# Practice in Reality for Virtual Reality Games: Making Players Familiar and Confident with a Game

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**Abstract.** Game designers include training levels in video games to prepare players so that they can enjoy the game. The training levels of virtual reality (VR) games are typically assumed to be within the virtual world of the game. New players must learn about a new game in such an unfamiliar virtual world. A tutorial in the real world offers a potential way to enable players to learn about a new game and to practice the skills in a familiar world. To explore any effects of a real-world tutorial in VR games, an experiment was conducted, the results of which show that a real-world tutorial is effective in helping new players feel confident about and familiar with a VR game before playing it. However, it is not as effective as virtual-world tutorial in increasing game performance.

## 1 Introduction

Virtual reality (VR) headsets have become popular in recent years. VR technologies enable game designers to explore new forms of gameplay. Many players may be new to VR games and may require assistance in getting familiar with virtual environments and gaining basic skills. Therefore, game designers design tutorials in video games to prepare new players for a game.

Unique challenges arise when designing tutorials for VR games. Video game tutorials are typically presented within the video game environment. If the same approach is used in VR games, the tutorials would be presented in a VR environment that is new in every VR game. Players must wear a VR headset and fully immersed in an unfamiliar environment while simultaneously acquiring basic skills for the game. This is similar to someone new to basketball preparing for a basketball match that will be played on an unfamiliar court. Receiving training in the court may be helpful; however, he or she may feel more comfortable receiving basic training in a familiar place (e.g., his or her own backyard). In VR games, whether players can receive basic tutorials in a familiar place (e.g., their own living room) instead of the unfamiliar virtual environment of a VR game should be considered. This paper focuses on real-world tutorials for VR games.

Tutorials in the real world can help new players learn how to play a game. In the real world, designers can replicate certain objects (e.g., tools) from VR games. Such objects provide new players with an opportunity to experience the settings and interactions in a manner similar to that in the VR game. Thus, players can learn about a new


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game in a familiar, real setting while acquiring some basic skills on how the game is played. Then, when they start playing a VR game, they can feel familiar with the game mechanics and achieve goals with the basic skills that they have acquired. This raises a concern of whether real-world tutorials can fulfill two purposes of game tutorials: (1) letting new players become familiar with the game, and (2) allowing them to acquire the necessary skills to play.

Tutorials in the real world provide opportunities for players to familiarize themselves with a new VR game because they are given in a familiar setting. Full immersion into the virtual world is not required until the players are prepared and start playing the VR game.

Another purpose of in-game tutorial is the acquisition of basic skills. An obvious concern about transferring game tutorials to the real world is whether the skills acquired in reality can be transferred to a VR world. VR simulation training for real-world tasks has become a common approach in training in many applications (e.g., military and aviation training). This suggests that skills can be transferred between virtual and real worlds. In other words, skills acquired in the real world are potentially transferable to a virtual world.

Real-world tutorials for VR games have practical benefits in certain applications. In most public VR public installations, such as those in shopping malls, few VR devices are available for people to use. Moreover, people must queue for a long time, yet they are typically allowed to enjoy the installation for only a few minutes. Tutorials in the real world would allow participants to practice while waiting and thus ensure that they are ready when it is their turn to play the VR applications.

This approach involves players' participation in two realities. The tutorial is given in a familiar setting (the real world) but the actual gameplay occurs in a virtual world. The research question in the present study thus concerns whether and how a tutorial in reality is effective in aiding new players with becoming familiar with and acquiring basic skills for playing a VR game.

## 2 Related Work

### 2.1 Tutorials and Practice in Video Games

A tutorial is a common feature in video games. A tutorial prepares players for gameplay by providing instructions and letting the players practice. The players' abilities must match the challenges in the game so that they can enjoy it [10]. If a tutorial is not available, new players can start with the first or second levels. However, players may spend their attention experimenting and developing skills during their gameplay in the initial levels instead of engaging themselves in the game content (e.g., narratives, visual aesthetics). Tutorials provide an opportunity for new players with limited ability to gain knowledge and ability before playing the main part of a game. Practice in the tutorial provides the same mechanism as the game, but with fewer constraints, such as the absence of a time limit. Examples include *Tom Clancy's Splinter Cell* (2002) and *Portal 2* (2011).

