



Article

Virtual Reality Pursuit: Using Individual Predispositions towards VR to Understand Perceptions of a Virtualized Workplace Team Experience

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Abstract: This study investigates how individual predispositions toward Virtual Reality (VR) affect user experiences in collaborative VR environments, particularly in workplace settings. By adapting the Video Game Pursuit Scale to measure VR predisposition, we aim to establish the reliability and validity of this adapted measure in assessing how personal characteristics influence engagement and interaction in VR. Two studies, the first correlational and the second quasi-experimental, were conducted to examine the impact of environmental features, specifically the differences between static and mobile VR platforms, on participants' perceptions of time, presence, and task motivation. The findings indicate that individual differences in VR predisposition significantly influence user experiences in virtual environments with important implications for enhancing VR applications in training and team collaboration. This research contributes to the understanding of human–computer interaction in VR and offers valuable insights for organizations aiming to implement VR technologies effectively. The results highlight the importance of considering psychological factors in the design and deployment of VR systems, paving the way for future research in this rapidly evolving field.

Keywords: virtual reality; VR predisposition; presence; embodiment; workplace teams



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1. Introduction

The world of work is continuing to change rapidly as technologies become increasingly accessible and integrated into the way we approach and perform our jobs [1]. For example, the legacy version of Virtual Reality (VR) from the 1980s and 1990s has been surpassed by VR reemergence in the 2010s, which offers a highly immersive, high-fidelity experience [2]. Current VR offers realistic virtual experiences that are being used in a number of applications. In the workplace, some organizations are using VR, for training employees on new skills [3], holding meetings with dislocated teams [4], and recently holding realistic interviews in VR [5]. VR is rapidly advancing in both innovation and hardware accessibility, presenting significant potential for workplace applications like this as well as research applications [6]. The focus of this manuscript is on the advancement of VR technologies and the growing trend of finding ways to utilize and integrate VR into the world of research and work [7–9]. We seek to understand if there is a natural individual predisposition towards VR that can help predict an individual's experience in a VR environment.

While other emerging technologies such as AI and machine learning are valuable for automating processes and enhancing efficiency, VR distinguishes itself as a people-centered tool that creates believable virtual worlds that can transport people across space and time using high-fidelity experiences [10]. We are defining VR as a technology that uses a head-mounted device (HMD) to immerse an individual in a virtual world or experience that is beyond reality [11]; this could be an interactive or pre-recorded experience (e.g., a VR video that an individual watches or is a part of) [12]. One of the most critical aspects of VR is that it can create a unique sense of presence and embodiment for individuals in the virtual world [13]. We will explain both presence and embodiment as they are critical components of what makes VR technology distinctive.

1.1. Presence in VR

The first critical component of VR that we will discuss is presence, a perceptual illusion in which individuals know that they are not in a real environment, but still experience a feeling of being in the virtual environment [14]. Presence is critically important to the VR experience, because the individual must believe they are there for the virtual illusion to have an impact. Previous research on technology-based solutions has shown that minor glitches can break virtual illusions and shift a positive user experience into a negative user experience (e.g., avatars that are too humanlike can feel creepy) [15]. One meta-analysis on the topic of virtual presence asserts that understanding how people are affected by VR and the perception that the environment looks and feels like real life is important, as VR has the potential to influence users' decisions when presence is high [16]. We assert that feeling more presence in the VR environment will lead to a more positive experience for participants.

1.2. Embodiment in VR

The second critical component of VR that we will discuss is embodiment, which is the sensation of being located within, having ownership of, and being in control over a virtual body [17]. A similar concept is the *Proteus Effect*, characterized by the embodiment of something outside of our real selves and identifying with this outside object, avatar, or character as a new identity [18]. Self-perception theory asserts that people come to understand their own internal states by observing themselves from a third-person perspective [19]. Following the logic of this theory, virtual avatars can elicit the Proteus Effect in virtual environments, meaning VR creates an environment with simplified embodiment capabilities. The embodiment of objects outside ourselves has been a subject of research for many decades. In the classic rubber hand experiment [20], watching and feeling the touch of a brush against a rubber hand while simultaneously feeling a brush against the hidden true hand led to an embodiment and sense of ownership over the false rubber hand. VR creates a sense of presence and embodiment, enabling experiences that typically require in-person interaction to be achieved [21].

