On the Preference for Travel by Steering in a Virtual Reality Game

Martin Kraus[a]

Computer Graphics Group, Aalborg University, Rendsburggade 14, 9000 Aalborg, Denmark

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Abstract: Travel is one of the most important tasks in virtual reality (VR) experiences. Paradoxically, the most popular travel techniques in virtual reality games are known to be more likely to cause cybersickness than some of the less popular travel techniques. Recently, at least one VR gaming company shared quantitative data on this issue. In an attempt to explain this data, this work argues that steering techniques might result in stronger immersion, better physical ergonomics, and more pleasure than offered by teleportation techniques. Furthermore, trends are identified that might reduce the preference for steering techniques in the future. The presented discussion of current and future preferences for steering techniques in VR games might help to better understand and design for the needs of VR players.

1 INTRODUCTION

Travel in virtual reality experiences is the task of moving from one virtual location to another virtual location. LaViola et al. (LaViola et al., 2017, p. 318) observed that "travel is easily the most common and universal interaction task in 3D interfaces." While travel is not required by all Virtual Reality (VR) experiences, many VR applications and VR game genres require travel.

Travel techniques are interaction methods that enable users of an interface to travel. Travel techniques may be classified by the metaphors that they are based on. LaViola et al. (LaViola et al., 2017, pp. 325) distinguish between walking metaphors (including real walking and redirected walking), steering metaphors (including gaze-directed steering and hand-directed steering), and selection-based travel metaphors (including selection of a target location and teleportation or very fast "blink" movement to it), and manipulation-based travel metaphors.

A well-known problem of many travel techniques (with the exception of real walking) is that they often result in cybersickness (also known as simulator sickness or – more specifically – VR sickness) because they require a mismatch between the sensory information received by the visual system and the vestibular system of users (LaViola et al., 2017, p. 462). Therefore, changing the travel technique is among the most promising methods of preventing cybersickness (LaViola et al., 2017, p. 507).

However, developers of VR games are facing requests by players to offer travel techniques – in particular steering techniques – that are known to cause more cases of cybersickness. The next section discusses the specific case of the multiplayer video game "Rec Room" (Rec Room Inc., 2016); including data on VR players' overwhelming preference for steering techniques compared to teleportation techniques.

Section 3 discusses possible reasons for these preferences. Comments by players on discussion forums suggest that many players are willing to go through a period of repeated cybersickness to adapt to steering techniques ("getting their VR legs") such that they are able to use steering techniques without significant symptoms of cybersickness. This willingness of VR players suggests that there are significant benefits to steering techniques compared to teleportation. Specifically, Section 3 argues that there are features of steering techniques that are likely to result in stronger immersion, better physical ergonmonics, and more pleasure than offered by teleportation techniques (including very fast "blink" movement).

Section 4 attempts to identify trends that might change today's preferences for steering techniques in the future. Section 5 concludes this work, while Section 6 summarizes suggestions for future work on this topic.

[a] https://orcid.org/0000-0002-0331-051X

2 DATA ON PLAYERS' PREFERENCES

Controlled, large-scale user studies about players' preferred travel techniques are difficult for various reasons. One important challenge is that players might be quick to reject techniques that cause symptoms of cybersickness in a controlled lab experiment. On the other hand, there is anecdotal evidence that some VR games can provide the motivation to adapt to such techniques such that players prefer them over other techniques – a process that might require weeks of exposure to cybersickness. Creating a VR game of sufficient quality to provide this motivation is difficult. Even if a published popular VR game is used, it would be ethically and organizationally difficult to provide test participants with the opportunity to adapt to a travel technique that causes symptoms of cybersickness. This leaves the possibility of finding a representative sample of existing players of a popular VR game that offers multiple travel techniques. This approach is challenging because of the small userbases of today's VR games.