Tutorials have different formats. Some tutorials are aimed at providing information to new players. Tutorials that are mainly based on images and text can engage players in relatively complicated games [2]. Players may be able to learn how to play a game through experimentation [19].

When players play a VR game, they must become familiar with the virtual environment and how to use tools (e.g., shotguns) to interact with objects in the virtual world (e.g., shooting zombies). Practice-based tutorials may assist in overcoming this problem. Through practice, players can become accustomed to a tool, hold it, and use it as an extension of their body. Moreover, knowing the rules and tasks of a VR game is insufficient (e.g., an information-driven tutorial based on images and text); new players must be given an opportunity to actually practice using the tools (e.g., weapons in a game) to face challenges they encounter in the game (e.g., killing zombies).

A typical approach involves designing a training sequence in a VR game that enables players to experience the game before enjoying the main game content. This means that practice occurs in the virtual environment, which is new and unique in every VR game.

### 2.2 Influences Between Reality and Virtual Reality

Researchers in various disciplines have examined the relationship between experiences in real and virtual worlds. In human-computer interaction (HCI), researchers have explored training in a virtual environment with virtual human influence behavior in the real world [8, 9, 22]. For example, Chollet et al. [8, 9] used a virtual audience to train people in public speaking skills. In their user studies, they found that training with a virtual audience can improve trainees' public speaking skills. Trainees were also found to have improved eye contact and fewer unnecessary pause fillers in their talks.

In media studies, researchers have investigated the effects of media content on audiences' behavior in the real world. One research focus concerns whether and how violence in video games influences children's and adolescents' behavior [1]. The relevant findings have implications on policymaking and regulation. Such an influence can be perceptual to some gamers, rather than being behavioral. de Gortari et al. [26] interviewed gamers and found that some of them experienced difficulties in the perception of real-life events, elicitation of automatic thoughts, sensory perceptions, and dissociative experiences. This is called the game transfer phenomenon.

Most previous studies examining the relationship between experiences in the virtual world and the real world have mainly focused on the effect of the virtual world on experiences and behavior in reality, but not the converse. One exception is a study by Ho [18], who investigated the influence of real-world experiences on immersive experiences in the virtual world. The result suggests that the experience of a game in the real world causes experienced players to become more immersed in the VR game simulating it. The effect on inexperienced players is the opposite. However, the statistical result was not sufficiently strong to be conclusive.

One research area that evidently shows influences of VR on the real world is simulation training in motor learning literature, which is reviewed below.

### 2.3 Motor Skills and Practice

Playing VR games often involves some motor skills such as turning the head to inspect the environment and avoid obstacles. Thus, practice for VR games can be considered a type of motor skill training. According to research on motor learning [27], a skill is any ability that facilitates task completion with maximum certainty and minimum costs. Costs involves physical and mental energy as well as time. All skills comprise three elements: perception of the environment, decisions of what muscular actions to perform (and when to perform them), and the actual execution of such actions to achieve a goal.

Practice is the most crucial activity in learning a motor skill [27, p. 199]. A primary goal of practice is for learners to acquire a skill. They can improve their abilities to selectively perceive information that is crucial to achieving a goal and detect errors by themselves. Through the process of practicing, they can also reduce the amount of attention required to complete a task.

Another crucial goal of practice is skill transfer (also known as skill generalization), which refers to the concept that skills acquired from practice or experience with one task can be applied to another task. Learners are expected to transfer their skills from practice scenarios to novel scenarios that they have not encountered before. The transfer of a skill is referred to as positive if the skill is enhanced by practice but negative if the skill is reduced.

The degree of transfer depends on the similarity between the practice task and a target task [27]. The similarity between tasks can be decomposed into three aspects: (1) fundamental movement pattern, (2) perceptual elements, and (3) strategic and conceptual similarities. Fundamental movement patterns refer to the movement patterns involved in a task. If the fundamental movement pattern (e.g., arm movement in throwing a baseball) of practice and actual tasks are similar, skill transfer are likely to be successful. Moreover, if the perceptual cues involved in a practice task (e.g., perceiving a ball trajectory) are similar to those in the actual task, learners can react appropriately to different situations and thus the skill can be transferred. Skill transfer also depends on the similarity of strategic and conceptual elements. Different activities can have similar rules, strategies, guidelines, and concepts. For example, the similarity in road rules between commonwealth countries assists tourists from one commonwealth country when traveling in another commonwealth country, but this may cause a negative transfer effect if they travel to North America, where the road rules are different.