1.3. Task Motivation

Task motivation in the workplace is important as it drives employees to engage in their work, out of genuine interest and satisfaction, rather than external rewards or pressures [22]. That is, a task-focused individual who is intrinsically motivated will participate in an activity for enjoyment rather than for potential benefits [23]. Previous research has shown that task motivation enhances creativity, productivity, and job satisfaction, leading to higher levels of performance and innovation [24]. When employees are task-motivated, they are more likely to take initiative, seek out challenges, and demonstrate persistence in the face of difficulties [25]. This study will look at the task motivation that participants felt toward the assigned activity in VR.

2. Literature Review

2.1. Virtualized Workplace Teams

Workplace teams are a foundational aspect of modern businesses, driving collaboration, fostering innovation, and enhancing productivity [26]. The integration of collaborative technologies over the past 20 years has transformed how organizations utilize virtualized teams [27]. Virtual teams offer numerous advantages for global businesses [28,29] but still face challenges that can reduce effectiveness [30–33]. VR may be an effective solution for some team interactions by simulating in-person interactions and providing a sense of presence and immersion that could enhance communication, team cohesion, and trust-building [34].

VR Workplace Teams

The use of VR as a tool to facilitate virtual teams holds potential for organizations due to its unique capabilities [35]. Its applications within virtual teams can enhance collaboration, boost performance, and increase employee autonomy, which is linked to increased job satisfaction and retention rates [36]. By effectively leveraging VR, organizations can harness this technology's potential, ensuring they remain competitive in today's dynamic market [37]. However, VR research encounters numerous obstacles when attempting to understand teams within virtual environments, resulting in a lack of clear recommendations for identifying the best fit for different contexts [10].

2.2. Team Experiences

A crucial aspect of workplace teams is understanding how individuals experience team interactions. We aim to explore the following.

2.2.1. Perceived Effectiveness

Team effectiveness, also called team performance, is a team's capacity to reach its goals [38,39]. When a team is effective, it leads to better results for its members, including greater satisfaction and commitment, as well as improved outcomes from the team's work [40]. In this study, we investigate how individuals perceive the effectiveness of their team interactions during the VR activity.

2.2.2. Knowledge Sharing

Knowledge sharing involves the exchange of information, insights, and expertise among team members, enhancing collective understanding and performance through both explicit knowledge (documented facts and procedures) and tacit knowledge (personal know-how and experiences) [12,41,42]. In this study, we will look at the degree to which an individual felt the members of their team shared knowledge during the assigned activity in VR.

2.3. VR Predisposition

When researching technology, it is important to consider how individuals perceive the experience of using the technology [43]. Previous research has highlighted that individuals can have predisposed interests in a particular technology and that this predisposition can be measured and used to predict how the individual will perceive and interact with the technology [44]. This study examines if VR-specific predispositions can be measured and how those VR predispositions impact an individual's experience in a VR environment. In this study, VR predisposition is defined as the natural inclination an individual has toward exploring and using VR technology. This concept has been adopted from the concept presented by [44] regarding their Video Game Pursuit Scale. We believe that individuals with a predisposition towards VR will feel an intrinsic motivation towards the VR experience, which will enhance their experience in the virtual environment.

