associated with self-belief and perceived control. Stemming from Self-Determination Theory (SDT) [17], perceived competence assesses an individual’s subjective proficiency within a given domain, which gives insight into their sense of control. Self-efficacy, from social cognitive theory (SCT) [4], pertains to one’s confidence in their aptitude to execute specific tasks,
and reflects their belief in their capacity to navigate and control associated challenges. While less frequently investigated, dominance is a construct within the Pleasure-Arousal-Dominance (PAD) emotional state model [39], and evaluates the extent to which individuals perceive they can exert influence over their environment, signifying their perceived agency in influencing outcomes. While self-efficacy, dominance, and competence are invaluable constructs in understanding specific aspects of control, the broader concept of control beliefs offers a more holistic, flexible, and integrative framework for understanding how individuals perceive their ability to influence their environment and outcomes.

2.2.1 Self-Efficacy

Self-efficacy is closely related to control beliefs, given that individuals possessing a strong sense of control typically exhibit higher self-efficacy beliefs [57]. Bandura’s concept of self-efficacy, as outlined in his work [4], pertains to an individual’s belief in their capability to accomplish a specific task. Efficacy beliefs vary across a wide range of activities or domains—a strong sense of efficacy in one specific activity domain does not automatically translate to self-efficacy in other areas [6]. General self-efficacy, synonymous with confidence [64], represents a cross-domain trait within the realm of self-efficacy beliefs [60, 24]. Separately, domain-specific self-efficacy pertains to a belief in one’s capacity within a specific domain (e.g., mathematics), while task-specific (or situational) self-efficacy pertains to a precise skill or task—such as an individual’s belief in their ability to complete a math puzzle.

Achieving success in a given task reinforces the belief in one’s capability to succeed in similar future situations, whereas failures can diminish one’s efficacy expectations [12]. Additionally, to a lesser extent, observing someone else successfully complete a task can also enhance one’s self-efficacy in that same task [4, 12].

2.2.2 Perceived Competence

Self-efficacy and perceived competence share a strong theoretical overlap in their facilitation of mastery experiences [51, 47, 29, 31], but remain distinct constructs. Specifically, self-efficacy exhibits a domain-specific orientation and is closely connected to anticipated outcomes, whereas competence—a foundational construct of SDT—represents a psychological need and source of intrinsic motivation. The subjective experience of competence is inherently gratifying, motivates autotelic behaviour, and exerts a positive influence on wellbeing that extends beyond the behaviour that facilitated it [16, 17, 53].

2.2.3 Dominance

Affective experiences are often assessed via Russell’s circumplex model of affect—a two-dimensional model that allows for the evaluation of emotion along the dimensions of ‘valence’ (that is, the tone of an emotion) and ‘arousal’ (that is, the intensity of the emotion) [55]. Earlier Work by both Mehrabian and Russell introduce
dominance within the PAD (Pleasure-Arousal-Dominance) Emotional State Model [10], and is likewise later included by Bradley and Lang in their Self-Assessment Manikin [10]. In these deployments, dominance is intended to assess the degree of control or confidence felt in response to a stimuli, and is robustly correlated with pleasure. Additionally, dominance is shown to be positively correlated with confidence [34]. The dimension of dominance tells us about the relative degree of dominance or submissiveness of the emotional state: for example, a low-valence, high-arousal emotion might be either fear or anger—but high dominance would suggest anger, whereas low dominance would suggest fear [65]. Dominance differs from self-efficacy and perceived competence in that it is a complementary measure of emotion—but the parallels between dominance, self-efficacy, and perceived competence are clear, in that all constructs pertain to an individual’s sense of control and capability within a specific measured context.

2.3 Control Beliefs in Games Literature

While the games and play research community has not yet discussed or examined control beliefs directly, it has examined related constructs in a piecemeal way through the constructs of competence, dominance, and self-efficacy. Control beliefs stand to serve as a unifying lens, allowing constructs from a diverse theory base to gain new meaning, and expanding our understanding of their effect on the player experience.

Before further discussing control in the context of video games, it is important to note that control beliefs are conceptually distinct from widely measured player experience constructs relating to controls, such as the intuitiveness of a game’s control interface. Intuitive controls, measured through the Player Experience of Needs Satisfaction [56], and ease of control, measured through the Player Experience Inventory [2], each concern the learnability of corresponding input on a game controller or interface, while control beliefs refer to a players’ perception of their ability to meet task demands.

2.3.1 Self-Efficacy in Games

Self-efficacy in video games is closely related to motivation [12, 30, 31], performance [9, 31, 67, 7], and game enjoyment [24, 67, 14]. Individuals with higher self-efficacy tend to invest greater effort and time in tackling the more challenging aspects of a game, such as facing powerful enemies, compared to those with lower self-efficacy [12, 48]. This inclination is driven by the desire to master the game they are engaged in. Importantly, mastery experiences, which involve successfully overcoming challenges, precede and significantly contribute to one’s motivation and enjoyment to a point that a player’s choice of games hinges on their perception of whether they can attain a level of mastery in those games [12].

Bandura describes self-efficacy as influenced by four components: Mastery experiences, Vicarious experiences, Verbal persuasion, and Physiological states [4]. In the following section, we outline self-efficacy components and their corresponding game elements as identified in games literature.

Mastery Experiences: This component is the first and potentially most impactful source of self-efficacy [4].
Mastery experiences are afforded by game elements that offer opportunities for players to gradually acquire skills, overcome challenges, achieve success, and contribute to their belief in their ability to perform well in the game.

Games literature has identified several elements that are associated with mastery experiences. Adapting the challenge to the players’ performance, either gradually or in real-time through Dynamic Difficulty Adjustment (DDA) systems, has been shown to boost self-efficacy [12, 71, 14] and enjoyment in games [74, 14]. Additionally, self-similar avatars have been found to increase mastery experience and influence players’ self-efficacy [32]. Step-by-step in-game tutorials at the beginning of games have been shown to facilitate the development of mastery experiences, as they provide guidance on what actions are required or possible within the game [31]. Tutorials not only expedite the learning curve for players but also empower them to envision themselves successfully performing the tasks, thus building self-efficacy within the game. Another effective mechanic for promoting the feeling of mastery experiences is recognizing player performance. Providing feedback to players regarding their achievements allows them to attribute their success to their own skills, which is a significant contributing factor to self-efficacy. In-game performance feedback can be delivered through mechanisms such as displaying scores [31, 26], visual and sound effects when earning or losing points [31], and the use of a progress bar [52].

Vicarious Experiences: The inclusion of game mechanics that enable players to observe and learn from the successful performances of others may enhance their self-efficacy, as it provides viewers with vicarious experiences for making efficacy comparisons [74, 15]. Game researchers [9, 31, 75] have suggested that leaderboards allow players to improve their performance through comparison with other competitors—finding that participants enjoy seeing a leaderboard feature in games, and use it to compare themselves to the top scorers. In addition to the mentioned elements, narratives are believed to offer players vicarious learning experiences [19], increased player curiosity, and, consequently, higher engagement [20].

Verbal Persuasion: The use of motivational verbal phrases has been proven to increase self-efficacy, motivation, and performance in players [3]. Game elements that incorporate social interactions, such as multiplayer features or cooperative gameplay, can positively influence players’ self-efficacy through praise, encouragement, and support from peers or non-player characters (NPCs). Praise from others when undertaking a task facilitates positive affect, and reinforces that the player is successfully meeting the challenges of the game.

Physiological and Affective States: This construct pertains to the emotional and physiological state of an individual when confronted with a task [31, 71]—suggesting, in addition to the task at hand, one’s latent affective state may influence a person’s self-efficacy. In games research, self-efficacy has been identified as a significant predictor of physiological regulation—and so represents a critical point of consideration in designing games that utilize biofeedback [71].
2.3.2 Perceived Competence in Games

As a fundamental construct of self-determination theory (SDT), perceived competence is one of the most widely studied constructs in games literature [68]. The primary aim of game mechanics associated with competence is often to facilitate player mastery. In this regard, a substantial overlap exists between these game elements and those related to self-efficacy. For instance, game mechanics such as point accumulation and leveling systems improves players’ perceptions of their competence by reflecting on their progress within the game [31, 52]. The inclusion of leaderboards is a common feature in games designed to enhance players’ competence. Notably, the introduction of manipulated leaderboards, although not indicative of genuine in-game performance, has been found to increase players’ perceived competence [9]. Additionally, sensory feedback, encompassing visual and auditory game effects, has been identified as a means to augment players’ perceptions of competence [52, 31, 50, 42].

Within the literature, various competence-supporting game frameworks have been explored. For instance, Peng et al. [50] developed a narrative-driven exercise game rooted in the satisfaction of the competence need. This game incorporated competence-supporting elements such as dynamic difficulty adjustments, a visual score system, and achievement badges. Their findings revealed that these elements effectively satisfied players’ need for competence when compared to a control condition. Similarly, Jamshid et al. designed an infinite runner game aligned with SDT principles and integrated game elements associated with competence [31]. These elements included leaderboards, scoring mechanisms, progressive levels, and instant positive feedback. Although their study did not explicitly investigate the impact of these elements on SDT, they anticipated that the amalgamation of SDT and self-efficacy theory (SET) game elements would yield superior performance compared to games featuring SDT or SET elements independently, although this specific outcome was not observed in their study.

2.3.3 Dominance in Games

Dominance is usually investigated in games scholarship within the context of the emotional or affective player experience. In these contexts, it is typically assessed via the deployment of the Self-Assessment Manikin [10]—which, in turn, is founded on both the circumplex model of affect [55] and PAD Emotional State Model [40]. The experience of dominance has been associated with gameplay both generally, and with specific game content. Research has found that, regardless of the presence or absence of violent content, simply playing a video game increases dominance [61]—but specific links have also been made between increased dominance and game modes featuring combat (i.e., through defeating opponents) [85]. Dominance has likewise been associated with ‘functional’ player experiences (i.e., experiences that offer significant granularity in opportunities for interaction) [28], willingness to recommend a game title to others [28], and preference for a title [41].


2.4 State of the Literature

In summary, while control beliefs are explored in domains like sports psychology, the notion of control beliefs has not yet been explored in the context of video games. Instead, player experience research has taken a piecemeal approach to investigating facets of control beliefs through other theoretical lenses, such as SDT, SCT, and the PAD emotional state model. While the control-related constructs of these theories have proven applicability in player experience research, they have not yet been applied in a way that examines feelings of control holistically. The integration of control beliefs addresses this gap, and offers a helpful lens that refocuses the disparate constructs of competence, self-efficacy, and dominance onto the sense of control that they give rise to. This fresh perspective stands to give new insight into existing literature, and highlights a new approach to exploring the effects of self-efficacy-supporting game elements.

As control beliefs have not been explored in games research, the literature does not yet contain any recommendations on how to design in a way that supports control beliefs. To address this gap, we developed a control beliefs framework (detailed in the following chapter), that highlights game elements with theoretical links to self-efficacy, competence, and dominance facilitation.
3 Space Oddity: Designing The Research Game

This chapter presents the framework that details and justifies our self-efficacy supporting (SE-supporting) game elements. Following the development of the framework, we created a digital game consisting of two versions: one incorporated SE-supporting game elements (the SE version), aiming to elicit feelings of self-efficacy, and one without these elements (the NSE version).

3.1 Self-Efficacy Framework

Our approach in constructing the self-efficacy framework was theory-driven, and influenced by reviewing game elements associated with self-efficacy, competence, and dominance in the existing literature. To further scope our project, we focused on a set of elements that would be compatible with a typical arcade game. With these factors in mind, we primarily designed our framework around self-efficacy due to its strong correlation with perceptions of task difficulty, motivation, and perceptions of control [3].

The process of compiling game elements aimed at enhancing self-efficacy began with an extensive literature review. We initiated this phase by cataloguing elements from games literature that link specific game elements with source components of self-efficacy. The incorporation of the physiological aspect of self-efficacy theory was not feasible within the context of our present study, primarily because of the constraints imposed by the existing body of literature and the scope of our own project. However, the physiological component presents an encouraging and potentially fruitful direction for subsequent research endeavours.

Subsequently, I lead our research team—consisting of myself, and my co-supervisors, who are established player experience researchers—in conducting an expert group discussion to explore potential game elements and mechanics that could enhance players’ self-efficacy. At this stage, we had not yet determined the game type or study experiment. This collaborative session proved invaluable, as it also involved discussions on the integration of these elements into games. Figure 3.1 provides photographs of a part of the game elements generated during the session and Tables A.1 to A.3 in Appendix A depict the full outcome of the session.

The subsequent step involved consolidating the compiled game elements derived from both the literature and our expert group discussion which resulted in forming the elements of our framework, presented in Table 3.1 This table includes a list of related constructs, a corresponding list of game elements, as well as examples of how those elements were incorporated into Space Oddity.

The elements that facilitate mastery experiences primarily revolve around providing performance feedback and offering assistance to the player during critical situations by utilizing dynamic difficulty adjustments and
Figure 3.1: We recorded our ideas on sticky notes and categorized them under each self-efficacy component.
power-ups\textsuperscript{1}. We introduced allied NPCs that fit the dual purpose of both supplementing vicarious experiences and providing verbal persuasion (see Table 3.1). In the former, we implemented a ‘ghost’ NPC: a semi-opaque agent who, at pre-determined times, appears alongside the player. This concept was co-opted from racing titles (such as Mario Kart 8 \textsuperscript{45}), in which players race against permeable ‘ghost racers’ that echo previous course attempts.