One application area that depends on the principles of skill transfer is simulation practice. A simulator is a device that replicates the features of a real-world target task in a virtual environment. Simulator training can be essential in situations where training with real-world tasks is expensive, when facilities are limited, or where practice in the real world is not feasible (e.g., surgery).

Researchers on training simulations have examined whether the skills acquired in VR training for serious tasks can be effectively transferred to the real world. Gallagher et al. [16] conducted two studies that involved surgical training—one in a VR simulation environment and one in the real world. They found that VR simulation improved skill levels in the real world, regardless of the level of previous experience of the trainees. Similar studies on the effects of training in a virtual simulation environment have also been conducted in military and aviation training [3, 14].

If the quality of a simulation is high, skill transfer to real-world application is expected to be effective. In the discussion of quality of simulation, two types of fidelity are concerned [23]. Physical fidelity refers to the extent to which the surface features (e.g., audiovisual elements) of a simulation and the target task are replicated. Psychological fidelity refers to the extent to which a simulation can produce behaviors and processes required for a target task. This type of fidelity is more concerned with the skills and behaviors required to perform a target task. The two types of fidelity should be complementary to each other.

### 2.4 Methodology of Studying Digital Games

An experiment is a standard research method in digital games (such as [5, 6, 12]). Researchers use this method for studying very specific aspects [4]. It is often done in a relatively controlled environment and carefully manipulate specific aspects of the stimulus (i.e. a game in game research). Researchers either select an existing game and modify the settings (e.g., [5, 11, 20]) or custom make their own game to suit specific purposes (e.g., [12, 13, 17]). In some cases, a custom-made game can be relatively simple such that one specific aspect can be focused in a study. For example, Depping and his colleagues [12] created a game called Labyrinth for their experiment aiming to study how players build trust in a game environment. Labyrinth was a 2-player game that requires cooperation to collect all the gems in a maze. The two players had different roles (so-called pusher and collector). They needed to communicate via voice chat to cooperate. The authors reported each pair of participants completed a round in 2 min. The game deliberately made simple such that they can be focused on how the challenges and cooperation in games can influence interpersonal trust. We took a similar approach in creating a simple game for our experiment.

## 3 Investigating Practice in Real World for VR Games

The real world is familiar to players and presents opportunities for practice sessions. On the basis of the perspectives covered in the previous section, the approach of real-world-based practice is analyzed in this section to examine its effectiveness in enhancing new players' confidence, familiarity, and skill learning. The research hypotheses are then proposed.

Practice in the real world provides a familiar environment for players to prepare themselves for a game. Players in a familiar environment may be more comfortable in learning about the mechanics of a game. As shown in previous research on and applications of simulation training, skills can be transferred from VR to the real world, which suggests that skills can be transferred between realities. Thus, real-world training for VR games should be effective as well.

Practicing in reality for VR games can involve tools and objects that replicate their counterparts in a VR game. Players can attempt challenges similar to those in the VR game. During practice, players can hold replicas of tools in the VR games, attach them to their bodies, and perform tasks similar to the challenges in the game. This attachment is considered a coupling process in the embodied interaction perspective [15].

Practice in virtual worlds and the real world differ in their strengths and weaknesses. Practice in a virtual world may be more effective for skill learning and transfer because of the high level of physical and psychological fidelity in simulations. The audiovisual effects in a VR practice environment can replicate those in a VR game (physical fidelity). Basic game rules and mechanics that require new players to strategically think and behave in a manner similar to how they would in a VR game can also be replicated in VR practice (psychological fidelity). The drawback with this approach is that it requires new players to be immediately immersed in an unfamiliar virtual world that they must learn about. By contrast, practice in the real world may be limited in creating a simulation with a high level of physical fidelity because recreating the audiovisual effects used in VR games may be impractical in the real world. However, a certain level of psychological fidelity can be realized if the real-world practice requires new players to think and behave in a manner that is similar to what is required in a VR game.