To test this, we first need to find a measure that can be used to evaluate and identify individuals with a VR predisposition. Our first goal will be to establish that VR predisposition can be measured reliably. We plan to adapt the Video Game Pursuit Scale [44] to

a VR context and to measure the reliability and convergence with a similar scale. For a similar scale, we plan to adapt the Intimidation with Games Scale [44] to a VR context and evaluate if this measure significantly converges with the adapted VR Pursuit Scale. The adapted VR Intimidation refers to the overall feeling of discomfort or confusion that an individual experiences towards VR technology. This definition was also adapted from the concepts presented by [44] regarding their Intimidation with Games Scale.

After establishing VR Pursuit as a measure of predisposition towards VR, we hypothesize the following.

Hypothesis 1 (H1). *Having a predisposition toward VR pursuit will be positively and significantly related to presence (H1a), embodiment (H1b), task motivation (H1c), perceived effectiveness (H1d), knowledge sharing (H1e), and negatively related to VR discomfort (H1f).*

2.4. Environmental Features of VR

Research has shown that how a VR environment is designed can largely impact the user experience [40]. We plan to isolate one design feature to determine its impact on the user's experience. We examined the passive awareness of the passage of time using an environmental feature of a moving platform. We believed that the consistent feeling of movement would help participants maintain an awareness of the passage of time, which would lead to a more positive experience for participants.

Hypothesis 2 (H2). *The mobile platform group will experience significantly higher levels of presence (H2a), embodiment (H2b), task motivation (H2c), perceived effectiveness (H2d), knowledge sharing (H2e), and lower levels of VR discomfort (H2f) compared to the static platform group.*

2.5. Current Studies

The purpose of this study is to expand our understanding of VR predisposition and to understand if this individual difference impacts the user's experience.

In study 1, we look at establishing the reliability and validity of a measure for VR predisposition. By making adaptations to the existing Video Game Pursuit Scale [44], we will collect data to establish if the scale is reliable when used in a VR context (i.e., Cronbach's alpha above 0.70). Second, we will determine if the scale shows convergent validity with a similar scale. In adapting the Intimidation with Games scale to a VR context, we will seek to understand if there is a significant negative relationship between the two measures (i.e., Pearson's correlation with a p -value below 0.05). We seek to understand if there is an acceptable level of reliability and convergent validity to provide initial evidence for using the adapted scale in a VR context.

In study 2, we sought to understand if VR pursuit and the environmental cue of the moving platform would change the VR experience for participants. In a VR activity, we placed participants in a work team playing the role of an HR manager making a hiring decision to understand how participants experienced the activity.

2.6. Power Analysis

A power analysis was conducted using G*Power v3.1.9.7 [45] to determine the sample size needed for both studies. We referred to a study by Sanchez and Langer [44] where they examined the relationships between video game predisposition and game-based outcomes. They found that average effect sizes ranged from Cohen's $d = 0.20$ to 0.25 . Using these effect sizes and an alpha level of 1.0 with 80% power, we determined that the minimum sample size needed for the current study would be 113 participants for study 1 and 38 teams of 3 participants each in study 2. (Given that we dropped a large number of participant responses in study 1 due to insufficient effort responding (IER) and experienced several recruitment issues in study 2, we were not able to reach our minimum sample size for either study. We understand that the reduced statistical power of our sample sizes limits the generalizability of our results.)

3. Materials and Methods

3.1. Study 1

3.1.1. Participants

Surveys were collected from undergraduate students from San Francisco State University. Students responded to an advertisement to complete a survey in exchange for course credit. The criteria for participating required students to be at least 18 years of age, currently located in the US, not currently pregnant or incarcerated, and currently planning to enter the professional workforce in the next 3 years.

3.1.2. Procedures

After reading the advertisement on the internal research pool website, participants clicked a link to access the study. On the first page of the study, they read the consent form (see Table S1) where they agreed to participate in the study and then completed the survey (see Table S1).

3.1.3. Measures

All measures, excluding the demographic questions, were scored on a 5-point Likert-type scale from 1 = Strongly Disagree to 5 = Strongly Agree. All items from this survey can be found in Table S1.