3.2 Modding or Creating a Game?

After gathering the game elements, we confronted a crucial decision: whether to use an off-the-shelf game or create a custom research game. Had we opted for an existing game, our choices would have been confined to already existing games that support straightforward modding. Modding involves enhancing, adding, or removing in-game components to alter gameplay \textsuperscript{66} and is done by users. After careful consideration, we opted against modding an existing game due to experimental constraints, as we wanted a large degree of control over potential self-efficacy supportive covariates that had not been intentionally incorporated into the design. Even if integration were possible, the complexity and time required made it impractical. Instead, we chose to create a bespoke game that aligns with our research objectives.

The choice to create a custom game, as opposed to using an existing one, was motivated by our need for precise control over various parameters and the integration of a wide array of self-efficacy supporting game elements. Developing the game from scratch allowed us to seamlessly include all the gathered game elements and tailor it for short play sessions, in line with our aim to engage participants for a brief duration. Additionally, this approach facilitated a meaningful comparison between the game with embedded elements and the one without them.

3.3 The Game Artifact

To support and test our framework, we designed a bespoke research game, ‘Space Oddity’\textsuperscript{2} to investigate the influence of control beliefs on the player experience. This section focuses on explaining the design considerations made in relation to self-efficacy supporting game elements and game difficulty. Subsequently, a comprehensive overview of Space Oddity’s gameplay is provided, shedding light on the game mechanics, objectives, and relevant features that contribute to a positive player experience.

Space Oddity is a top-down arcade shooter game developed in Unity 2022.1.13f to showcase the self-efficacy game elements framework. The majority of the game assets, sound effects, and music used were downloaded through the Unity Asset Store, and are licensed for personal and commercial use. The NPC character art was developed using stable diffusion.

\textsuperscript{1}Power-ups are a form of game reward that temporarily grants the player special abilities.

\textsuperscript{2}The artifact’s title, Space Oddity, pays tribute to David Bowie’s iconic song of the same name, which narrates the story of an astronaut embarking on a space mission.
<table>
<thead>
<tr>
<th>Self-Efficacy Component</th>
<th>Game Element</th>
<th>Game Mechanic in <em>Space Oddity</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mastery Experiences</td>
<td>Progress Bar</td>
<td>A progress bar shows player progress and remaining tasks.</td>
</tr>
<tr>
<td></td>
<td>Growing Numbers</td>
<td>Score and coin counter grow with performance.</td>
</tr>
<tr>
<td></td>
<td>Dynamic Difficulty Adjustment</td>
<td>Power-up type matches player health.</td>
</tr>
<tr>
<td></td>
<td>Temporary Power-ups</td>
<td>Health pack, temporary magnet, wide-angle weapon.</td>
</tr>
<tr>
<td></td>
<td>Juicy Visual and Sound Effects</td>
<td>Satisfying SFX/VFX, encouraging sounds on item collection.</td>
</tr>
<tr>
<td></td>
<td>Usernames</td>
<td>Players name their spaceship.</td>
</tr>
<tr>
<td></td>
<td>NPC Guidance</td>
<td>NPCs explain game mechanics and how to succeed.</td>
</tr>
<tr>
<td></td>
<td>Gameplay Video</td>
<td>20-second preview before gameplay.</td>
</tr>
<tr>
<td>Vicarious Experiences</td>
<td>Manipulated Leaderboard</td>
<td>Shows manipulated leaderboards where the player is consistently top-ranked.</td>
</tr>
<tr>
<td></td>
<td>Embedded Narrative</td>
<td>Two NPCs narrate the game’s backstory.</td>
</tr>
<tr>
<td></td>
<td>Ghost Replay</td>
<td>Players watch semi-opaque NPCs attempting past courses.</td>
</tr>
<tr>
<td>Verbal Persuasion</td>
<td>Encouragements from NPCs</td>
<td>NPCs express faith and provide encouragement.</td>
</tr>
<tr>
<td></td>
<td>Verbal Praise</td>
<td>NPCs offer verbal praise during gameplay.</td>
</tr>
<tr>
<td></td>
<td>Achievement Acknowledgement</td>
<td>Crowd cheers and ‘Congratulations’ on game completion.</td>
</tr>
</tbody>
</table>
3.3.1 Gameplay

Designed to echo familiar space shooter titles (such as Cinematronics’ *Space Wars* [13] and Nintendo’s *Star Fox* series [44]), players must shoot asteroids and enemy spaceships, avoid enemies and obstacles, and pick up coins that are dropped by enemies when they are destroyed. In this setup, enemies actively advance towards the player and pursue them with the intent to collide. Collisions with enemies result in the player losing a portion of their health. Additionally, there are mobile asteroids that do not pursue the player, but colliding with them results in a health deduction. Colliding with large asteroids inflicts double the damage compared to colliding with smaller asteroids. Furthermore, destroying the larger asteroids demands more effort from the player.

The goal of the game is to survive three levels, each of which lasts three minutes. To mitigate variability related to player skill, we opted to simplify the gameplay for participants. As a grounded example of this, the player’s spaceship is equipped with continuous automatic shooting, a concept inspired by *Vampire Survivors* [36]. Further, To maximize accessibility, and minimize the level of skill required to play the game, *Space Oddity* can be played using only the directional arrows on a keyboard. If the player dies, they must replay the same level until they can beat it. As the game progresses, each level becomes more challenging than the previous ones—the challenge is scaled by introducing additional enemies and the strategic placement of enemy spawns. In addition to the challenges, each level has a different background and soundtrack for more visual and auditory distinction. The rationale behind designing our game with three levels, each offering a consistent playtime, was to ensure that players would have a sufficient duration of gameplay to cultivate control beliefs.

3.3.2 Game Versions

Two versions of *Space Oddity* were developed and experimentally tested: the SE-supporting version (SE), which incorporates all the in-game SE-supporting elements described in Table 3.1, as well as a not SE-supporting version (NSE), in which all of the SE-supporting elements described in our framework are absent. The SE and NSE versions of the game offer nearly identical gameplay experiences, differing only in the absence of narrative elements, NPC interactions, leaderboards, and power-ups in the NSE version—where basic sound and visual effects are used instead. The game’s flow for both the SE and NSE versions is visually illustrated in Figure 3.2. In the following sections, we explore the distinction between the two game versions.

The SE version

**Game Narrative:** The game begins with a landing page as seen in Figure 3.3, where players name their spaceship and initiate their gameplay. This name is prominently displayed beneath the player’s spaceship throughout gameplay.

Then, the player is welcomed by two non-playing characters (NPCs), Major Tom and Lady M, who
Figure 3.2: The flow of the game pages in the SE and the NSE versions.

Figure 3.3: The landing page
narrate the game's brief storyline. They offer encouraging words to the player, expressing their belief in the player's ability to overcome Ziggy Stardust, the villain NPC. Subsequently, they proceed to explain the game mechanics and objectives of the game, followed by introducing the controls. The entire narrative unfolds as a conversation between the NPCs and the player, provided in Appendix B. Figure 3.4 provides a snapshot of the in-game conversation. Following this, the player selects the “Start Mission” button and engages in Level One, which is succeeded by Levels Two and Three. At any point in the game, players can pause their progress and later resume their gameplay.

**Ghost Replays:** Another game element present at this version is demonstrating ghost replays. During specific points in Level One and Level Three, players encounter semi-opaque spaceships of the deceased NPCs, which reenact their previous course. This representation occurs in the final seconds before these ghostly ships explode, accompanied by a blast and smoke. The game narration has addressed this as part of the game's story. A single ‘ghost’ NPC appearing in the game is visible in Figure 3.8 and is also enlarged in Figure 3.5.

**Leaderboards:** Additionally, players have access to a leaderboard for comparison with the game’s three NPCs (two of which are allies and one enemy). These leaderboards, however, are manipulated, ensuring the player always holds the top rank, regardless of their actual performance. In the Level One leaderboard, the narrative aligns with the game’s story, indicating Major Tom’s exit from the competition. Ziggy Stardust, the enemy NPC, and Lady M claim the second and third positions, as seen in Figure 3.6. A similar pattern continues in the Level Two leaderboard, and in the Level Three leaderboard, Lady M joins the ranks of the defeated, alongside Major Tom, leaving only Ziggy Stardust and the player in the competition in which the
player finishes at the top of the leaderboard. This page further acknowledges the player’s victory, celebrating their achievement with animated text and sounds of applause and cheers from the crowd.

**Power-Ups:** While both game versions incorporate coins as part of the reward system, power-ups are exclusive to the SE version. The primary function of power-ups is to dynamically adjust the game’s difficulty. Players can acquire these power-ups by shooting and destroying particularly challenging large asteroids, which drop power-ups upon destruction. In the SE version of *Space Oddity*, there are three distinct power-ups available: health pack, temporary magnet, and wide-angle weapon, all of which are shown in Figure 3.7. The type of power-up is determined randomly, except when the game situation becomes critical for the player.

- The health pack augments a player’s health by adding 30 to their current health value (with 100 being the maximum health, which cannot be exceeded). The Dynamic Difficulty Adjustment (DDA) feature of the game ensures that the power-up is consistently a health pack when the player’s health falls to 20% or below and never a health pack when the player’s health is 100%.

- The magnet power-up accelerates the attraction of collectible items (including coins and power-ups) towards the player’s spaceship, but it has a limited duration of 10 seconds from the moment the player collects them. A visual timer appears on the screen to indicate the remaining duration of the temporary power-up, enabling players to track their availability.

- The wide-angle weapon power-up temporarily doubles the player’s projectiles and widens them, resulting in a more extensive area of destruction. Like the magnet power-up, this effect lasts for 10 seconds.
Figure 3.6: The leaderboard shows the ranking of the player in relation to the rival and allied NPCs.

Figure 3.7: Power-ups from left to right: health pack, wide-angle weapon, and magnet.
and is accompanied by a visual timer.

**UI Elements:** The role of the User Interface (UI) elements is to convey essential game metrics and offer performance feedback to players, hence inducing control beliefs in players. The visual elements within the UI on the screen include an animated progress bar, which indicates the remaining time to complete the level. Additionally, players can view their score and the coin count. Notably, a crescent-shaped health bar, following the player’s spaceship, dynamically changes colour based on the player’s current health status. The health percentage is also displayed adjacent to the health bar, ensuring players have access to critical health information. Figures [3.8 and 3.9](#) show the difference between the interface of the two game versions in Level Three.

**Visual and Sound Effects:** A significant auditory feature in the SE version is the inclusion of praise phrases, including expressions like “Amazing!”, “Keep up the good job!”, and “Wonderful!” coming from the allied NPCs, *Major Tom* and *Lady M*. These positive phrases are triggered whenever a player successfully blasts a large asteroid, resulting in the release of a power-up. This implementation creates the illusion that the NPCs are accompanying the player character and providing support throughout the gameplay. Furthermore, to enhance the game’s engagement, we introduced ‘juicy’ visual and sound effects. Destroying asteroids and enemies are accompanied by distinct blasting effects, although the differentiation may not be exceedingly pronounced, and each is accompanied by corresponding blasting sounds. Moreover, collecting coins and power-ups triggers separate encouraging sound effects, contributing to a more immersive gaming experience.

**The NSE version**

The NSE version begins with a landing page identical to that of the SE version. Nevertheless, in this version, the name chosen by players for their spaceship is not visible beneath the player’s spaceship during gameplay. The introduction of the game controls occurs entirely without the presence of any NPCs. In this version, too, players can pause their progress and later resume their gameplay at any point in the game.

In this version, the game sound effects for destroying both asteroids and enemies are identical and lack the engaging ‘juicy’ quality. Similarly, the visual effects accompanying the destruction of enemies and asteroids are basic and exactly the same. This version does not feature auditory encouraging phrases from the NPCs. Moreover, there are no ghost NPCs, no leaderboards, and no power-ups. Consequently, this version demands more skill from players since there are no health packs, for instance, to aid them. Overall, this version lacks the exciting elements present in the other version.

Once the design and development of both the SE and NSE versions of the game were finalized, we employed a WebGL build for both iterations of *Space Oddity*. Considering our intention to conduct online

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[3] The term ‘juicy’ is a common expression in game design. It refers to systems which offer satisfying and rewarding reactions to players’ in-game actions. [58].
Figure 3.8: The SE version: This version features SE-supporting game elements.

Figure 3.9: The NSE version: The SE-supporting game elements are absent.
Table 3.2: Observations from playtesting the NSE version with university students.

<table>
<thead>
<tr>
<th>Gamer Identity</th>
<th>#Deaths in Level 1</th>
<th>#Deaths in Level 2</th>
<th>#Deaths in Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student #1</td>
<td>Casual</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Student #2</td>
<td>Non-gamer</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Student #3</td>
<td>Casual</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Student #4</td>
<td>Non-gamer</td>
<td>3</td>
<td>Quit playing</td>
</tr>
<tr>
<td>Student #5</td>
<td>Non-gamer</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Student #6</td>
<td>Non-gamer</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Student #7</td>
<td>Casual</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Data collection, we made the decision to release a browser-based game for the study. This approach ensured a seamless participant experience and eliminated the need for participants to download any files, therefore streamlining the study process.

3.4 Playtesting

As the NSE version did not feature power-ups intended to assist the player, we wanted to determine if this absence made the game overly challenging for players. To investigate, we enlisted the participation of seven university students, varying from non-gamers to casual gamers, and had them play the NSE version in-person. We closely monitored their gameplay experiences to gain insights into how it felt to play this version and also, to test the usability of the game. Additionally, we recorded the number of times they died within the game at each level. Table 3.2 provides a summary of our observations.

Since our intention was not to design an overly simplistic or excessively challenging game, the death rates noted in this version, at this stage of development, seemed to be in line with our desired level of difficulty. We then programmed our game to record the deaths of each player in every level and store this data in a database.