From this viewpoint, the key questions of the present study concern whether the experience gained in reality can help new players in a VR game, and if so, whether such practice is better offered in the real world or within a VR game itself.

### 3.1 Can Real-World Practice Prepare Players?

Practice-based tutorials enable new payers to experience a game's gameplay. If the challenges and tools in the practice-based tutorial are consistent with those in the VR game, players can attempt to use the tools. This paper focuses on three aspects of gameplay: confidence in playing the game, familiarity with the game, and game performance. To facilitate answering this question, hypotheses were formulated.

**Confidence.** Confidence refers to the extent to which players believe they can perform well in the game. Psychologists refer to this concept as self-efficacy [28]. The focus involves preparing new players for a VR game and therefore their confidence after any practice and before actual gameplay. Practice in the real world should develop new players' confidence in a VR game as long as the challenges and tools in the VR game are replicated in the real world. Thus, the proposed hypothesis is as follows:

*H1.1: New players who practice in the real world will feel more confident playing a VR game than those who do not have any practice.*

**Familiarity.** Familiarity refers to the extent to which players are familiar with a game before they actually play it. Although it is a different reality from the virtual world, the real world is a familiar reality to the players; therefore, they may benefit from such practice.

*H1.2: New players who practice in the real world will be more familiar with a VR game than those who do not have any practice.*

Players' familiarity with a game can also be observed form their behavior. If players are familiar with a VR game, they should be prepared to start the game as soon as they affix a VR headset. Players who are less familiar with a VR game will require more time to prepare.

*H1.3: Once new players who practice in the real world enter a VR game, they will take less time to prepare and start the game than those who do not have any practice.*

**Game Performance.** Game performance refers to players' actual measurable performance in playing a VR game. Practice in reality can enable players to gain certain basic skills. Skills acquired in the real world should be transferrable to a virtual world provided that the real-world practice simulates the game rules and mechanics of a VR game with a high level of psychological fidelity. Therefore, real-world practice should be an effective form of practice for VR games. Thus,

*H1.4: New players who practice in the real world will perform better in a VR game than those who do not have any practice.*

## 3.2 How Does Real-World Practice Compare with VR Practice?

The real world enables players to practice in a familiar reality. New players use tools with their body in the real world. By contrast, in VR practice, players must use tools in the virtual world with their characters' body in the virtual world using their own body and any game controllers in the real world.

**Confidence.** Practice in the real world enables players to face challenges in the VR game with concrete and realistic sensory-motor experience, similar to how they learn a new skill in their daily lives. However, the advantage of practice in the virtual world is that the players understand that they are practicing in the same world as that in which the actual gameplay takes place. The proposed hypothesis is as follows:

*H2.1: New players who practice in the real world will feel more confident playing a VR game than those who practice in the virtual world.*

**Familiarity.** In terms of familiarity that players can gain from practicing, the difference between real-world practice and VR practice is that the real world is a reality that new players are already familiar with. Arguably, players who receive practice in the real world should be aware that actual gameplay will occur in a different, virtual world. They might still be unfamiliar with the game after such practice. However, given that players understand that the challenges and tools are the same as those in the VR game, the concrete experience of touching these tools in the real world should provide them with a higher sense of familiarity.

*H2.2: New players who practice in the real world will be more familiar with a VR game than those who practice in the virtual world.*

The more familiar they are, the faster they can prepare once they enter the virtual environment. Following the same argument about familiarity, the following hypothesis is proposed:

*H2.3: Once new players who practice in the real world enter a VR game, they will take less time to prepare and start the game than those who practice in the virtual world.*

**Game Performance.** Regarding game performance, the key focus concerns whether practice in the real world trains players more effectively than that in the virtual world. Compared to practice in the real world, practice in the virtual world of a VR game provides a high level of physical and psychological fidelity. Therefore, virtual-world practice should be more effective than real-world practice.

*H2.4: New players who practice in the virtual world will perform better in a VR game than those who practice in the real world.*

The first three hypotheses concern about confidence and familiarity while the forth hypothesis is about game performance. We argue that practice in the real world benefits new players better in terms of confidence and familiarity because the real world is where people acquire skills since birth. It should allow people to feel confident about and familiar with a task (playing a game in this case) that they are going to engage in. In contrast, game performance here is concerned about how well new players actually perform in a game. Regarding performance, practice in virtual world should benefit new players better because the virtual world is more similar to the environment where the game takes place than the real world. This is based on the literature in motor learning regarding the influence of similarity between training environment and task environment.