- **Demographic Questions.** Participants were first asked to report their age, gender, ethnicity, industry of future work, and access to a VR system. A summary of demographic information can be found in Table 1. The full set of demographic questions can be found in Table S1.

Table 1. Summary of demographic information for study 1.

Variable	Category	Count	Percent
Gender	Female	58	65%
	Male	28	31%
	Trans Male	1	1%
	Genderqueer/Non-binary	3	3%
Ethnicity	White or Caucasian	18	20%
	Black, African American, or Other African Origin	4	5%
	Latina/o/x or Hispanic	41	45%
	Asian American or Asian Origin	15	17%
	Native American or Alaska Native	1	1%
	Two or more Races	11	12%
Industry	Accommodations and Food Services	26	29%
	Administrative and Support Services	7	8%
	Agriculture, Forestry, Fishing, and Hunting	1	1%
	Arts, Entertainment, and Recreation	11	12%
	Educational Services	16	18%
	Finance and Insurance	1	1%
	Government	1	1%
	Health Care and Social Assistance	9	10%
	Information Technology	2	2%
	Management of Companies and Enterprises	1	1%
	Professional, Scientific, and Technical Services	2	2%
	Retail	13	15%
	Other (not listed here)	62	70%
VR Access	HTC Vive	22	24%
	Index	2	2%
	Oculus	1	1%
	No access to a VR system	3	3%

Note. $n = 90$. This table only displays categories selected by respondents. See Table S1 for a comprehensive list of all response options shown to participants.

- **VR Pursuit.** VR Pursuit encompasses the intentions and motivations that lead individuals to voluntarily engage with VR. This concept was taken from [44] where we adapted the 19-item Video Game Pursuit (VGpu) Scale [44] with the four original subscales: intentional gameplay, video game self-efficacy, enjoyment of games, and prone to game immersion. The adaptations changed the points of reference from the words video game and play to the words VR and use. The remaining language was unchanged. We are calling this adapted scale the Virtual Reality (VR) Pursuit Scale with the revised subscales: intentional VR use $\alpha = 0.85$, VR self-efficacy $\alpha = 0.92$, enjoyment of VR $\alpha = 0.88$, and prone to VR immersion $\alpha = 0.34$. Because item 2 from the prone to VR immersion subscale created a below-acceptable reliability value, we dropped that item and only used the overall VR Pursuit Scale which produced good reliability with the current sample $\alpha = 0.93$.
- **Intimidation with VR.** We define intimidation with VR as having a general sense of discomfort or confusion when using VR [44]. We measured this using a 6-item Intimidation with VR Scale $\alpha = 0.88$, which was similarly adapted from the Intimidation with Games Scale where the words video game and play were changed to VR and use [44].

3.2. Study 2

3.2.1. Participants

The recruitment methods, sample source, and selection criteria for study 2 were the same as those described for study 1. We additionally established that none of the study 2 participants were participants in study 1.

Surveys were collected from undergraduate students from San Francisco State University. Students responded to an advertisement to complete a survey in exchange for course credit. The criteria for participating required students to be at least 18 years of age, currently located in the US, not currently pregnant or incarcerated, and currently planning to enter the professional workforce in the next 3 years.

3.2.2. Procedures

Participants signed up for the study using an internal research pool. They completed the consent form (see Table S2), an audio and screen release form (see Table S2), and the pre-survey (see Table S2). They were then directed to a link that allowed them to sign up for a date and time to visit the research lab in-person. At the scheduled date and time, the participants arrived at the research lab. They were each placed in separate rooms to prevent in-person interaction. They joined a virtual team meeting on Zoom using their computers and were equipped with head-mounted displays (HMDs), with an Oculus Rift or Oculus Quest. In the team meeting, they were introduced to two other participants who would be their teammates in the VR activity. They also received instructions about the VR activity. All participants were then placed into a VR world built in Mozilla Hubs (Researchers interested in replicating our study should be aware that Mozilla ended support for Mozilla Hubs on 31 May 2024. <https://support.mozilla.org/en-US/kb/end-support-mozilla-hubs> (accessed on 20 September 2024). Our recommended alternatives are spatial, Frame VR, AltspaceVR, VirBELA, and VR Chat) for the purposes of this study, and the VR activity described below was completed. Participants then returned to Zoom, completed a brief one-on-one interview with the research assistant (RA) about their experience, and completed the post-survey (see Table S2) before receiving a debrief statement about the purpose of the study and being dismissed.