Following the playtesting, we established a threshold for the number of deaths. We concluded that if a player experienced a high number of deaths within a single level, it indicated a lack of sufficient skill to progress in the game. To address this, we introduced a mechanism to end the game for participants who lost six times in Study One, and this threshold was subsequently adjusted to five in Study Two, as five attempts would still offer them enough chance to beat the level but would mean less frustration in players. Consequently, we proceeded to initiate Study One.
4 Study One

In this study, we aimed to explore the influence of our self-efficacy supporting framework on players’ self-efficacy and the enjoyment factor of the player experience. Therefore, the primary research questions guiding this study were as follows:

**S1-RQ1:** Do SE-supporting game elements influence players’ self-efficacy?

**S1-RQ2:** Do SE-supporting game elements affect game enjoyment for players?

4.1 Methodology

To investigate our research question, we developed a between-groups online experiment in which participants engaged with one version of our research game and provided post-gameplay responses to a series of self-efficacy and player experience inventories. The detailed steps of our solution are described in the following section.

4.1.1 Self-Report Measures

To measure self-efficacy, we utilized an existing validated scale for one dimension of self-efficacy and adapted versions of the existing validated scale for the other dimensions. The validated questionnaire used original scaling and items were presented in randomized order. We deconstructed self-efficacy into three dimensions: general self-efficacy, domain self-efficacy (self-efficacy within the domain of video games), and task self-efficacy (self-efficacy specific to playing Space Oddity). Participants answered the questions from the following questionnaires after gameplay.

**General Self-Efficacy Measure**

To measure players’ general self-efficacy, we used the validated General Self-Efficacy Scale (GSES) for our study [60]. Participants indicate their degree of agreement with each of the 10 items on a scale of 1 (not at all true) to 4 (exactly true). The scale was administered to participants after the intervention (i.e. gameplay) to evaluate any changes in their general self-efficacy construct following the game task. Participants were instructed to reflect on their typical life experiences. Serving as a well-known and validated measure, this scale was selected due to its potential of generalizability to various contexts, as it provided a foundation upon which we could modify and adapt it to measure domain and task self-efficacy in our study. Example items
include, “It is easy for me to stick to my aims and accomplish my goals”, and, “When I am confronted with a problem, I can usually find several solutions”. The GSES questionnaire can be found in Figure C.9 of Appendix C.

Domain Self-Efficacy Measure

To measure domain self-efficacy, i.e., player self-efficacy in video games, we used a variation of the GSES (10 items) that has been previously used by Pavlas et al. [49]. As a measure of domain self-efficacy, this scale closely resembles the GSES, though adds the phrase ‘a video game’ to each item. Participants were instructed to reflect on their typical experiences playing video games. All of the other facets of this measure are identical to the GSES. Example items include, “It is easy for me to stick to my aims and accomplish my goals in a video game”, and, “I can solve most problems in a video game if I invest the necessary effort”. Pavlas’s modified version of GSES for video games can be seen in Figure C.8 of Appendix C as presented in the experiment.

Task Self-Efficacy Measure

To measure post-play task self-efficacy, we modified the 10 items from GSES, adapting them to refer to our research game in order to assess players’ task self-efficacy after playing Space Oddity. Similar to [49], this was done by replacing the phrase ‘a video game’ of the modified scale in [49] with Space Oddity. Participants were instructed to reflect on their experience playing Space Oddity. All of the other facets of this measure are identical to the GSES. Example items include, “It is easy for me to stick to my aims and accomplish my goals in Space Oddity”, and, “Thanks to my resourcefulness, I know how to handle unforeseen situations in Space Oddity”. Our modified version of GSES for Space Oddity is brought in Figure C.7 of Appendix C.

Enjoyment Measure

To measure game enjoyment, we used the ‘Enjoyment’ subscale of the Intrinsic Motivation Inventory (IMI) [38] which consists of seven items. Participants were instructed to reflect on their experience playing Space Oddity. Participants indicate their degree of agreement with each item on a scale of 1 (not at all true) to 7 (very true). Two of the items in this subscale are reverse-coded, and were transformed for analysis. Example items include, “I enjoyed doing this activity very much”, and, “This activity was fun to do”. This questionnaire is presented in Figure C.10 of Appendix C.
Self-Determination Measure

The focus of this study was not to evaluate players’ self-determination. However, we included measures related to it, as it is a standard assessment in games user research. To assess players’ self-determination after the intervention, we utilized the Competence (3 items), Autonomy (3 items), and the Relatedness (3 items) subscales from the Player Experience of Needs Satisfaction (PENS) [56]. Participants indicate their degree of agreement with each statement on a scale of 1 (do not agree) to 7 (strongly agree). Participants were instructed to reflect on their experience playing Space Oddity. One of the items in the Relatedness subscale is reverse-coded, and was transformed for analysis. We cannot provide the items for this scale as it is a commercial product.

4.1.2 Pilot Testing

To ensure that the study was prepared for full implementation, we conducted 6 test runs of the study with 5 labmates as part of a pilot test. We addressed certain issues related to the instructions and page flow of the study based on the feedback received.

4.1.3 Procedure

We gathered data through an online study, using BoF, the Interaction Lab’s custom browser-based experiment tool [33]. Participants were recruited through Prolific, a user-testing platform. Participants who accepted the task provided informed consent before engaging in the study. We used a between-groups design, such that participants were assigned to play one version (either SE-supporting [SE] or not SE-supporting [NSE]) of the game. After completing the game, participants responded to questionnaires on self-report measures of self-efficacy and enjoyment after the play session. Following this, participants provided information about their demographic background. Additionally, three optional open-ended questions allowed participants to provide feedback about the game, the study, and any technical issues they encountered during the study. The game session and the questionnaires were completed within a single session, requiring approximately 20 minutes for participants to finish the procedure. All participants received £3.10 as compensation for their time. This experiment was approved on ethical grounds by the University of Saskatchewan Research Ethics Board.

4.1.4 Participants

A total of 80 participants were initially recruited for this study. However, the data from one participant had to be excluded due to its unreliability, characterized by consistently selecting similar answers within a short period of time. This left us with 79 participants, with an average age of 31.7 (SD = 9.09), representing individuals from Canada, the UK, Ireland, Australia, and New Zealand. Of the participants, 40 identified as
men, 37 as women, and 2 as non-binary. We recruited participants through Prolific, a platform to conduct online research experiments. Our pre-screening criteria included a minimum of 3-6 hours of video game playtime per week, English fluency, and a minimum approval rate of 90% on Prolific. The rationale behind selecting participants with a minimum of 3-6 hours of weekly playtime was to observe the effects of the game features in the context of individuals who regularly engage with video games, thus allowing for a more meaningful exploration of real-life applications. The participants were randomly assigned to either the SE or NSE groups (41 in the SE and 38 in the NSE conditions).

4.2 Analyses

4.2.1 Statistical Approaches

All statistical analyses were carried out using Jamovi, an open-source statistical software suite built upon the R programming language [1]. For each quantitative measure, mean scores were calculated and used in our analyses.

Manipulation Checks

We examined our sample, comparing the age and gamer identity of participants in both conditions to ensure they were comparable. Subsequently, we assessed the number of deaths in both conditions. These three measures were used to characterize our sample. We used independent t-tests for group comparisons as our study involved only two conditions.

Group Comparisons

We aimed to explore the effects of the SE-supporting game elements on our participants’ self-efficacy measures (general, domain, and task) and enjoyment. Since we had one experimental variable (condition) and two experimental conditions, t-tests were utilized to compare the two groups.

Assumption Checks: Before conducting t-tests, we assessed the assumption of normality using the Shapiro-Wilk test for all dependent variables. The Shapiro-Wilk test revealed violations of the normality assumption, therefore we opted for the Mann-Whitney U test, a non-parametric equivalent. Otherwise, Student’s t-test was employed when the data met the normality assumption.

4.3 Results

We first present the manipulation checks of our experiment design, followed by the results for the t-tests regarding group comparisons.
Table 4.1: Manipulation checks indicate non-significant differences between the SE and NSE groups.

<table>
<thead>
<tr>
<th>Statistic</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.455</td>
</tr>
<tr>
<td>Gamer Identity</td>
<td>0.697</td>
</tr>
<tr>
<td>Total Deaths</td>
<td>0.645</td>
</tr>
</tbody>
</table>

4.3.1 Manipulation Checks

Histogram plots illustrating the sample’s distribution of age, gamer identity (from 1 to 10), and total number of deaths, divided by condition, can be observed in Figure 4.1. The t-tests indicate that there is no significant difference (p > 0.05) between the two groups in terms of age, gamer identity, and the total number of player character deaths (38 deaths in SE and 31 deaths in NSE). The manipulation checks are presented in Table 4.1. As a result, the two groups were comparable.

4.3.2 Group Comparisons

Self-Efficacy Constructs

Table 4.2 presents the descriptive statistics of all three self-efficacy dimensions for each condition. In both conditions, the mean self-efficacy score for the task (playing *Space Oddity*) is lower than that for the domain (video games), which, in turn, is lower than the score for general self-efficacy (cross-domain confidence).

We compared the two groups by utilizing a non-parametric t-test (Mann-Whitney U). As seen in Table 4.3, no significant differences in general, domain, and task self-efficacy were observed between the two conditions of the experiment (p > 0.05).

Enjoyment

In spite of no observed differences in the self-efficacy dimensions, enjoyment was significantly higher in the SE condition compared to the NSE condition. The descriptive statistics show a mean enjoyment score of 5.40 (out of 7) in the SE condition, whereas this score stood at 4.26 (out of 7) in the NSE condition. The boxplot in Figure 4.2 illustrates the experienced enjoyment of the experimental conditions. We performed a Student’s t-test and as a result, we found that the difference between the groups is significant (p < .001).

Self-Determination Constructs

As seen in Table 4.4, competence is not affected by the SE-supporting game elements, whereas autonomy and relatedness are significantly different between the SE and NSE conditions.
Figure 4.1: The histogram and density plots of the age (top left), gamer identity (top right), and the total number of player deaths (bottom) per condition in our sample.
Table 4.2: The scores for self-efficacy dimensions in each condition.

<table>
<thead>
<tr>
<th>Condition</th>
<th>General SE</th>
<th>Domain SE</th>
<th>Task SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE</td>
<td>41</td>
<td>41</td>
<td>41</td>
</tr>
<tr>
<td>NSE</td>
<td>38</td>
<td>38</td>
<td>38</td>
</tr>
<tr>
<td>Mean</td>
<td>SE</td>
<td>3.50</td>
<td>3.31</td>
</tr>
<tr>
<td></td>
<td>NSE</td>
<td>3.52</td>
<td>3.39</td>
</tr>
<tr>
<td>Median</td>
<td>SE</td>
<td>3.60</td>
<td>3.40</td>
</tr>
<tr>
<td></td>
<td>NSE</td>
<td>3.55</td>
<td>3.50</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>SE</td>
<td>0.487</td>
<td>0.557</td>
</tr>
<tr>
<td></td>
<td>NSE</td>
<td>0.434</td>
<td>0.405</td>
</tr>
<tr>
<td>Minimum</td>
<td>SE</td>
<td>2.20</td>
<td>2.00</td>
</tr>
<tr>
<td></td>
<td>NSE</td>
<td>2.10</td>
<td>2.60</td>
</tr>
<tr>
<td>Maximum</td>
<td>SE</td>
<td>4.00</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td>NSE</td>
<td>4.00</td>
<td>4.00</td>
</tr>
</tbody>
</table>

Table 4.3: The comparison between the two conditions in terms of self-efficacy dimensions

<table>
<thead>
<tr>
<th>Statistic</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Self-efficacy</td>
<td>Mann-Whitney U 703</td>
</tr>
<tr>
<td>Domain Self-efficacy</td>
<td>Mann-Whitney U 740</td>
</tr>
<tr>
<td>Task Self-efficacy</td>
<td>Mann-Whitney U 739</td>
</tr>
</tbody>
</table>

4.4 Discussion

4.4.1 Self-Efficacy

S1-RQ1: Do SE-supporting game elements influence players’ self-efficacy? No, we did not see any significant differences in self-efficacy between the conditions.

Based on the results of this study, it appears that our SE-supporting framework did not significantly affect the level of self-efficacy among players. The scores for general, domain, and task self-efficacy in both the SE and NSE conditions are very similar, with the mean self-efficacy scores in the NSE condition even slightly higher than in the SE version. This implies that the presence or absence of such a design framework in a game, although designed to support self-efficacy, makes no difference in inducing self-efficacy in players. However, the literature states that certain game elements, at least individually or a small collection of them, lead to improvements in the self-efficacy of players [14, 31]. Our framework, which includes a collection of
Figure 4.2: The SE group enjoyed playing the game more than the NSE group.

Table 4.4: Manipulation checks indicate non-significant differences between the groups.

<table>
<thead>
<tr>
<th>Statistic</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competence</td>
<td>Mann-Whitney U 644 0.183</td>
</tr>
<tr>
<td>Autonomy</td>
<td>Student’s T 2.90 0.005</td>
</tr>
<tr>
<td>Relatedness</td>
<td>Mann-Whitney U 399 &lt;.001</td>
</tr>
</tbody>
</table>

those elements, seems to contradict previous work.

Given the outcomes of this study, we were inclined to conclude that SE-supporting game elements may not impact players’ self-efficacy. However, examining the total player death numbers in both conditions suggests that the difficulty of both the SE and NSE versions was similar. We had expected the NSE version to yield a higher fatality rate than the SE version due to the lack of assisting elements, such as the gameplay video and the power-ups. As a result, we recognized the need to acknowledge certain limitations in the study design, which prompted a thoughtful reflection on the experiment we conducted.