On the other hand, user data of successful VR games is usually protected by companies that not only need to protect the privacy of their users but also the competitive advantage that their user data provides them. Due to these difficulties, it is particularly worthwhile to interpret data from "natural experiments" (DiNardo, 2016) that is provided by VR game companies. While this data usually does not meet the standards for data from scientific experiments – and, in fact, many "natural experiments" are not scientific experiments – it can still provide valuable insights if interpreted with care as shown by many examples in economics and social sciences (DiNardo, 2016).

Here, we cite data provided in September 2019 by Cameron Brown ("gribbly"), Chief Creative Officer (CCO) of Rec Room Inc., about players of the video game Rec Room (Rec Room Inc., 2016): *"... looking at VR players only, ∼90% of our VR users choose to use smooth locomotion. This is the case even though teleport is the recommended default. So fully 90% of the VR userbase is actively opting in to smooth locomotion"* (Brown, 2019). Rec Room is a cross-platform, multiplayer online game that allows players to play and create a wide variety of games together, e.g., sports games, first-person shooters, dungeon crawlers, tabletop games, etc.

2.1 Userbase

To understand the meaning of the cited comment (Brown, 2019), additional information about the user-base of the game Rec Room is necessary: It was first published in June 2016 for SteamVR Head-Mounted Displays (HMDs) with 6-degrees-of-freedom controllers, specifically the HTC Vive headset. Since December 2016, the game has also been available in the Oculus store for Oculus Rift headsets with Oculus Touch controllers; since October 2017 for PlayStation VR headsets with Move controllers; also since October 2017 for Windows Mixed Reality headsets (due to the release of the "Windows Mixed Reality SteamVR preview"), and since May 2019, for Oculus Quest headsets with Oculus Touch controllers. The game has also been available on other platforms but players on those platforms are not part of the "VR userbase".

No accurate figures are available for the number of active players. In early 2019, Rec Room Inc. announced that the (free-to-play) game was installed on more than one million VR headsets (Rec Room Inc., 2019). Shawn Whiting, Head of Community and employee of Rec Room Inc., implied in a comment in early 2019 that there were more than 5,000 daily players on Steam (Au, 2019). However, this number includes non-VR players using the Steam version but it does not include players on PlayStation VR nor players of the Oculus versions of the game.

For the purpose of this work, it appears safe to assume that Rec Room has a significant number of active VR players – more than most lab experiments could include – on the most popular VR headsets as of mid 2019.

2.2 Teleportation

As implied in the cited comment by Brown (Brown, 2019), new VR players of Rec Room have a choice between "smooth locomotion" and "teleport", with "teleport" being the "default." (On some platforms at certain times, new players have been required to make a choice between "smooth locomotion" and "teleport" with the recommendation to choose "teleport" if in
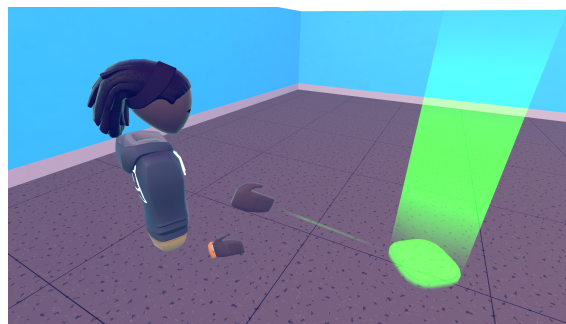

Figure 1: A player in Rec Room, who is selecting a target position (green) for teleporting.

doubt.)

Until March 2018, the only travel technique for VR players was teleportation with an arc originating from either controller to select the target location (see Figure 1). To avoid spatial disorientation, players are usually not rotated by the teleportation. An exception is teleportation onto virtual seats, which automatically rotates players to face in the forward direction of the seat. Since April 2017, a so-called "motion teleport" option is the default, which is a very quick movement to the target location as recommended by LaViola et al. (LaViola et al., 2017, p. 345).

2.3 Steering Techniques

In May 2018, steering techniques for travel were introduced in Rec Room, which were refined within a few months. The default option is a one-handed "hand-directed steering" technique (LaViola et al., 2017, p. 340) where the user has to specify a "walking hand" to control travel while the corresponding button on the other hand's controller allows virtual jumping.