## 4 Study Design

To test the hypotheses, an experiment was designed and conducted. Practice was the independent variable, which resulted in three conditions: no practice (Control Condition), practice in reality (Reality Condition), and practice in VR (VR Condition). The effects of treatments in preparing players for a VR game were investigated. Specifically, four areas corresponding to the hypotheses were examined: confidence with the game, perceived familiarity with the game, initial exploration time and game performance. Confidence and perceived familiarity were measured using a survey question with a 7-point Likert scale. The initial exploration time was measured according to the time after participants wore a VR headset and before they indicated that they were ready to start the game.

Regarding measuring players' performance, there are many different choices (e.g., [24, 25]). Studies use different measures for different types of games [21]. In our custom-made game, the task was to put five balls into the target container. If they have the skill to transfer balls to the target, they should be able to do so efficiently. In this experiment, the purpose of measuring performance is to investigate the effect of skill transfer across different realities. The game performance was measured according to the time each player required to complete the game (possible score: 5 points).

Sixty participants (52 women) with different levels of gaming experience were recruited. Their ages ranged from 19 to 28 years (mean (M) = 21.6, standard deviation (SD) = 1.9). Among these participants, 51 had experience playing video games, which ranged from 4 to 18 years. All of them indicate they have zero years of experience in playing VR games.

### 4.1 The Game

A VR game called "Hospital On Fire" was designed for this experiment. In the game narrative, the player is trapped in a hospital that is on fire. The player must extinguish the fire by triggering water sprinklers. However, the player can only move his or her head. A spoon-like tool is attached to the player's head. The player must move his or her head to catch a ball from a dispenser on his or her left and then transfer the ball to a target container on his or her right. For every ball the player puts into the target container, a water sprinkler is triggered to extinguish a portion of the fire. To complete the game, the player must put five balls into the target container. The game was developed using Unity and Oculus Rift DK2. Screenshots of the game are shown in Fig. 1. Two types of practice were created for the game: practice in reality and practice in VR.

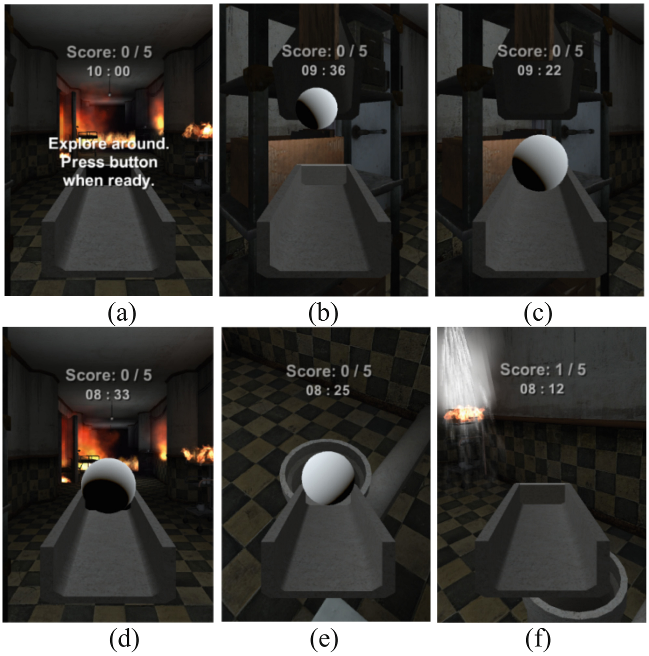


**Fig. 1.** (a)–(f) Screenshots of steps to gain one point in the game

## 4.2 Practice in Reality

For practice in reality, a replica of the spoon-like tool was created (see Fig. 2). The tool was attached to a pair of goggles. A small plastic bucket was placed on the right-hand side of the participant and was used as a physical replica of the target container. A researcher stood on the left-hand side of the participant. During practice, the participant affixed the goggles (with the tool attached). Every time the participant turned left, a researcher placed a ball in the spoon-like tool. The participant was asked to practice transferring balls to the small plastic bucket. Each participant was given 1 min to practice.