The observed high self-efficacy scores in both conditions, as reflected in the mean scores detailed in Table 4.2, raise a few issues. Firstly, we did not consider the baseline general self-efficacy (prior confidence) of the participants in our experiment. Secondly, we overlooked the importance of the perceived difficulty of the game between the groups.

Regarding the first point, it is plausible that participants entered the study with already elevated levels of self-efficacy, meaning that there was no room for the game elements to increase their already high self-efficacy. Moreover, individuals vary in their levels of confidence, which could influence their self-perception differently. Having a method to distinguish between individuals with high and low confidence prior to the test (baseline general self-efficacy), could have enabled us to compare the self-efficacy scores of these two distinct groups.

The second point is about the difficulty of the game. The results could indicate that our game was perceived as relatively easy, providing participants with minimal challenges. Bandura’s theory points out
that a requisite level of challenge is essential for eliciting feelings of self-efficacy; without it, individuals might uniformly exhibit high self-efficacy \[^6\]. If we examine the descriptives in Table 4.2, the self-efficacy scores are slightly higher (but not significantly higher) in the NSE version. We believe this is because the NSE version was perceived as more challenging to players, and as Bandura suggested, this increased challenge may have allowed participants to experience a requisite level of challenge.

Additionally, Study One revealed complexities in balancing difficulty between the versions. While one version has game features that make the game easier (e.g., power-ups), the other version lacks such features and could be perceived as more difficult. This unintended shift in perceived difficulty might have contributed to inaccurate results.

These considerations encouraged us to refine our study to address the limitations and examine self-efficacy in a more structured manner. Thus, we started the process of designing a second study.

4.4.2 Enjoyment

S1-RQ2: Do SE-supporting game elements affect game enjoyment for players? Yes, enjoyment was higher in players who had played the SE version.

The SE-supporting game elements had a positive effect on player enjoyment, as players in the SE condition reported higher levels of enjoyment after playing the game. These game elements significantly contributed to the overall feedback and interactivity of the game. Additionally, the inclusion of a story added depth and meaning to the game, motivating players to uncover the narrative and reach the end of the story. Moreover, the provision of a gameplay video helped enhance mastery, reducing the initial sense of being lost in the game. These factors collectively contributed to the increased enjoyment reported by players in the SE condition.
Chapter 5 Transition to Study Two

Study One revealed complexities in experimental design, particularly the importance of balancing the perceived difficulty of the game in both versions. Following Study One, we recognized the need to address these factors and proceeded to design a new study. This chapter provides an in-depth exploration of the modifications made to the game and experiment design. The specifics of Study Two are detailed in the next chapter.

5.1 Game Modifications

It was important for us to isolate the effects of self-efficacy from the effects of difficulty. The presence of self-efficacy game elements (e.g., power-ups, dynamic difficulty adjustment) complicates the evaluation of self-efficacy features, as these features can make the game easier—thereby confounding results. We tackled two issues regarding the difficulty of the game. Firstly, we aimed to make the gameplay more challenging for both conditions. Secondly, we focused on balancing the perceived difficulty between the two versions of the game.

5.1.1 Increasing the Game’s Challenge

To introduce additional challenges to the game, we implemented a feature where enemies could shoot projectiles back at the player. In the original game from Study One, the primary threat from enemies was colliding with the player. However, in the modified game, enemies not only pursue the player to initiate collisions but also shoot projectiles in the player’s direction. These enemy projectiles are visually designed to resemble plasma (as seen in Figure 5.1), signalling to players that they are not destructible and, therefore, they have to focus on dodging the projectiles. In both conditions, each enemy projectile was programmed to deduct the same portion of the player’s health.

5.1.2 Balancing Perceived Game Difficulty

To ensure that game difficulty remained relatively stable between the SE version and the NSE version of the game, we conducted a series of informal evaluations of game balance, seeking feedback from students on campus and lab mates. Initial testing revealed that the NSE version is more difficult to beat than the SE version. The final level of the NSE version proved exceptionally challenging, with several students unable to successfully complete it even after five attempts. Our observations supported that while player baseline
health and enemy values remained the same between the SE and NSE conditions, the self-efficacy features implemented in the SE condition (such as power-up pickups) rendered this version of the game less difficult. Based on our observations, we opted to compensate for this disparity by manipulating player health. Prior to another pilot test, the following modifications were made:

- **SE version**: Player health was reduced to 50 from the original 100 across all levels, intensifying the difficulty of this version.

- **NSE version**: Player health was increased to 130 from the original 100 in levels 1 and 2. However, for level 3, it was further increased to 160, recognizing the increased level of difficulty encountered in this stage compared to the first two levels.

Importantly, this modification is not visually apparent in the game’s presentation, in contrast to alternatives such as modifying the number of enemies or hazards. This discreet approach allowed us to manipulate the difficulty levels while ensuring a seamless and consistent player experience across both versions of the game. Moreover, as we obfuscated player health by displaying it as a percentage value, this did not alter players’ perception of the health pool in either condition.

### 5.2 Evaluating Game Difficulty

To confirm that game difficulty remained consistent between the SE version and NSE version of the game, we conducted a pilot test on Prolific with 20 participants. Participants responded to the performative challenge items of the Challenge Originating from Recent Gameplay Interaction Scale (CORGIS) [13], and also rated the overall difficulty of the specific game version they played using a Likert scale item (Refer to section 6.2.1 for a detailed description of the measures). The online experiment involved two distinct groups. One group was assigned to play the SE version of Space Oddity, while the other group played the NSE version. As seen in Table 5.1 and 5.2, this phase of pilot testing suggested that there were no differences in perception of difficulty between the SE and NSE versions.
Table 5.1: The descriptives of the pilot study prior to Study 2.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Performative Challenge (1-7 scale)</th>
<th>Game difficulty (1-10 scale)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>NSE</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>6.50</td>
<td>4.18</td>
</tr>
<tr>
<td>NSE</td>
<td>6.31</td>
<td>3.78</td>
</tr>
<tr>
<td>Median</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>6.75</td>
<td>4</td>
</tr>
<tr>
<td>NSE</td>
<td>7.00</td>
<td>4</td>
</tr>
<tr>
<td>Standard deviation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>0.77</td>
<td>1.60</td>
</tr>
<tr>
<td>NSE</td>
<td>1.01</td>
<td>1.64</td>
</tr>
<tr>
<td>Minimum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>4.50</td>
<td>2</td>
</tr>
<tr>
<td>NSE</td>
<td>4.00</td>
<td>1</td>
</tr>
<tr>
<td>Maximum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>7.00</td>
<td>7</td>
</tr>
<tr>
<td>NSE</td>
<td>7.00</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 5.2: Comparing the performative challenge and difficulty of the SE and NSE version

<table>
<thead>
<tr>
<th></th>
<th>Statistic</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performative challenge</td>
<td>Mann-Whitney U</td>
<td>47.5</td>
</tr>
<tr>
<td>Game difficulty</td>
<td>Student’s t</td>
<td>0.555</td>
</tr>
</tbody>
</table>
6 Study Two

6.1 Problem and Research Question

Study One primarily examined the impact of SE-supporting game elements on player self-efficacy. However, as we dived deeper into the psychology literature while Study One was in progress, we recognized the importance of perceived competence and the sense of dominance as integral psychological constructs contributing to the player experience. These factors collectively form what we term control beliefs. The literature review in Chapter 2 highlighted that various game elements not only support self-efficacy but also influence perceived player competence, subsequently shaping feelings of dominance and control in gaming situations. While self-efficacy is significant, control beliefs provide a more comprehensive understanding of the player experience.

In Study Two, we expanded our investigation to explore the effects of our designed framework on player control beliefs, recognizing the interconnected nature of self-efficacy, competence, and dominance in shaping the gaming experience.

Based on the broad gaps in the literature, we developed the following exploratory research questions to guide our research process in Study Two:

*S2-RQ1:* Do SE-supporting game elements affect game enjoyment for players?

*S2-RQ2:* Do SE-supporting game elements affect players’ control beliefs?

*S2-RQ3:* Do SE-supporting game elements affect perceived game difficulty?

6.2 Methodology

For this study, we addressed the limitations identified after completing the experiment in Study One. As a result, we introduced new scales related to perceived competence and dominance to incorporate control beliefs. Additionally, we added baseline measurements for general self-efficacy, domain self-efficacy, and dominance to the study as part of the within-subjects analysis to measure potential changes in these constructs over time. We also conducted an assessment of the perceived difficulty between the game versions. The game builds from Study One were replaced by the new, more challenging games, as detailed in Section 5.1. The flow of the experiment is illustrated in Figure 6.1.

We utilized existing validated scales, minor modifications to existing validated scales, as well as a single-item difficulty question devised by our team. Validated items used original scaling and items were presented
Figure 6.1: The flow of the study from start to finish.

in randomized order.

6.2.1 Self-Report Measures

In this study, our experiment incorporated repeated measures, consisting of pre- and post-gameplay assessments. Similar to study One, we measured self-efficacy in three different dimensions — task, video games domain, and general. We introduced additional measures to Study One to address our research questions in Study Two.

General Self-Efficacy Measure

The employment of the General Self-Efficacy Scale mirrors that of Study One and is detailed in Section 4.1.1. However, in Study Two, the GSES was administered to participants both before and after the intervention to evaluate their baseline general self-efficacy, as well as any changes in this construct following the game task. This was also done as a manipulation check to detect whether the game had any impact on participants’ control beliefs. More significantly, these steps were taken to explore the influence of participants’ baseline general self-efficacy (pre-test confidence) on their control beliefs. Furthermore, a snapshot of this scale in Study Two can be found in Figure D.5 of Appendix D.

Domain Self-Efficacy Measure

As in Study One (See Section 4.1.1), we employed Pavlas’s modified version of GSES for video games with the exception that it was presented to participants both before and after gameplay. This was also done as a manipulation check to detect whether the game had any impact on participants’ control beliefs. A snapshot of this scale can be seen in Figure D.6 of Appendix D as presented in the experiment.

Task Self-Efficacy Measure

We employed our modified version of GSES for Space Oddity post-gameplay as in Section 4.1.1 of Study One,
which is brought in Figure D.12 of Appendix D as presented in the experiment.

**Enjoyment Measure**

The ‘Enjoyment’ subscale of the Intrinsic Motivation Inventory (IMI) was employed post-gameplay as detailed in Section 4.1.1 of Study One. This questionnaire is presented in Figure D.16 of Appendix D.

**Competence Measure**

To assess players’ perceived competence after the intervention, we administered the three subscales of PENS associated with self-determination as outlined in the *Self-Determination Measure* in Section 4.1.1 of Study One. However, we solely examined the scores related to ‘Competence’. The data for ‘Autonomy’ and ‘Relatedness’ were not utilized, as self-determination was not the focus of this study.

**Dominance Measure**

We used the ‘Dominance’ component of the Self-Assessment Manikin (SAM) pre- and post-intervention. SAM is a non-verbal pictorial assessment technique that directly measures the affective dimensions [10]. Participants were asked to select one of seven pictures that best represented how they were currently feeling. The dominance dimension represents changes in the size of the manikin, where the smallest manikin corresponds to minimum control in the situation (mapped to 1), and the largest figure indicates maximum control in the situation (mapped to 7). This assessment can be found in Figure D.7 of Appendix D.

**Performative Challenge Measure**

To mitigate differences in perceived difficulty as an experimental confound, we employed the ‘Performative Challenge’ subscale of the Challenge Originating from Recent Gameplay Interaction Scale (CORGIS) [18] as a post-play measure of challenge. This subscale comprises four items, and participants rated their level of agreement with each statement on a scale ranging from 1 (strongly disagree) to 7 (strongly agree). Participants were instructed to reflect on their experience while playing *Space Oddity*. Example item includes, “Thinking fast was an important part of the game”. Figure D.17 of Appendix D presents this questionnaire.

**Bespoke Difficulty Measure**

To mitigate differences in perceived difficulty as an experimental confound, we developed a single-item bespoke measure of perceived difficulty. The item was, “Please rate how difficult you found the game.”
used a seven-point slider to rate the game from 1 (not at all difficult) to 7 (extremely difficult). This post-play measure was used in conjunction with the performative challenge of the CORGIS, to confirm that challenge and difficulty remained consistent between each version of *Space Oddity*.

### 6.2.2 Procedure

We gathered data through an online study, using BoF, a custom browser-based experiment tool [33]. Participants were recruited through Prolific, a user-testing platform. Participants who accepted the task provided informed consent before engaging in the study and answered three pre-gameplay self-report measures (general self-efficacy, domain self-efficacy, and dominance) to provide baselines. We used a between-groups design, such that participants were assigned to play one version (either SE-supporting [SE] or not SE-supporting [NSE]) of the game. After completing the game, participants responded to questionnaires about their control beliefs and enjoyment after the play session. Additionally, participants responded to questionnaires regarding the game’s perceived difficulty and challenge. Following this, participants provided information about their demographic background. The game session and the questionnaires were completed within a single session, requiring approximately 30 minutes for participants to finish the procedure. All participants received £4.5 as compensation for their time. This experiment was approved on ethical grounds by the University of Saskatchewan Research Ethics Board.

### 6.2.3 Participants

A total number of 142 participants were recruited for our study. After the data cleaning process (detailed in chapter 6.3.1), 120 participants remained with a mean age of 31.4 (SD = 8.66) representing individuals from Canada, the UK, Ireland, Australia, and New Zealand. Of the participants, 62 identified as men, 55 as women, and 3 as non-binary. We recruited participants through Prolific, a platform to conduct online research experiments. Our pre-screening criteria included a minimum of 3-6 hours of video game playtime per week, English fluency, a minimum approval rate of 90% on Prolific, and exclusion of participants who had taken part in our pilot study. The participants were randomly assigned to either the SE or NSE groups (61 in the SE and 59 in the NSE conditions).