All supported controllers – except the PlayStation Move controllers – include a two-degrees-of-freedom thumbstick or touchpad, which optionally may be used for one of two "Thumbstick Walk modes." If "Thumbstick Walk mode" is set to "Head", the steering technique corresponds to an extension of "gaze-directed steering" (LaViola et al., 2017, p. 339) that maps the forward direction of the controller's thumbstick or touchpad to the viewing direction of the player. Correspondingly, left, right, and backward directions of the controller's thumbstick or touchpad are mapped to directions relative to this viewing direction. As mentioned by LaViola et al., this allows for the ability to strafe. If "Thumbstick Walk mode" is set to "Hand", the forward direction of the controller's thumbstick or touchpad is mapped to the direction that the controller of the "walking hand" is pointing at. Other directions on the thumbstick or touchpad are again mapped to directions relative to this direction. Supposedly, this large range of steering techniques was included to accommodate the preferences of as many players as possible, in particular players who are used to one of these steering techniques in other VR games.

3 REASONS FOR PLAYERS' PREFERENCES

This section presents potential reasons for the preference for steering techniques over teleportation by 90% of VR players of Rec Room that was described

in Section 2. This preference is surprising as steering techniques are known to be more likely to cause cybersickness (LaViola et al., 2017, p. 462) and comments by Rec Room players in discussion forums show that steering in Rec Room is no exception.

3.1 Game-specific Reasons

The strong preference for steering techniques in Rec Room is particularly surprising since all of the games and rooms in Rec Room were originally (until May 2018) only playable with teleportation and were designed for this travel technique. Specifically, many games require a short pause between successive teleportations, which leads to very specific forms of gameplay, e.g., a two-player close-range combat where players alternate between shooting each other and teleporting behind the back of each other. Some players prefer teleportation because of these forms of gameplay.

Since steering has been introduced in May 2018, the developers appeared to attempt to balance teleportation and steering to allow players who are using different travel techniques to play the built-in games together. The main exception is a built-in game ("Stunt Runner") that was released in September 2019 and only supports steering techniques. It is unclear whether the data cited by Brown (Brown, 2019) was already influenced by the release of this game.

Many player-created rooms in Rec Room (which were introduced in December 2017) only support steering techniques for travel, which is likely to contribute to the preference for steering techniques. Players spend about 40% of their time in player-created rooms (Rec Room Inc., 2019), which means that the influence of the steering-only player-created rooms on players' preferences is somewhat limited.

Presumably, the players of Rec Room are relatively young, which might mean that they are on average less susceptible to cybersickness than the general population. However, no information about the age distribution of players is available.

Since Rec Room is a social game, players interact and, therefore, are likely to influence each other's preferences for travel techniques. Players preferring one travel technique might exert peer pressure on players preferring a different travel technique, for example, because they perceive that the other travel technique provides an unfair advantage. Such efforts by players in favor of steering techniques as well as teleportation techniques have been observed. While this can be a reinforcing factor, it cannot in itself explain why a large majority of players of a game that was originally only playable with teleporta-

tion change their preference in favor of steering techniques.

Overall, there are more game-specific reasons in Rec Room that are likely to increase the preference for steering techniques over teleportation than to the opposite effect, but it is unlikely that these reasons alone could explain the overwhelming preference for steering techniques.

3.2 Immersion

In this section, "immersion" refers to "the objective degree to which a VR system and application projects stimuli onto the sensory receptors of users in a way that is extensive, matching, surrounding, vivid, interactive, and plot informing." (Jerald, 2015, p. 45).

In general, real movement (i.e., physical movement by the player that is mapped directly to virtual movement) is known to be more immersive compared to other travel techniques (LaViola et al., 2017, p. 326-328). In a comparison between steering techniques and teleportation for playing, however, it is less clear, which technique is more immersive.

Some players argue that teleportation leads to a more "immersive" game experience for them. The reasoning is that teleportation is often designed to require small pauses between successive teleportations (a "cooldown period"). During these pauses, players can only move by real movement. In shooting games, these movements include dodging projectiles, taking cover, peeking around corners, etc. Thus, the usage of teleportation can indirectly increase immersion by strongly encouraging real movement to perform better in a game.