**Fig. 2.** (a) Equipment for practice in reality, (b) demonstration of wearing the goggles with the tool, and (c) demonstration of transferring a ball with the tool

### 4.3 Practice in VR

For practice in VR, a VR program was created (see Fig. 3). In the practice program, a spoon-like tool similar to that in the actual VR game was placed in front of the participant's face. The participant controlled the tool by moving his or her head. A target container and a ball dispenser were placed on the player's right- and left-hand sides, respectively. During practice, every time the player turned left, a ball was dispatched. The participant was asked to transfer balls to the target container. Each participant was given 1 min to practice.

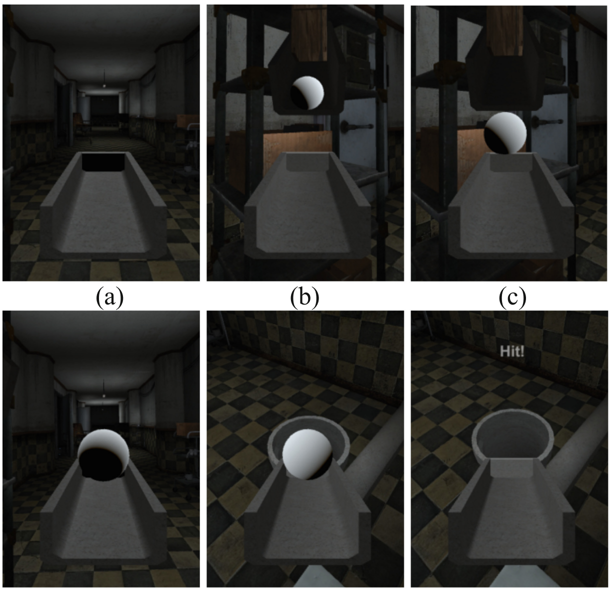


**Fig. 3.** (a)–(f) Screenshots of steps in practice in VR.

### 4.4 Procedure

Participants were randomly assigned to the three conditions. A total of 20 participants were included for each condition. When a participant arrived the laboratory, he or she was briefed and asked to read and sign a consent form. The participant then completed a questionnaire regarding background information, such as gender and age. A PDF document introducing the VR game was then shown to the participant. The introductory document presented the story, rules, and gameplay instructions with some screenshots. Participants in the Reality Condition then practiced within the reality program. Participants in the VR Condition practiced with the VR practice program. Participants in the Control Condition did not have any practice. Before playing the VR game, participants were asked about their confidence and familiarity with the game. They then affixed the VR headset. The game did not start immediately. The participants were reminded to explore the game environment. When the participant was prepared, he or she told the researcher to start the game. The researcher then helped the participant start the game, and the participant began playing the VR game. When they finished the game, they removed the VR headset. Finally, they were debriefed.

### 4.5 Results

An analysis of variance (ANOVA) on the confidence before gameplay showed significant differences among the conditions ($F(2, 57) = 7.40$, $p < .005$, $n^2 = .21$). Bonferroni test was performed to examine how the conditions compare with each other. The Bonferroni test revealed that confidence in the Reality Condition ($M = 4.75$, $S.D. = 1.45$) was significantly higher ($p < .005$) than confidence in the Control Condition ($M = 3.20$, $S.D. = 1.24$). Therefore, H1.1 is supported. No significant difference was identified between the Reality Condition and VR Condition ($M = 4.40$, $S.D. = 1.31$). Therefore, H2.1 is not supported.

Confidence in the VR Condition was found to be higher than that in the Control Condition, with statistical significance ($p < .05$). Tukey's-b test for homogeneous subset was performed to examine if there are additional groupings among the conditions. The result is shown in Table 1. It shows that the Reality Condition and VR Condition statistically belong to the same group with a higher level of confidence, whereas the Control Condition belongs to its own group with lower confidence.