### 6.3 Analyses

#### 6.3.1 Data Cleaning

Prior to analysis, we performed several steps of data cleaning. First, we removed participants who failed to complete the study (n = 4), or otherwise provided suspected inauthentic responses (n = 3). Inauthenticity was determined by the sequence and timing of responses to the survey items (e.g., a regular pattern of responses provided within an impossible timeframe). To reduce variability in task attention, we removed 15 participants...
who died five or more times in a single level (ten in the SE condition, and five in the NSE condition)—the establishment of this exclusion criteria was informed by quantitative telemetry and qualitative feedback from our pilot testing that explicitly examined difficulty and challenge.

6.3.2 Statistical Approaches

All statistical analyses were carried out using Jamovi, an open-source statistical software suite built upon the R programming language [1]. For each quantitative measure, mean scores were calculated and used in our analyses.

Manipulation Checks

A sample characterization step was conducted to ensure that both conditions had similar demographics. Non-parametric t-tests were employed to compare the two groups, as the dependent demographic variables did not show a normal distribution, as determined by the Shapiro-Wilk normality test. Furthermore, to confirm that participants in both conditions encountered a comparable level of challenge and difficulty in the game, we conducted manipulation checks, analyzing the performative challenge score as well as the single-item difficulty measure. Shapiro-Wilk normality tests indicated that both variables exhibited a non-normal distribution, prompting the use of non-parametric t-tests (Mann-Whitney U tests) in our analyses. Additionally, we conducted non-parametric paired samples t-tests on our pre- and post-measures as a manipulation check to assess whether our game elements had any impact on these control beliefs.

Baseline General Self-Efficacy

We included baseline general self-efficacy in our analysis to account for individual differences among participants. A median split procedure was employed to categorize the participants into two groups based on their baseline general self-efficacy scores. The computed median value of baseline general self-efficacy among the participants was found to be 2.9 (out of 4). Accordingly, individuals whose baseline general self-efficacy surpassed 2.9 were categorized as ‘High baseline GSE’ while those scoring below 2.9 were designated as ‘Low baseline GSE’. This categorization facilitated a comparative assessment between the two groups in subsequent analyses. The distribution of participants is relatively equal in each condition after applying the median split. In the ‘Low baseline GSE’ category, there were 28 participants in the SE condition and 29 in the NSE condition. In the ‘High baseline GSE’ category, there were 33 participants in the SE condition and 30 in the NSE condition. This categorization enabled an examination of potential differences in the studied outcomes among participants with different levels of baseline self-efficacy when exposed to the self-efficacy supporting game elements.
Within-Subject Comparisons

We aimed to assess the effect of our research game on players’ general self-efficacy, domain self-efficacy, and dominance with time (baseline, post-play) as a within-subject factor (each participant was exposed only to one experiment condition). To achieve this, we employed a series of Repeated Measures ANOVAs for each of these metrics. These analyses examined the influence of time on the metrics while also considering condition and baseline GSE as between-subject factors.

Between-Group Comparisons

We aimed to explore the effects of the SE-supporting game elements in conjunction with participants’ baseline general self-efficacy on our study’s various dependent variables (control belief measures, enjoyment, and perceived difficulty). Since we have two independent variables (condition and baseline general self-efficacy), a series of two-way ANOVAs were performed to reveal any main and interaction effects of the independent variables on the dependent variables. After conducting two-way ANOVAs, post hoc comparisons were performed to determine specific group differences in test scores. The significance level for the post hoc tests was adjusted using Tukey’s correction method.

Assumption Checks: Before proceeding with the ANOVAs, we examined the assumptions of homogeneity of variances and normality. Levene’s test confirmed that the assumption of homogeneity of variances was met ($p > 0.05$). However, the Shapiro-Wilk test revealed violations of the normality assumption. We proceeded with ANOVAs followed by post hoc tests due to the relatively large sample size per cell, noting that ANOVAs are robust to violations of normality in this context [59].

6.4 Results

We organize our results into three parts. The first part pertains to the manipulation checks. The second part is dedicated to our repeated measures which investigate whether any significant changes were observed over time. The third part focuses on the between-group comparisons, assessing the differences between the groups through a series of two-way ANOVAs.

6.4.1 Manipulation Checks

Sample Characterization

Using the collected demographic data, the mean values of age and gamer identity (ranging from 1 to 10) were computed for both the SE and NSE conditions. Figure 6.2 illustrates the distributions of age and gamer identity across the two conditions, showcasing minimal variation. A t-test was conducted to statistically compare the groups, and the results, detailed in Table 6.1, indicate no significant difference between the conditions in terms of age and gamer identity. Consequently, the two conditions were deemed comparable.
**Figure 6.2:** The histogram and density plots of the age (left) and gamer identity (right).

**Table 6.1:** Manipulation checks indicate non-significant differences between the groups.

<table>
<thead>
<tr>
<th>Statistic</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
</tr>
<tr>
<td>Mann-Whitney U</td>
<td>1730 0.717</td>
</tr>
<tr>
<td>Gamer Identity</td>
<td></td>
</tr>
<tr>
<td>Mann-Whitney U</td>
<td>1629 0.363</td>
</tr>
</tbody>
</table>
Game Difficulty Balance

To confirm that difficulty was not an experimental confound affecting other analyses, we conducted Mann-Whitney U tests on both performative challenge and our bespoke measure of game difficulty. Results of these analyses reveal that there are no statistically significant differences in terms of either performative challenge ($U = 1625, p = 0.343$), or game difficulty ($U = 1788, p = 0.950$) between the SE and NSE conditions. The mean and standard deviation of the performative challenge score and the perceived difficulty score for both game versions are presented in Table 6.2.

Table 6.2: Performative challenge and perceived game difficulty scores of Space Oddity

<table>
<thead>
<tr>
<th>Condition</th>
<th>Performative Challenge</th>
<th>Perceived Difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE</td>
<td>6.34</td>
<td>2.74</td>
</tr>
<tr>
<td>NSE</td>
<td>6.16</td>
<td>2.73</td>
</tr>
<tr>
<td>Standard deviation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>0.887</td>
<td>1.38</td>
</tr>
<tr>
<td>NSE</td>
<td>0.937</td>
<td>1.36</td>
</tr>
</tbody>
</table>

6.4.2 Within-Subject Comparisons

The effect of our SE-supporting framework over time was evaluated by comparing pre- and post-results of general self-efficacy, domain self-efficacy and dominance in players. As indicated in Table 6.3, all three metrics changed significantly over time. Furthermore, we noted other meaningful main and interaction effects:

Table 6.3: Repeated Measures for general self-efficacy, domain self-efficacy, and dominance. Statistically significant results are displayed in bold. The degree of freedom for all rows is 1. Baseline GSE denotes baseline general self-efficacy.

<table>
<thead>
<tr>
<th></th>
<th>General Self-Efficacy</th>
<th>Domain Self-Efficacy</th>
<th>Dominance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F  p  $\eta^2_p$</td>
<td>F  p  $\eta^2_p$</td>
<td>F  p  $\eta^2_p$</td>
</tr>
<tr>
<td>Time</td>
<td>32.306 $&lt;.001$ 0.218</td>
<td>15.868 $&lt;.001$ 0.120</td>
<td>42.178 $&lt;.001$ 0.267</td>
</tr>
<tr>
<td>Time*Condition</td>
<td>0.009 0.925 0.000</td>
<td>4.954 $0.028$ 0.041</td>
<td>1.462 0.229 0.012</td>
</tr>
<tr>
<td>Time*Baseline GSE</td>
<td>2.555 0.113 0.022</td>
<td>7.813 $0.006$ 0.063</td>
<td>0.155 0.695 0.001</td>
</tr>
<tr>
<td>Time<em>Condition</em>Baseline GSE</td>
<td>2.185 0.142 0.018</td>
<td>0.014 0.907 0.000</td>
<td>2.942 0.089 0.025</td>
</tr>
</tbody>
</table>

- Main effect of Time:
  Post hoc comparisons revealed significant increases in general self-efficacy and dominance after gameplay when compared to the pre-gameplay assessments.
• **Two-way interaction effect (Time * Condition):**
  Domain self-efficacy exhibited an interaction effect between time and condition. Post hoc comparisons revealed that in the SE condition, domain self-efficacy significantly increased over time.

• **Two-way interaction effect (Time * Baseline GSE):**
  An interaction effect between time and baseline GSE was observed in the domain self-efficacy. Further post hoc testing indicated a significant increase in domain self-efficacy among participants with low baseline general self-efficacy over time.

### 6.4.3 Between-Group Comparisons

#### Player Character Death Rate

In the SE condition, there were 85 recorded player deaths in total, while in the NSE condition, there were 51 player deaths. This leads to an average player death rate of 1.39 for the SE condition and 0.86 for the NSE condition. A two-way ANOVA analysis, considering both the condition and baseline general self-efficacy as factors, reveals a statistically significant difference in player death rate between the conditions ($F(1)=5.42$, $p=0.022$, $\eta^2 p = 0.045$).

#### Enjoyment and Control Belief Measures

The descriptive results of the experiment groups are provided in Table 6.4 and illustrated in Figure 6.3. Moreover, the results of the conducted two-way ANOVAs are displayed in Table 6.5. As a reminder, the two independent variables for these analyses are condition and baseline general self-efficacy. All the dependent variables used in the between-group comparisons are post-intervention measures.

• **Main effects of Condition:**
  There was a statistically significant main effect of condition on enjoyment, dominance, and competence (see Table 6.5 for values). Post hoc comparisons indicated that participants who played the SE game version reported higher competence ($t(116)=2.54$, $p_{\text{tukey}}=.013$), dominance ($t(116)=2.48$, $p_{\text{tukey}}=.015$), and enjoyment ($t(116)=2.80$, $p_{\text{tukey}}=.006$) than those who played the NSE game version.

• **Main effects of Baseline GSE:**
  There was a statistically significant main effect of baseline GSE on task self-efficacy and dominance. Further post hoc comparisons showed that participants with high baseline general self-efficacy had significantly higher task self-efficacy and dominance compared to those with low baseline general self-efficacy.

• **Two-way interaction effect (Condition * Baseline GSE):**
  Domain self-efficacy exhibited an interaction effect between the condition and the baseline general
**Table 6.4:** Descriptive statistics for enjoyment and control belief measures. ‘SD’ stands for standard deviation. ‘Baseline GSE’ denotes baseline general self-efficacy, and ‘SE’ is an abbreviation for self-efficacy for better table readability.

<table>
<thead>
<tr>
<th></th>
<th>Baseline GSE</th>
<th>Condition</th>
<th>General SE</th>
<th>Domain SE</th>
<th>Task SE</th>
<th>Competence</th>
<th>Dominance</th>
<th>Enjoyment</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Low</td>
<td>SE</td>
<td>28</td>
<td>28</td>
<td>28</td>
<td>28</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NSE</td>
<td>29</td>
<td>29</td>
<td>29</td>
<td>29</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>SE</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NSE</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Mean</td>
<td>Low</td>
<td>SE</td>
<td>2.68</td>
<td>3.16</td>
<td>3.29</td>
<td>5.40</td>
<td>4.54</td>
<td>5.54</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NSE</td>
<td>2.62</td>
<td>3.35</td>
<td>3.36</td>
<td>4.87</td>
<td>3.93</td>
<td>4.55</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>SE</td>
<td>3.43</td>
<td>3.56</td>
<td>3.67</td>
<td>5.69</td>
<td>5.64</td>
<td>5.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NSE</td>
<td>3.26</td>
<td>3.40</td>
<td>3.46</td>
<td>5.22</td>
<td>5.00</td>
<td>4.93</td>
</tr>
<tr>
<td>SD</td>
<td>Low</td>
<td>SE</td>
<td>0.418</td>
<td>0.507</td>
<td>0.502</td>
<td>1.01</td>
<td>1.29</td>
<td>1.24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NSE</td>
<td>0.567</td>
<td>0.459</td>
<td>0.486</td>
<td>1.09</td>
<td>1.07</td>
<td>1.54</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>SE</td>
<td>0.401</td>
<td>0.405</td>
<td>0.408</td>
<td>1.07</td>
<td>1.19</td>
<td>1.61</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NSE</td>
<td>0.352</td>
<td>0.485</td>
<td>0.607</td>
<td>1.12</td>
<td>1.29</td>
<td>1.35</td>
</tr>
</tbody>
</table>

**Table 6.5:** Represents the ANOVAs. Significant results are displayed in bold.

<table>
<thead>
<tr>
<th></th>
<th>Condition</th>
<th>Baseline GSE</th>
<th>Condition * Baseline GSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyment</td>
<td>F 6.127</td>
<td>0.027</td>
<td>1.629</td>
</tr>
<tr>
<td></td>
<td>p 0.015</td>
<td>0.870</td>
<td>0.204</td>
</tr>
<tr>
<td></td>
<td>$\eta^2p$ 0.050</td>
<td>0.000</td>
<td>0.014</td>
</tr>
<tr>
<td>Domain self-efficacy</td>
<td>F 0.026</td>
<td>7.110</td>
<td>4.390</td>
</tr>
<tr>
<td></td>
<td>p 0.873</td>
<td>0.009</td>
<td>0.038</td>
</tr>
<tr>
<td></td>
<td>$\eta^2p$ 0.000</td>
<td>0.058</td>
<td>0.036</td>
</tr>
<tr>
<td>Task self-efficacy</td>
<td>F 0.577</td>
<td>7.224</td>
<td>2.291</td>
</tr>
<tr>
<td></td>
<td>p 0.449</td>
<td>0.008</td>
<td>0.133</td>
</tr>
<tr>
<td></td>
<td>$\eta^2p$ 0.005</td>
<td>0.059</td>
<td>0.019</td>
</tr>
<tr>
<td>Competence</td>
<td>F 6.435</td>
<td>2.582</td>
<td>0.029</td>
</tr>
<tr>
<td></td>
<td>p 0.013</td>
<td>0.111</td>
<td>0.866</td>
</tr>
<tr>
<td></td>
<td>$\eta^2p$ 0.053</td>
<td>0.022</td>
<td>0.000</td>
</tr>
<tr>
<td>Dominance</td>
<td>F 7.831</td>
<td>23.935</td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td>p 0.006</td>
<td>&lt;.001</td>
<td>0.943</td>
</tr>
<tr>
<td></td>
<td>$\eta^2p$ 0.063</td>
<td>0.171</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Figure 6.3: Means for general, domain, task self-efficacy, competence, dominance, and enjoyment scores by conditions and level of baseline general self-efficacy.
self-efficacy level (see Table 6.5 for values). Post hoc comparisons revealed that participants with High baseline GSE, who were in the SE condition reported higher domain self-efficacy than their low baseline GSE counterparts ($t(116)=3.390, p_{tukey}=0.005$). All other interactions were not statistically significant.