3.2.3. VR Activity

The VR activity consisted of a practice phase followed by three activity phases. In the practice phase (see Figure 1), participants were given time to get comfortable in the VR environment, including learning how to use the controls to move around, select objects, pick up objects, and zoom in to text for easier reading. After several minutes of practice,

participants were escorted to a platform for the VR activity (see Figure 2). The VR activity consisted of three phases and was designed to replicate the hidden profile paradigm [46].



Figure 1. Practice phase of the VR activity.



Figure 2. A section of the platform in the VR activity.

Phase 1. Participants assumed the role of an HR manager and read the job description for a commercial pilot position. They reviewed blocks containing knowledge, skills, and abilities (KSAs) for a pilot, ranking their top three in each category.

Phase 2. Participants individually went to their assigned podium and reviewed the resumes and references of four candidates to gather information. Each participant received shared and unique information that only they saw. This simulated a real-life scenario where HR managers review resumes independently before a collective discussion.

Phase 3. Participants reconvened to discuss the four candidates. They collectively chose the best candidate based on the top KSAs they ranked in Phase 1 and the information they reviewed in Phase 2. The instructions aimed to encourage information sharing and enriched discussion.

Conditions. In this study, there were two conditions; teams were assigned to either the control condition (i.e., static group) where their platform remained in a static position for the duration of the study or assigned to the experimental group (i.e., mobile group) where their platform moved toward the top of a mountain for the duration of the study. This manipulation was designed to investigate whether passive movement of the VR environment would influence the participants' perceptions of the passage of time.

3.2.4. Pre-Survey Measures

All questions except the demographic questions were recorded using a 5-point scale from 1 = Strongly Disagree to 5 = Strongly Agree. The full pre-survey for study 2 can be found in Table S2.

- **Demographic Questions.** Participants reported age, gender, ethnicity, industry of future work, and access to a VR system. Table 2 provides a summary of the demographic information.

Table 2. Summary of demographic information for study 2.

Variable	Category	Count	Percent
Gender	Female	23	51%
	Male	20	45%
	Genderqueer/Non-binary	2	4%
Ethnicity	White or Caucasian	7	15%
	Black, African American, or Other African Origin	8	18%
	Latina/o/x or Hispanic	17	38%
	Asian American or Asian Origin	9	20%
	Middle Eastern or North African Origin	1	2%
	Two or more Races	3	7%
	Accommodations and Food Services	5	11%
Industry	Administrative and Support Services	1	2%
	Agriculture, Forestry, Fishing, and Hunting	1	2%
	Arts, Entertainment, and Recreation	8	18%
	Educational Services	8	18%
	Finance and Insurance	2	5%
	Government	1	2%
	Health Care and Social Assistance	2	5%
	Professional, Scientific, and Technical Services	4	8%
	Retail	9	20%
	Transportation and Warehousing	3	7%
	Utilities	1	2%
VR Access	HTC Vive	22	48%
	Oculus	3	7%
	Other (not listed here)	20	45%

Note. $n = 45$. This table only displays categories selected by respondents. See Table S2 for a comprehensive list of all response options shown to participants.