**Table 1.** Result of Tukey's-b test for homogeneous subsets based on four dependent measures. Means and standard deviations (in brackets) of respective measurements of three groups are shown in the table cells

| Conditions | Confidence | | Perceived familiarity | | Exploration time | | Performance | |
|---|---|---|---|---|---|---|---|---|
| | Subset 1 | Subset 2 | Subset 1 | Subset 2 | Subset 1 | Subset 2 | Subset 1 | Subset 2 |
| No practice | 3.20 (1.24) | | 2.85 (1.27) | | 20.6 s (5.55 s) | | 65.3 s (18.4 s) | |
| Practice in reality | | 4.75 (1.45) | | 4.40 (1.39) | 20.0 s (7.57 s) | | 53.7 s (19.1 s) | |
| Practice in VR | | 4.40 (1.31) | | 4.25 (1.37) | | 15.4 s (6.03 s) | | 38.7 s (16.7 s) |

An ANOVA on the self-reported familiarity before gameplay indicated significant differences among the conditions ($F(2, 57) = 8.08$, $p < .005$, $n^2 = .22$). In the post-hoc analysis, the Bonferroni test showed that familiarity in the Reality Condition (M = 4.40, S.D. = 1.39) was significantly higher than ($p < .005$) that in the Control Condition (M = 2.81, S.D. = 1.27). This supports H1.2. No statistical difference was identified between the Reality Condition and the VR Condition (M = 4.25, S.D. = 1.37). This does not support H2.2. Familiarity in the VR Condition was found to be significantly higher than that in the Control Condition ($p < .01$). Tukey's-b test for homogeneous subset-offered groupings is shown in Table 1. It shows that the Reality and VR Conditions statistically belong to the same group with higher familiarity, whereas the Control Condition belongs to its own group with lower familiarity.

An ANOVA on the exploration time showed significant differences among the conditions ($F(2, 57) = 3.78$, $p < .05$, $n^2 = .12$). In the post-hoc analysis, the Bonferroni test showed no statistical significance between the Control Condition (M = 20.55 s, S.D. = 5.55 s) and the Reality Condition (M = 20.00 s, S.D. = 7.67 s). Therefore, H1.3 is not supported. Exploration time in the VR Condition (M = 15.45 s, S. D. = 6.03 s) was found to be shorter than that in the Reality Condition, with marginal significance ($p = .09$). This does not support H2.3. Exploration time in the VR Condition was found to be significantly shorter than that in the Control Condition ($p < .05$). Tukey's-b test for homogeneous subset-offered groupings is shown in Table 1. It shows that the Control Condition and Reality Condition statistically belong to the same group, whereas the VR Condition belongs to its own group.

An ANOVA on the game performance showed significant differences among the conditions ($F(2, 57) = 10.85$, $p < .001$, $n^2 = .28$). In the post-hoc analysis, the Bonferroni test showed no statistical difference between the Control Condition (M = 65.30 s, S.D. = 18.38 s) and the Reality Condition (M = 53.75 s, S.D. = 19.09 s). Therefore, H1.4 is not supported. Game performance in the VR Condition (M = 38.75 s, S.D. = 16.65 s) was found to be significantly higher than that in the Reality Condition. Therefore, H2.4 was supported. Tukey's-b test for homogeneous subset-offered groupings is shown in Table 1. It shows that the No Practice and Practice variables in the Reality Condition statistically belong to the same group, whereas Practice in the VR Condition belongs to its own group. Table 2 shows a summary of the results.

**Table 2.** Summary of results

| Dependent variables | Question 1: Is practice in reality effective? | Question 2: How does practice in reality compare with practice in VR? |
|---|---|---|
| Confidence | H1.1^ | H2.1 |
| Perceived familiarity | H1.2^ | H2.2 |
| Exploration time (actual familiarity) | H1.3 | H2.3 |
| Performance | H1.4 | H2.4* |

^*Supported with statistical significance ($p < .005$).* **Supported with statistical significance ($p < .05$).*

# 5 Discussion

## 5.1 Real-World Practice Is Effective in Increasing Confidence and Perceived Familiarity

Practice in reality helps players feel more confident and familiar with a VR game. This is in line with our earlier discussion regarding the potential benefits of practice in a familiar reality. This suggests that our common understanding about practicing can be applied to reality and VR: practicing in a familiar place increases confidence and familiarity with the challenge to be faced in an unfamiliar place. Even if the players have not played the VR game, practicing in a familiar reality makes them feel as confident and familiar as someone who has practiced in the VR (as reflected by the groupings shown in Table 1).