6.5 Discussion

6.5.1 Enjoyment

**S2-RQ1: Do SE-supporting game elements affect game enjoyment for players?** Yes, SE-supporting game elements do influence game enjoyment for players. Enjoyment was significantly higher in the SE version compared to the NSE condition.

Our results show participants in the SE group experienced significantly higher enjoyment, as compared to the NSE condition. Other than SE-supporting elements, the game is fundamentally mechanically identical; participants still shoot enemies, dodge bullets, and destroy asteroids. The quantity of enemies and the structure of enemy waves are also similar. Therefore, players are as equally likely to experience victory or loss conditions, as they are exposed to an equal level of challenge—however, the ‘set dressing’ provided by the SE condition secures a substantive increase in enjoyment. This showcases the benefits the SE framework (and, within it, SE-supporting elements) promises for the player experience. This result aligns with the conclusions drawn from Study One.

While this result speaks to the power of SE-supporting elements in video games, it is not particularly surprising. We know that the individual constructs deployed—dominance, self-efficacy, and perceived competence—are each associated with improved valence and game enjoyment outcomes [14, 24, 67, 10, 73]. As such, the SE condition was significantly more enjoyable than the NSE condition which authenticates what we know about self-efficacy and control beliefs in games literature.

We believe that certain game elements played a more prominent role in enhancing player enjoyment. The dynamic difficulty adjustment is an effective feature of *Space Oddity* in increasing enjoyment by matching the level of difficulty to the player’s performance, a concept supported by existing literature [14, 74]. The inclusion of a narrative element in the game contributed to increased player curiosity and engagement [20]; a factor known to positively influence enjoyment [25, 12]. Additionally, the integration of ‘juicy’ visual and sound effects heightened the satisfaction derived from actions like blasting enemies or asteroids. Collecting pickup items (coins in our case), and power-ups are also a satisfying part of the SE game. We also believe that the inclusion of game feedback features in the SE version played a role in enhancing the overall enjoyment of the gaming experience. The NSE version provided only basic performance feedback (e.g., non-juicy sound effects for damage and destruction) to minimize confusion among players regarding their performance, but lacked detailed game feedback (e.g., health and progress indicators or coin counts). In stating this, we do not imply that game designers have neglected such elements. We are well aware that many games incorporate various elements, including game feedback and narratives, alongside other elements not present in our SE-supporting
framework, to enhance player enjoyment. Our statement is that the incorporation of our carefully selected set of elements not only did not diminish the fun aspect of the game but also contributed to its overall enjoyment. Furthermore, examination of Table 6.5 leads us to an interesting finding that enjoyment is not confined by a player’s baseline general self-efficacy. This suggests that individuals with various confidence levels enjoy playing the SE version of the game. Consequently, the integration of the SE-supporting framework appears to enhance enjoyment across different confidence levels.

6.5.2 Control Beliefs

S2-RQ2: Do SE-supporting game elements affect players’ control beliefs? Yes, SE-supporting game elements affect control beliefs in players. In the SE condition, we observed higher levels of perceived competence and dominance. However, domain self-efficacy was higher in participants with high baseline general self-efficacy in the SE condition. The effect of SE-supporting game elements was not observed in general and task self-efficacy.

Self-Efficacy

In this section, we discuss our self-efficacy findings, as presented in Table 6.5. Initially, we examine the impact of the main independent factor, condition, and subsequently, we consider both condition and baseline general self-efficacy. We then elaborate on our repeated measures outlined in Table 6.3 factoring in time, condition, and baseline general self-efficacy.

Interestingly, we found no significant difference in self-efficacy between the SE and NSE conditions in either of the general, domain or task dimensions. This outcome is rather surprising, considering that we carefully designed our game elements with a focus on self-efficacy, hence the name SE-supporting framework. Our selection of elements aimed to support three out of the four sources of self-efficacy—mastery experiences, vicarious experiences, and verbal persuasion. This finding underscores the challenge of altering an individual’s perception of their abilities and confirms the findings of Study One regarding self-efficacy. One possible explanation for the absence of a significant difference between the conditions is the limited effectiveness of our SE-supporting framework in fostering the development of self-efficacy components in players. There are two plausible scenarios to consider:

Scenario one: Given that mastery experiences are the primary source of driving self-efficacy, we intentionally selected many game elements in our framework to enhance players’ sense of mastery. However, one might suspect that our mastery elements fell short in elevating self-efficacy. We can rule out this scenario based on the results, which demonstrated a significant increase in perceived competence. It is well-established that mastery experiences also drive feelings of competence in players [47, 29, 31], suggesting that our mastery elements effectively worked.

Scenario two: The lack of a difference in self-efficacy dimensions between the groups is likely due to the underperformance or absence of game elements associated with other self-efficacy source components, rather
than mastery. This is a plausible scenario. *Space Oddity* is a single-player game, and we aimed to design elements that could emulate a multiplayer experience. For instance, the ghost replays and leaderboards were intended to provide a sense of competition. However, players might not have felt the vicarious experiences strongly, especially since they did not see real players’ performances. The leaderboard featured the player alongside NPCs, not real players, and players may not have related to the NPCs as intended. Additionally, in the verbal persuasion category, NPCs spoke encouraging phrases to players when they collected power-ups. We took care to ensure these audio clips were not played randomly to avoid accidental sarcasm if they coincided with a player’s underperformance. However, there is a possibility that players took damage at the time of picking up power-ups, which means the encouraging phrases could have been misunderstood. Moreover, as mentioned in Chapter 3, physiological states were out of the scope of the project and were excluded from the list of our self-efficacy components. The extent to which physiological states influence self-efficacy in a game like *Space Oddity* is open to future research.

The absence of a significant difference between the conditions could also be attributed to the relatively high self-efficacy scores in both conditions, as evident in Table 6.4 (also see Figure 6.3 for visual comparison). To detect a significant difference in self-efficacy, it would require a condition where self-efficacy scores, especially in the NSE condition, were comparatively lower. This is unsurprising given the familiarity of most players with arcade-style space shooter games, including *Space Oddity*, which was designed to mitigate complexity. Introducing more complex game mechanics might have increased the likelihood of observable change in self-efficacy, as players would perceive the task as more challenging. Additionally, methodological considerations play a role, where the scale used for general self-efficacy was validated, but the scales for domain and task self-efficacy were not. Adapting the GSES for measuring task self-efficacy may not have captured all the nuances of gameplay, and a more tailored questionnaire could have provided a detailed understanding of the challenges players faced in *Space Oddity*. As an example, the item “I can always manage to solve difficult problems in *Space Oddity* if I try hard enough” is general and may seem vague in the context of a video game. A more customized questionnaire could have offered a substitute for the mentioned item, such as: “I can survive the attacks in level three without picking up the wide-angle weapon power-up.”, providing a more specific and task-oriented measure of self-efficacy. The same concern applies to the adapted GSES scale used for domain self-efficacy. Since a gaming situation is not a general domain, there are concerns about whether the assessment captured all the necessary information and avoided overlooking crucial aspects.

Another plausible explanation for observing no significant difference between conditions may be found in players’ baseline general self-efficacy. It is possible that baseline general self-efficacy—synonymous with confidence—could represent an antecedent to increasing domain and task self-efficacy, such that low general self-efficacy may prevent a player from experiencing self-efficacy increases.

Following additional analyses on the interaction between baseline general self-efficacy and condition (see Table 6.5), we found that for those players with above-average baseline GSE, *task* self-efficacy was significantly greater. It is important to note that increases in task self-efficacy appear to be unaffected by the presence of
SE-supporting game elements, as there is no observed interaction effect between baseline GSE and condition. To explain these results, we speculate that players with low baseline general self-efficacy may attribute task self-efficacy reinforcing outcomes to other sources—for example, high placement on the leaderboard (in the SE condition) or successful completion of a level (in either condition) may be attributed to the game’s perceived ease, rather than to their own ability. Conversely, those with high baseline general self-efficacy may be more likely to internalize these events as relating to their perceived domain mastery.

By examining the impact of time (see Table 6.3), we observe a significant increase in general self-efficacy over the course of gameplay, irrespective of the presence of our SE-supporting framework and regardless of players’ initial confidence levels. Although our analysis indicates no significant disparity between conditions in post-gameplay general self-efficacy, the temporal effect of playing a game appears to enhance this perception in players. This result implies that both groups, characterized by low and high levels of general self-efficacy, can derive confidence-boosting benefits from playing games. However, the interaction effect of time and condition in domain self-efficacy indicates that the SE-supporting framework increases players’ domain self-efficacy. Nevertheless, due to the small to medium effect size, it’s essential to interpret our conclusions with caution. The extension of this result has interesting implications—for example, in the use of a simple SE-supporting game to improve players’ perspectives of their efficacy in playing games more broadly. Additionally, we find there is a significant increase in domain self-efficacy observed in players with low confidence. This finding aligns with expectations; since Space Oddity is not a complex game, we expect players with low confidence to benefit more from playing the game. The increased domain self-efficacy observed in these players may translate to a greater willingness to participate in other gaming activities, contributing to a more inclusive and enjoyable gaming community.

**Perceived Competence**

Participants in the SE condition reported higher competence than their counterparts in the NSE condition. Our results support that our SE-supporting framework serves to facilitate players’ perceived competence (medium effect size). This result aligns with both our intention and expectation, as the elements in the framework were designed to improve mastery experiences and mastery is a substantial facilitator of competence [31, 31]. Furthermore, while our game elements were selected to support self-efficacy, some also contribute to perceived competence—for example, manipulated leaderboards, which have been previously shown to increase competence outcomes [9]. The statistics in Table 6.4 indicate that, unlike self-efficacy, participants in both conditions did rate their perceived competence at the highest range, allowing the detection of differences in this construct. This also suggests that Space Oddity provided a certain level of challenge to players.
Dominance

Our results likewise support that our SE-supporting framework facilitates player dominance. While this was an intended outcome, the framework was not specifically designed for dominance—due to a lack of examples of dominance-oriented game design in the literature. Moreover, the pre- and post-gameplay assessment of dominance indicates an increase in dominance as a result of gameplay. We propose that completing a task—that is playing *Space Oddity*—brings an end to the perception of being controlled, leading to a sense of regaining control after the end of gameplay. Extant literature investigating dominance in video games also finds that dominance increases simply as a result of play [61], but also following game modes that enable players to defeat enemies [35]. *Space Oddity* satisfies both these conditions, as it offers a combat-style game where participants engage in destroying enemy spaceships from start to finish. That dominance increased in-kind with competence highlights the interconnected nature of these constructs, and points to opportunity for their synthesis through the lens of control beliefs in future research. However, it is also possible that a version of the game artifact *sans* combat may have produced a different pattern of results. For example, consider a scenario in *Space Oddity* where the player is restricted to dodging projectiles without the ability to shoot enemies. In such a case, elements of mastery and competence are still present in the game, but the player’s control over the outcome is diminished compared to a situation where they can shoot. Consequently, dominance may not increase or could even decrease.

Table 6.5 also indicates that dominance is higher in players with high baseline GSE compared to those with low baseline GSE. However, the absence of an interaction effect between the condition and baseline GSE prevents us from attributing a meaningful connection of our framework to confidence. What is evident is that confidence serves as a predictor of feelings of dominance after playing *Space Oddity* which is in line with established psychological literature [34].

Through the Lens of Control Beliefs

Control beliefs serve as a collective umbrella encompassing self-efficacy, perceived competence, and dominance. The objective of this study was to examine whether our SE-supporting design framework could effectively evoke control beliefs in players. In summary, we saw that the SE condition is significantly more successful than the NSE condition in increasing dominance and perceived competence outcomes, with some players also seeing increasing domain self-efficacy outcomes which highlights nuances in designing for self-efficacy and control beliefs. Further, it is plausible that some—or all—SE-supporting elements may be less successful for those with low baseline general self-efficacy, thus necessitating consideration of player state.