However, this effect depends on the willingness and ability of players to move physically. If players do not actually move physically, steering techniques provide visual stimuli that match the experience of continuous travel much better than teleportation between locations. Furthermore, the visual stimuli are more vivid in the sense of continuous optical flow during travel. Perceptually, they are usually more extensive since the apparent movement of a 3D environment usually features motion parallax, which is an important depth cue (Jerald, 2015, p. 118-120).

3.3 Physical Ergonomics

In VR, steering techniques and teleportation in Rec Room make use of 6-degrees-of-freedom controllers. These controllers are (at least to a certain degree) designed for good physical ergonomics; specifically, they require very little physical effort to use them. As discussed in Section 3.2, however, the required

pauses between successive teleportations encourage real movement. Specifically, dodging projectiles encourages unnaturally sudden and fast movements that may result in high physical exertion. In this sense, the use of teleportation may indirectly result in more exertion and, therefore, worse physical ergonomics than the use of steering.

Avoiding the exertion by real movements (specifically dodging projectiles) or the inability to perform these real movements is therefore a reason to prefer steering techniques because it allows players to perform some of these actions virtually just by pressing buttons with their fingers.

3.4 Pleasure

This section discusses three features of steering techniques compared to teleportation in Rec Room and how they may shape players' preferences: immediate feedback, integration with other interaction techniques, and matching players' expectations.

In interaction design, it is well known that "feedback should be immediate; otherwise users may become frustrated or give up before tasks are completed" (Jerald, 2015, p. 283). As mentioned above, teleportation in Rec Room often requires players to pause between successive teleportations. If players try to teleport during these pauses, immediate visual feedback is provided but teleporting is not possible until the end of the pause. On the other hand, steering techniques offer "continuous control of the direction of motion by the user" (LaViola et al., 2017, p. 339), i.e., feedback in the form of a new direction or velocity is immediate. Therefore, steering techniques potentially result in a greater sense of freedom and control, which may result in greater game enjoyment (Ryan et al., 2006).

LaViola et al. suggest that a travel technique should be chosen "that can be easily integrated with other interaction techniques in the application" (LaViola et al., 2017, p. 368). Teleportation in Rec Room is not integrated with virtual "jumping" (i.e., pushing the player's avatar and virtual camera upwards for a short period of time), presumably because it may cause cybersickness. On the other hand, steering techniques in Rec Room are integrated with virtual jumping, presumably because players who are not negatively affected by steering techniques are likely to tolerate jumping as well. Thus, steering techniques in Rec Room allow for intense movements, e.g., long jumps from buildings, jump attacks, and sliding down steep slopes. Players who want to enjoy virtual jumping or any movement that it makes possible have to use a steering technique instead of teleportation.

One way to improve the chances of providing a pleasurable experience to players is to match their expectations, which are often based on a game's genre or – more generally spoken – on a "schema" (Douglas and Hargadon, 2000) that players associate with a game. For readers of interactive narratives, Douglas and Hargadon describe the relation in this way: "Readers' enjoyment of affective experiences is tied closely to their expectations, which are linked directly to the schemas readers identify. By invoking familiar schemas [...], writers and designers of interactive narratives provide readers with an experience that closely matches their expectations" (Douglas and Hargadon, 2000). If there is a similar relation between players' expectations and game genres, then travel techniques that provide more features of an associated game genre are more likely to provide a pleasurable experience than other travel techniques. Since many games in Rec Room are strongly associated with First-Person Shooters (FPS), it is to be expected that players who enjoy traditional FPS tend to enjoy steering techniques, which support strafing (and therefore techniques in FPS such as "circle strafing") and jumping (and therefore techniques in FPS such as "bunny hopping" and "trickjumps"), more than they enjoy teleportation.