However, the results show that even if practice in reality helps new players feel more familiar with a VR game, they still require time to prepare for the game when they first enter it. Their actual familiarity with the game is similar to conditions that they have no practice. This suggests that their perception of familiarity differs from their actual familiarity. Practice in reality makes them feel that they are familiar with a VR game before playing it, whereas they are actually not that familiar with it. This enhancement in perceived familiarity can potentially encourage new players to try out a VR game for the first time, which is crucial in game design [7].

This also implies that the effects of practice-based practice can be multidimensional. Future research in practice should investigate the effects of practice in different aspects.

## 5.2 Practice in Reality vs. Practice in VR

Our study provides evidence of the effects of experience in the real world on experience in VR. The results show that practice in VR is more effective than practice in reality in terms of actual familiarity and game performance. Practice in reality and VR are equally effective in increasing new players' confidence and familiarity.

These results do not show that the skills acquired through reality-based practice is applicable in confronting the challenges in a VR game. The acquired skills was not shown to reduce players' performance in VR games in this study; in other words, no negative skill transfer was observed. The results suggest that player performance can be improved through practicing in the virtual environment of a VR game. This is consistent with the skill transfer principles. Similarity is a determinant of skill transfer between reality and VR. This raises a concern of whether skill transfer between realities can be effective. If every VR game had its own version of reality, the skills acquired in one VR game might not apply to other VR games.

The effect of practice in reality on confidence is as beneficial as that of practice in VR. This means that practice in the real world helps players to be confident, as if they have practiced in VR, whereas their game performance is as if they had no prior training. This interesting finding suggests that practice in reality is beneficial to players in emotional and motivational aspects. Further research on psychological effects of real world practice is warranted.

## 5.3 Practical Implications

To game designers, this opens new opportunities for practice design. As mentioned, VR games are relatively new in major markets. The first experience is crucial in retaining players [7]. Encouraging new players to try out a VR game is crucial for success. One possibility involves helping them feel confident and familiar with a new game before they purchase it. Therefore, they would not be apprehensive. This result suggests that designing the practice to be experienced in reality helps new players feel more confident and familiar with it. Such practice may encourage players who are new to a VR game or VR games in general to try one. For example, in public VR installations, practice or some experience in the real world might encourage people who are new to, or even afraid, of an unfamiliar VR environment to gain confidence and become familiar with that environment.

This points to a potential new direction for tutorial design. The present paper suggests that practice in reality improves players' perceptions of their own confidence and familiarity. Game designers can consider including practice in tutorials in the real world. They can also explore the advantages of the real world, such as tools with materials other than plastic (which is often the case with VR headsets and controllers).

## 5.4 Limitations

Similar to other studies, the present study is not without limitations. The game designed for the experiment was relatively simple; it contained only one challenge (transferring balls) and one level. A typical VR game may contain different types of challenges and multiple levels. The key in the present study is to investigate the relationships between practice in reality and gameplay experience in VR. The simplicity of the game enables the isolation of the two factors being concerned through a high degree of control in the experimental conditions. The result offers evidence to support a causal relationship in certain aspects of gameplay experience.

In the experiment, the majority of the participants were female. This may reduce the generalizability of the results. We would like to point out that the game used in the study did not show nor imply the gender of the player character. The experimental procedure did not involve any gender-specific materials. We would argue that the influence of gender, if any, on the results would be very limited. Future studies may examine if gender moderates effects of practice in reality.

In the present study, the tasks in practice are assumed to be identical to those in actual gameplay. This means that practice in reality can only cover tasks in VR games that can be replicated in the real world. Therefore, this limits the applicability of this approach to VR games that contain challenges not replicable in reality, such as magic spells and killing zombies. However, practice in reality can be emphasized in the challenges that can be made available in the real world. Future research should focus on the influence of practice in reality on virtual experience in areas not covered by the practice.

## 6 Conclusion

The experiment reported offers evidence to show that practice can help new players of VR games in certain aspects, even if the practice is performed in the real world. Future research is required to further investigate the influences of such practice in other aspects of gameplay experience. Nonetheless, the result suggests a new approach to tutorial design for game designers to consider.

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