Through the lens of control beliefs, we have contributed a valuable perspective to games user research. Whether a player perceives themselves to be able to exert control in a game environment, offers valuable insights into player experience and design considerations to elicit such beliefs. While our framework primarily targeted self-efficacy, with some elements supporting perceived competence, the observed increases in dominance and competence highlight the interconnected nature of self-efficacy, competence, and dominance.
This emphasizes the significance of control beliefs in motivating future research opportunities. Esports—that is, competitive gaming—is one area that could benefit from future research in control beliefs, as esports players are demanded to perform at the top level, making their control beliefs a vital aspect to consider. We anticipate that validated scales tailored to measure control beliefs in games will capture the nuances of video games, offering a clearer understanding of self-efficacy, and with it, control belief constructs.

6.5.3 Perceived Game Difficulty

S2-RQ3: Do SE-supporting game elements affect perceived game difficulty? We have reason to believe that SE-supporting game elements such as power-ups will lower game difficulty. In our experiment context, it was important to ensure that difficulty did not confound our other results. In an attempt to experimentally control for difficulty as a variable, we systematically manipulated the NSE condition such that the player character had a larger health pool (ranging from 260% to 320% more than the SE condition, depending on the level). In isolation, the absolute difficulty of the game was higher in the SE condition compared to the NSE condition—but this should be offset by the decrease in difficulty attributed to SE supporting elements.

We assessed the actual difficulty of both the SE and NSE conditions by tracking the number of player character deaths. Simultaneously, we gauged perceived difficulty by asking participants to rate how challenging they found the game. While the death counts in the SE version suggest that it was more challenging (more deaths were logged in this version), it was perceived as equally difficult as the NSE version.

The results indicate that there are no statistically significant differences observed for either performative challenge or game difficulty rating between the two groups. While we are cautious not to over-interpret a null result, one interpretation is that our efforts to balance the game difficulty between the SE and NSE conditions have been successful and that difficulty has not confounded our experiment results. We highly recommend that future research accounts for the possible influence of game elements such as power-ups on actual and perceived difficulty.

Based on the results we found for S2-RQ1 and S2-RQ2, we showed that the study was mostly successful in meeting the research goal of improving player wellbeing through enjoyable games. Additionally, when combined with the results for S2-RQ3, the success of our framework in making difficult tasks more enjoyable is emphasized.

6.5.4 Implications

Previous research endeavours have examined control beliefs independently, focusing on aspects of self-efficacy, perceived competence, and dominance within the context of player experience. In contrast, our study takes a comprehensive approach by collectively addressing these constructs as control beliefs. Given that these
constructs collectively contribute to the affective experience of the player, we believe that considering them as an integrated bundle can be beneficial for games user researchers.

As control beliefs enhance player motivation and engagement [63, 62, 5, 21, 11, 12], game designers and developers stand to benefit from deeper consideration of control beliefs, as well as our self-efficacy framework. While many prominent games have used SE-supporting elements to enhance the player experience, many commercial games routinely exclude features outlined in our framework, such as verbal praise and leaderboard manipulations. Moving forward, developers might prioritize incorporating aspects of these features into most commercial game titles, which could lead to a potential boost in players’ control beliefs—and the engagement benefits that control beliefs support [12, 4]. While we acknowledge that untruthful elements, such as manipulated leaderboards, may not be suitable for authentic player assessment, especially in multiplayer video games, they can find utility in game tutorials or specific scenarios within single-player games with the intention that players engage with the game and continue playing.

Given the widespread use of control beliefs in the context of sport psychology, esports (that is, organized competitive digital gaming [23]) researchers and stakeholders are poised to make meaningful advancements through the lens of control beliefs. Research shows that, in high-pressure contexts, players may doubt their own ability and revert to a playstyle more likely to result in under-performance [8]. By deploying SE-supporting games immediately prior to competitive play, researchers and esports organizers may help to enhance professional players’ control beliefs—or, alternatively, restore these beliefs following control belief-undermining experiences (such as defeat, or low placement) in competitive formats.

One of our findings was that SE-supporting game elements have the ability to offset the difficulty of the game. Facing challenges in a game can be enjoyable if those challenges are not excessively difficult. Consequently, by integrating SE-supporting elements into challenging games, we can attract more players by diminishing the perceived challenge and enhancing the overall enjoyment of the game.

Finally, our game—regardless of the inclusion of the self-efficacy framework—has the potential to assist individuals struggling with low confidence in video games. Many individuals refrain from playing video games due to a lack of self-efficacy in gaming. Space Oddity can be viewed as a valuable platform for novice players to cultivate confidence in this domain.

6.6 Limitations and Future Opportunities

Within this research, we explore the concepts of perceived competence, dominance, and self-efficacy as individual facets of control beliefs. We propose that one promising direction for future research would be the development and validation of a ‘Control Beliefs in Video Games’ scale that synthesizes all three constructs, allowing for a more convenient and agile evaluation of control beliefs in player experience contexts. Additionally, we recognized the necessity for validated scales specifically tailored for task self-efficacy and domain self-efficacy, which comprehensively capture the nuances inherent to video games.
A limitation of our study was the use of three different variations of the GSES scale, which shared visual similarity, differing primarily in a few specific words. This may have led to participant fatigue, potentially impacting their responses as they progressed in the study. Future work should consider methods to mitigate this issue, such as optimizing the questionnaires to maintain participant engagement throughout the study.

Additionally, the online experiment setup introduced variability in participants’ technological conditions, including differences in screen refresh rates. This variability could have influenced player experiences, making it essential to account for these technological differences in future research for more consistent and controlled conditions.

It is important to note that although we considered our gameplay video as one of our in-game elements, it was not directly incorporated into the game itself. The decision to exclude it from the game and show it before gameplay during the study was rooted in the consideration that players commonly watch gameplay videos online, such as through video streaming services or live player streams. Hence, having a gameplay video within the game would feel unnatural to players. This aspect should be further explored and refined to seamlessly integrate video elements as true in-game elements.

Another limitation we encountered in designing the framework was our inability to integrate all the elements identified in the literature due to limitations in both the scope and the genre of the game. The physiological component of self-efficacy was omitted from our study due to project scope and game genre constraints. A promising avenue for future research involves designing games that incorporate player physiology and exploring how control beliefs impact physiological responses. This exploration could shed light on the intricate relationship between self-efficacy and player physiology, opening new opportunities for understanding and enhancing player experiences in video games. Future research should aim to expand the framework by including a broader array of elements, allowing for a more comprehensive exploration of their effects on player experiences and self-efficacy. Moreover, we acknowledge the need for a more in-depth exploration of elements related to increasing dominance. This area remains relatively unexplored and presents an opportunity for further research to enhance our understanding of these elements and their impact on player behaviour and self-efficacy. Further, we evaluate all SE-supporting elements as a single collective. Owing to the high number of SE-supporting elements we included in our design framework, individual evaluation of each element’s efficacy in enhancing control beliefs was out of scope for this research. Future work would benefit from investigating these elements either individually, or grouped thematically (e.g., by self-efficacy component). It is plausible that one or more elements might be especially efficacious in improving player control beliefs—or, conversely, that other elements are less successful in this capacity. Identifying the relative strengths and weaknesses of individual SE-supporting elements would allow developers to prioritize which elements to implement meaningfully.

Future research in this domain would also benefit from the examination of other games and game genres. In this study, we deploy a simple top-down arcade shooter video game—however, we also know that control beliefs may be influenced by game content and complexity. Novel opportunities for this research could include
evaluating whether control belief outcomes remain consistent for a game that does not feature combat—or for a game that offers greater opportunity for interactions.

Our framework for enhancing control beliefs in players was designed with a focus on self-efficacy theory and did not account for individual player preferences or characteristics. As a result, the effectiveness of the framework may vary among different types of players (e.g., some players may find leaderboards demotivating). Our goal was to develop a universal framework that could be applied broadly across games to benefit all player types, which limited our ability to customize elements for specific preferences. Additionally, tailoring the framework for different player types would require extensive research and many customized versions of the game. However, existing research [46], suggests that customization could lead to improved player experience. Therefore, exploring the effects of customization for different player types presents an exciting opportunity for future research. By tailoring the framework to suit the preferences and motivations of diverse player groups, we may observe significant enhancements in the promotion of control beliefs.

Finally, recognizing the potential transferability of improved control beliefs from video games to other areas of life, such as sports and education, opens up exciting possibilities. If players can experience increased self-efficacy and confidence through gaming, it may positively impact their performance and wellbeing in various domains. However, further research is needed to establish a solid correlation between gaming-related control beliefs and real-life outcomes. If proven effective, the framework developed in this study could indeed have significant implications for individuals preparing for sports competitions or seeking to enhance their learning experiences.
7 Conclusion

To conclude my M.Sc. thesis, this work explored control beliefs, operationalized as self-efficacy, competence, and dominance in the context of player experience research, with a particular emphasis on self-efficacy. We developed a design framework, comprising game elements intended to boost self-efficacy to explore how video games could be designed to cultivate player self-efficacy, perceived competence, and dominance, collectively constituting control beliefs. We demonstrated the application of this framework through a bespoke research game, Space Oddity. Findings from evaluating Space Oddity revealed that elements intended to enhance self-efficacy successfully resulted in higher subjective competence and dominance. While self-efficacy did not exhibit as straightforward results as the other two control belief constructs, we observed an interaction effect between the game elements and baseline general self-efficacy in the domain of video games. Beyond control belief measures, the presence of SE-supporting elements facilitated increased enjoyment, highlighting the value of incorporating these elements for game designers. Another finding was that the SE-supporting framework led to a perception of the game’s difficulty as less challenging than its actual difficulty. Taken together, this work makes a meaningful contribution to the games and play research domain by highlighting the value of control beliefs on player experience, as well as the need for additional research to support task self-efficacy through games.
References


Appendix A

Expert Group Discussion Outcome

Table A.1: Game elements and mechanics that emerged from our brainstorming session.

<table>
<thead>
<tr>
<th>Mastery Experiences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Challenge-skill balance</td>
</tr>
<tr>
<td>Dynamic Difficulty Adjustment (DDA)</td>
</tr>
<tr>
<td>Critical hits (with juicy feedback)</td>
</tr>
<tr>
<td>Level up + character progress</td>
</tr>
<tr>
<td>Numbers that go up (showing the growing score)</td>
</tr>
<tr>
<td>Screen glows up when players score multiple points</td>
</tr>
<tr>
<td>Bonus level where they can collect coins / collectibles</td>
</tr>
<tr>
<td>Avatar customization + progress</td>
</tr>
<tr>
<td>Positive visual/audio feedback [FX at collecting points]</td>
</tr>
<tr>
<td>Power-ups that increase ability of player character</td>
</tr>
<tr>
<td>Progress bar (a combination of mastery and encouraging comments)</td>
</tr>
<tr>
<td>Visual tutorials showing success</td>
</tr>
<tr>
<td>High precision movement (game controls)</td>
</tr>
</tbody>
</table>

Table A.2: The self-efficacy-enhancing game elements and mechanics that emerged from our brainstorming session.

<table>
<thead>
<tr>
<th>Vicarious Experiences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Showing past players’/rival’s stats before the level/combat starts</td>
</tr>
<tr>
<td>Watching someone play for tutorial (Recording or Confederate)</td>
</tr>
<tr>
<td>Watching Twitch streams</td>
</tr>
<tr>
<td>Tips and hints</td>
</tr>
<tr>
<td>Showing other players’ stats when they defeated the big boss (e.g. time)</td>
</tr>
<tr>
<td>Ghost overlays</td>
</tr>
<tr>
<td>Leaderboard (showing play time too. I.e. played 10 minutes and scored 500)</td>
</tr>
<tr>
<td>Notes from “other players”</td>
</tr>
</tbody>
</table>
Table A.3: The self-efficacy-enhancing game elements and mechanics that emerged from our brainstorming session.

<table>
<thead>
<tr>
<th>Social Persuasion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confederate praising participant (deception)</td>
</tr>
<tr>
<td>Praise from NPCs Disembodied “Great” displays DDR style</td>
</tr>
<tr>
<td>Friendly AI companion (e.g. Nani)</td>
</tr>
<tr>
<td>Dyad confederate (for in-person experiments)</td>
</tr>
<tr>
<td>Encouraging chat box text (From AI partner?)</td>
</tr>
</tbody>
</table>
Appendix B

Game Narrative

The NSE version of the game only displays the game controllers to the player, as depicted in Figure B.1.

Figure B.1: In the NSE version, the game controllers are introduced in the absence of game narration.

Figures B.2 to B.10 illustrate the narration of the game story by the NPCs in the SE version. The following block provides a transcription of the narration for readability purposes.

---

**Major Tom**: Hello, Shark Bait! This is Major Tom. I’m so excited you volunteered to take on this quest to beat Ziggy Stardust. Ziggy and I were the best pilots in our base. One day, ground control gave us a mission to travel to the alien territory to collect space loot and bring them to the base.  

**Major Tom**: Ziggy betrayed me. He sabotaged my spaceship. Not having my full attack power, the aliens killed me in the first stage of the mission. However, I came back as a ghost to guide other courageous adventurers, such as yourself, to avenge me and beat Ziggy Stardust’s record.  

**Major Tom**: Lady M was my best pilot so far. She almost beat Ziggy, but was killed only a few seconds before the end of the final stage.  

**Lady M**: I am a ghost now, but the memory is still fresh and painful! My spaceship was behaving strangely when it happened.  

**Major Tom**: In this quest, you will face threats like hostile ships and asteroids. Prove that you are the best pilot out there by eliminating the most threats, collecting coins and surviving the enemy ambush. I’m counting on you, Shark Bait!  

**Lady M**: Destroy the asteroids if you can. The big asteroids carry power-ups which will help you survive and progress. Also, the coins may disappear in space if you do not collect them quickly.  

**Major Tom**: Move around using the WASD or the arrow keys. Shooting is automatic. You can pause the game at any time by pressing the ESC button.  