4 PREDICTIONS ON FUTURE PREFERENCES

The discussion in Section 3 shows that there are several reasons that might explain the overwhelming preference for steering techniques in Rec Room. The discussion also showed that preferences for travel techniques in Rec Room changed over time. Therefore, this section presents some factors that are likely to change future preferences for steering techniques in VR games.

4.1 More Casual Players

As more powerful VR equipment is becoming more affordable and more attractive VR games are being published, the VR gaming audience is likely to shift from early adopters to mainstream, including many casual players. This larger audience will probably be less motivated to suffer cybersickness in order to adapt to steering techniques than today's early adopters; thus, future players are more likely to avoid steering techniques by choosing alternative travel techniques (including teleportation) or games that do not require travel as a core game mechanic.

4.2 Longer Play Sessions

While more casual users are probably less likely to use steering techniques, some "hardcore" players who want to play longer play sessions (i.e., multiple hours) might also prefer alternatives to steering techniques since they can cause discomfort that builds up slowly over time. Anecdotally, even the self-proclaimed "hardcore VR enthusiast" and YouTuber Thomas Poersch ("VoodooDE") admitted that he only plays VR sessions of up to one hour (Poersch, 2019). The author is also not using steering techniques in VR for more than an hour but is regularly using teleportation for multiple hours at a time.

4.3 More Real Walking

Many location-based VR experiences employ real walking and redirected walking (sometimes described as "free roam(ing) VR"), which is more immersive than steering techniques (LaViola et al., 2017, p. 327). As more VR players are exposed to these experiences, they are more likely to appreciate or even expect similarly immersive experiences at home. The popular VR game "Tea for God" (Ciupiński, 2019) provides a preview of the potential of such games at home.

4.4 New Travel Techniques

LaViola et al. suggest that "researchers who come up with the most effective methods [for preventing cybersickness] will have a huge impact on comfort in AR and VR" (LaViola et al., 2017, p. 508). While new travel techniques that prevent cybersickness might have a strong impact, the VR game "Tea for God" (Ciupiński, 2019) points to a different solution: previous research using real walking in self-overlapping architecture and impossible spaces (LaViola et al., 2017, p. 329) was usually concerned with users noticing the self-overlapping nature of these spaces. "Tea for God," however, does not attempt to hide the self-overlapping nature of the procedurally generated levels. On the contrary, this feature becomes a kind of optical illusion that many players appear to enjoy. This opens many possibilities for level design (in particular in small physical spaces) that were not considered in previous research. Thus, the solution might not be a new travel technique but new ways of using old ones.

5 CONCLUSIONS

This works presents data showing that a large part of today's VR gaming audience prefers steering techniques over teleportation. Therefore, it might be commercially reasonable to focus on steering techniques in some VR games – even if it means that many potential players are not able to enjoy these games due to cybersickness. It also means that non-gaming VR applications might benefit from an option to use steering techniques as many VR players will prefer these techniques compared to other travel techniques.

Multiple reasons for preferring steering techniques have been discussed. Combined, these reasons show how challenging the problem of finding preferable travel techniques is. Even the more immersive real walking techniques fall short in terms of exertion and meeting expectations of some players.

As LaViola et al. state, cybersickness from a VR product "is a serious problem—if someone gets seriously sick [...] they may not want to use it again or recommend it to their friends" (LaViola et al., 2017, p. 507). Some trends have been identified that might lead to preferences for other travel techniques with a smaller risk of causing cybersickness in the future. Supporting these trends might help to accelerate VR's development into a mainstream entertainment technology.

6 FUTURE WORK

The data presented in this work does not meet scientific requirements. It is presented here as starting point for a discussion of potential reasons that could explain it. More data about players' long-term preferences for travel techniques is needed. While the presented reasons are based on scientific literature, their relevance should be confirmed by studies on VR players. Similarly, the effects of the trends discussed in Section 4 are speculative and should be confirmed by studies on VR players.

Assuming that such studies would confirm some of the presented hypotheses, this work could encourage and – to a certain degree – guide research on VR travel techniques that prevent cybersickness and are attractive to VR players at the same time.

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