**Major Tom**: At some point in the first and third stages of the mission, you will see the ghost of my spaceship and Lady M’s respectively a few moments before we were killed.  

**Lady M**: Good Luck, Shark Bait!
Figure B.2: An allied NPC (Major Tom) starts narrating the story of the game. The player is addressed by their chosen username.

Figure B.3: The allied NPC (Major Tom) continues with the narration of the backstory of the game.

Figure B.4: The allied NPC (Major Tom) introduces another allied NPC (Lady M).
Figure B.5: Lady M continues with the backstory.

Figure B.6: Guidance from the NPCs; Major Tom explains the game mechanics. Encouragements from NPCs. The player is addressed by their chosen username.

Figure B.7: Guidance from the NPCs; Lady M explains the game mechanics.
Figure B.8: Guidance from the NPCs; Major Tom refers to the ghost replays.

Figure B.9: Guidance from the NPCs; the introduction of the game controls.

Figure B.10: Encouragements from the NPCs. The player is addressed by their chosen username.
Appendix C

Experiment Snapshots of Study One

Space Oddity: A Game Study

Before proceeding, please read the following. You must give your consent to continue.

Title: The Effects of Video Game Features on Players

Researcher(s):
- Maryam Samadi, Masters Student, Department of Computer Science, University of Saskatchewan, maryam.samadi@usask.ca
- Dr. Madison Klarowski, Assistant Professor, Department of Computer Science, 306-966-8940, m.klarowski@usask.ca
- Dr. Cody Phillips, Assistant Professor, Department of Computer Science, 306-966-5561, cody@cs.usask.ca
- Dr. Regan Mandryk, Professor, Department of Computer Science, rm412@mail.usask.ca

Purpose(s) and Objective(s) of the Research: The purpose of this study is to understand the influence of gameplay on the player.

Procedures:
- You will play a digital game.
- You will then complete questionnaires asking questions about yourself, and relating to your experience playing the game.
- You will then complete questionnaires asking additional questions about yourself, and your experience with games in general.

Funded by: The Natural Sciences and Engineering Research Council of Canada (NSERC).

Potential Risks and Benefits: There are no known or anticipated risks to you by participating in this research. Your participation will help us better understand the influence of playing computer games on players.

Confidentiality:
- Confidentiality will be maintained throughout the study. The entire process and data will be anonymized. Data will only be presented in the aggregate and any individual user comments will be anonymized prior to presentation in academic venues.
- Only the research team and their research assistants will have access to the data to ensure that your confidentiality is protected.
- Storage of Data
  - Data (including questionnaire responses and logs of computer use) will be stored on a secure password-protected server for 5 years after data collection.
  - After 5 years, the data will be destroyed. Digital data will be wiped from hard disks beyond any possibility for data recovery.

Right to Withdraw:
- Your participation is voluntary. You may withdraw from the research project for any reason, at any time without explanation.
- Should you wish to withdraw, you may do so at any point, and we will not use your data; we will destroy all records of your data.
- Withdrawal requests can be made by contacting us through the Prolific website.
- Your right to withdraw data from the study applies until one week following your participation. After this time, it is possible that some form of analysis will have already occurred and it may not be possible to withdraw your data.

Follow up: To obtain results from the study, please contact Maryam Samadi (maryam.samadi@usask.ca).

Questions or Concerns:
- Any questions you may have regarding consent can be sent to us by contacting us through the Prolific website or by sending an email to any of the contact emails listed in this consent form.
- This research project has been approved on ethical grounds by the University of Saskatchewan Research Ethics Board. Any questions regarding your rights as a participant may be addressed to that committee through the Research Ethics Office ethics.office@usask.ca (306) 966-2975. Out of town participants may call toll free (888) 966-2975.

Figure C.1: Introduction, briefing, and the consent form of the experiment.
**Figure C.2:** Consent form, (Cont.). Giving consent is necessary to proceed to the next page.

**Figure C.3:** Participants input their unique Prolific ID in this page. This is for payment purposes.

**Figure C.4:** Instructions before gameplay.
Figure C.5: The gameplay video page; only visible to the participants in the SE condition. Participants could play/pause the video on demand.

Figure C.6: The game; participants played *Space Oddity* on this page.
Figure C.7: The Task Self-Efficacy questionnaire.
**Figure C.8:** The Domain Self-Efficacy questionnaire.


**Figure C.9:** The General Self-Efficacy Scale (GSES) questionnaire.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Not at all true</th>
<th>Exactly true</th>
</tr>
</thead>
<tbody>
<tr>
<td>I can remain calm when facing difficulties because I can rely on my coping abilities.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I can solve most problems if I invest the necessary effort.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am confident that I could deal efficiently with unexpected events.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Thanks to my resourcefulness, I know how to handle unforeseen situations.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I can always manage to solve difficult problems if I try hard enough.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>If something/someone opposes me, I can find the means and ways to get what I want.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>If I am in trouble, I can usually think of a solution.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>It is easy for me to stick to my aims and accomplish my goals.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>When I am confronted with a problem, I can usually find several solutions.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I can usually handle whatever comes my way.</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
**Figure C.10**: The Enjoyment questionnaire.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Not at all true</th>
<th>Somewhat true</th>
<th>Very true</th>
</tr>
</thead>
<tbody>
<tr>
<td>While I was doing this activity, I was thinking about how much I enjoyed it.</td>
<td>○ ○ ○ ○ ○</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
<tr>
<td>I would describe this activity as very interesting.</td>
<td>○ ○ ○ ○ ○</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
<tr>
<td>I enjoyed doing this activity very much.</td>
<td>○ ○ ○ ○ ○</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
<tr>
<td>I thought this activity was quite enjoyable.</td>
<td>○ ○ ○ ○ ○</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
<tr>
<td>I thought this was a boring activity.</td>
<td>○ ○ ○ ○ ○</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
<tr>
<td>This activity was fun to do.</td>
<td>○ ○ ○ ○ ○</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
<tr>
<td>This activity did not hold my attention at all.</td>
<td>○ ○ ○ ○ ○</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
<td>○ ○ ○ ○ ○ ○ ○</td>
</tr>
</tbody>
</table>
Figure C.11: Demographics

What is your age?

Indicate your gender:
Select an option

Self-describe your gender, if applicable:

Please indicate how often (on average) you play games:
Select an option

If you played games more or less in the past, please indicate how often you used to play:
Select an option

How much do you self-identify as a gamer on the following scale:

not at all gamer

Please indicate the genres that you enjoy playing:
- Action
- Platform games
- First Person Shooter
- Beat ’em up
- Adventure
- Role Playing Games
- Mass Multiplayer Role Playing Games (MMORPG)
- Simulation
- Vehicle simulation
- Strategy
- Music games
- Puzzle games
<table>
<thead>
<tr>
<th>Item</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sport games</td>
<td>☐</td>
</tr>
<tr>
<td>Multiplayer Online Battle Arena (MOBA)</td>
<td>☐</td>
</tr>
<tr>
<td>Casual games</td>
<td>☐</td>
</tr>
<tr>
<td>Battle Royale</td>
<td>☐</td>
</tr>
</tbody>
</table>

**Did you play Space Oddity with sound on?**
- ☐ Yes
- ☐ Yes, but I could not hear the sound well
- ☐ I do not remember
- ☐ No

**Do you have any feedback related to the study?**

- [ ] study feedback

**Do you have any feedback related to the game?**

- [ ] game feedback

**Did you face any technical problems during the study? If yes, please describe below.**

- [ ] technical feedback

---

**Figure C.12:** Feedback questions

---

**Space Oddity: A Game Study**

**Debrief**

When you played the game, you were randomly assigned to one of two groups to play a version of Space Oddity with or without features that potentially increase self-efficacy such as a progress bar, encouraging phrases, and displaying usernames.

Our goals are:
- To determine if self-efficacy supporting features increase players' self-efficacy in Space Oddity, video games, and life.
- To determine if self-efficacy supporting features affect Player Experience in regards to enjoyment and self-determination.

---

**Figure C.13:** Debriefing of the study
Figure C.14: End page; redirecting the participants to Prolific.
Appendix D

Experiment Snapshots of Study Two

Space Oddly: A Game Study

Before proceeding, please read the following. You must give your consent to continue.

Title: The Effects of Video Game Features on Players

Researchers:
- Maryam Samadi, Master's Student, Department of Computer Science, University of Saskatchewan, maryam.samadi@usask.ca
- Dr. Madison Klarowski, Assistant Professor, Department of Computer Science, 306-966-8940, m.klarowski@usask.ca
- Dr. Cody Phillips, Assistant Professor, Department of Computer Science, 306-966-5561, cody@cs.usask.ca
- Dr. Regan Mandryk, Professor, Department of Computer Science, rim412@mail.usask.ca

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- You will play a digital game.
- You will then complete questionnaires asking questions about your experience playing the game and additional questions about yourself.

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Figure D.1: Introduction, briefing, and the consent form of the experiment.
Figure D.2: Consent form, (Cont.). Giving consent is necessary to proceed to the next page.

Figure D.3: Participants input their unique Prolific ID on this page. This is for payment purposes.

Figure D.4: Instructions before proceeding to the pre-gameplay surveys.
Figure D.5: The General Self-Efficacy Scale (GSES) questionnaire, presented to the participants pre-test.
### Space Oddity: A Game Study

**Figure D.6:** The Domain Self-Efficacy questionnaire, presented to the participants pre-test.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Not at all true</th>
<th>Exactly true</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is easy for me to stick to my aims and accomplish my goals in a video game.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>When I am confronted with a problem in a video game, I can usually find several solutions.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I can always manage to solve difficult problems within a video game if I try hard enough.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>In a video game, if something/someone opposes me, I can find the means and ways to get what I want.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I can remain calm when facing difficulties in a video game because I can rely on my coping abilities.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>If I am in trouble in a video game, I can usually think of a solution.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I can usually handle whatever comes my way in a video game.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Thanks to my resourcefulness, I know how to handle unforeseen situations in a video game.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am confident that I could deal efficiently with unexpected events in a video game.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I can solve most problems in a video game if I invest the necessary effort.</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

**Figure D.7:** Self Assessment Manikin (SAM), presented to the participants pre-test.

*Instructions*

Please choose the image that reflects how you are currently feeling.

This scale rates the dimension of controlled vs in-control. At the low end of the dominance scale are feelings like completely controlled, influenced, cared-for, submissive, guided. At the high end are feelings like completely controlling, influential, in control, important, dominant. Click the icon that represents your current emotional state.

---

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**Figure D.8:** Instructions before gameplay.

**Figure D.9:** The gameplay video page; only visible to the participants in the SE condition. Participants could play/pause the video on demand.
Figure D.10: The game; participants played *Space Oddity* on this page.

Figure D.11: Instructions after gameplay and before proceeding to the post-gameplay surveys.
**Figure D.12:** The Task Self-Efficacy questionnaire.
Figure D.13: The Domain Self-Efficacy questionnaire, presented to the participants post-test.
**Figure D.14:** The General Self-Efficacy Scale (GSES) questionnaire, presented to the participants post-test.

**Figure D.15:** Self Assessment Manikin (SAM), presented to the participants post-test.
Figure D.16: The Enjoyment questionnaire.

Figure D.17: The Performative Challenge questionnaire.
<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is your age?</td>
<td></td>
</tr>
<tr>
<td>Indicate your gender:</td>
<td>Select an option</td>
</tr>
<tr>
<td>Self-describe your gender, if applicable:</td>
<td></td>
</tr>
<tr>
<td>Please indicate how often (on average) you play games:</td>
<td>Select an option</td>
</tr>
<tr>
<td>If you played games more or less in the past, please indicate how often you used to play:</td>
<td>Select an option</td>
</tr>
<tr>
<td>How much do you self-identify as a gamer on the following scale:</td>
<td></td>
</tr>
<tr>
<td>Please rate how difficult you found the game.</td>
<td></td>
</tr>
<tr>
<td>Please indicate the genres that you enjoy playing:</td>
<td></td>
</tr>
<tr>
<td>Action</td>
<td>☐</td>
</tr>
<tr>
<td>Platform games</td>
<td>☐</td>
</tr>
<tr>
<td>First Person Shooter</td>
<td>☐</td>
</tr>
<tr>
<td>Beat ‘em up</td>
<td>☐</td>
</tr>
<tr>
<td>Adventure</td>
<td>☐</td>
</tr>
<tr>
<td>Role Playing Games</td>
<td>☐</td>
</tr>
<tr>
<td>Mass Multiplayer Role Playing Games (MMORPG)</td>
<td>☐</td>
</tr>
<tr>
<td>Simulation</td>
<td>☐</td>
</tr>
<tr>
<td>Vehicle simulation</td>
<td>☐</td>
</tr>
</tbody>
</table>

**Figure D.18:** Demographics + Single-item game difficulty question.
|☐| Adventure |
| ☐| Role Playing Games |
| ☐| Mass Multiplayer Role Playing Games (MMORPG) |
| ☐| Simulation |
| ☐| Vehicle simulation |
| ☐| Strategy |
| ☐| Music games |
| ☐| Puzzle games |
| ☐| Sport games |
| ☐| Multiplayer Online Battle Arena (MOBA) |
| ☐| Casual games |
| ☐| Battle Royale |

Did you play Space Oddity with sound on?
- ☐ Yes
- ☐ Yes, but I could not hear the sound well
- ☐ I do not remember
- ☐ No

Do you have any feedback related to the study?

Do you have any feedback related to the game?

Did you face any technical problems during the study? If yes, please describe below.

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**Figure D.19:** Feedback questions
**Figure D.20**: Debriefing of the study.

**Figure D.21**: End page; redirecting the participants to Prolific.