- **Prior Knowledge.** A single-item question was written for the purpose of this study and sought to understand the preexisting knowledge participants had about being an airline pilot, which is relevant to the scenario presented in study 2.
- **Time Monitoring.** Time monitoring is a time management behavior, defined as monitoring and controlling time through determining needs, setting goals, and prioritizing and planning tasks to achieve these goals [47]. Time Monitoring ($\alpha = 0.79$) was measured with a 6-item scale [48] and adapted to reference the VR activity.
- **VR Pursuit.** VR Pursuit is described in detail in the study 1 measures. All but one of the subscales produced good reliability estimates: intentional VR use $\alpha = 0.73$, VR self-efficacy $\alpha = 0.90$, enjoyment of VR $\alpha = 0.92$, and prone to VR immersion $\alpha = 0.43$. The second item in the subscale prone to VR immersion was dropped again due to poor reliability. Only the overall VR pursuit measure was used, which demonstrated good reliability of $\alpha = 0.87$.

3.2.5. Post-Survey Measures

All measures on the post-survey were scored on a 5-point Likert-type scale from 1 = Strongly Disagree to 5 = Strongly Agree. All items from this survey can be found in Table S2.

- **Presence.** Presence is defined as a perceptual illusion in which individuals know they are in a virtual environment that is not reality, but nonetheless experience a feeling of truly being in the virtual environment [14]. Presence was measured using the 5-item Physical Presence subscale ($\alpha = 0.71$) from the Multimodal Presence Scale [49].
- **Embodiment.** Embodiment is defined as the perception of existing within, and having control over, a virtual avatar [17]. Embodiment was measured using the 5-item Self-Presence subscale ($\alpha = 0.85$) within the Multimodal Presence Scale [49].
- **Task Motivation.** Task motivation describes feeling intrinsically motivated to complete a provided task and following one's own enjoyment or satisfaction of the task rather than pursuing an explicit reward [50]. The 15-item Intrinsic Motivation Inventory [51] was used to assess task motivation. This included four subscales: interest-enjoyment $\alpha = 0.90$, perceived competence $\alpha = 0.52$, effort-importance $\alpha = 0.74$, and pressure-tension $\alpha = 0.72$.
- **Perceived Effectiveness.** The perceived effectiveness of a team is characterized by the contributions, quality of work, interactions, knowledge, skills, and abilities exhibited within a team [35]. Perceived effectiveness for this study was measured using the 10-item Interacting with Teammates Subscale from the Team Member Effectiveness Scale $\alpha = 0.87$ [35].
- **Knowledge Sharing.** Knowledge sharing is the process of relaying knowledge between individuals as well as the collective creation of knowledge amongst team members [52]. Knowledge sharing was measured using an 8-item Knowledge Sharing Subscale $\alpha = 0.79$ [53].
- **VR Discomfort.** We define VR discomfort as the degree of unpleasant symptoms a participant reports having experienced while in the VR environment. VR discomfort was measured using the 6-item Distress Subfactor of the Presence Scale $\alpha = 0.83$ [54].

4. Results

4.1. Study 1

Insufficient effort responding (IER) is defined as survey answers from a participant that demonstrate little effort towards following survey instructions, comprehending survey content, and responding to survey items accurately [55]. We used three insufficient effort responding items that were developed following guidance from [56]. Individuals had to answer at least one of the questions correctly for their data to be retained in the final dataset. Responses were collected from 181 individuals. A total of 91 responses were removed from the data set for having incomplete responses or for not demonstrating sufficient attentive responding. A final sample of 90 individuals was retained in the final dataset for analysis. A summary of demographic information for the final sample is found in Table 1.

Our goal with study 1 was to establish reliable measures of VR predisposition. We established two adapted scales (i.e., VR Pursuit and Intimidation with VR) to test this. We sought to understand if both scales would produce acceptable reliability ($\alpha > 0.70$) and would be significantly correlated to one another ($p < 0.05$). Results showed that both VR pursuit ($\alpha = 0.93$) and intimidation with VR ($\alpha = 0.88$) produced above acceptable reliability and were significantly correlated with one another, $r = 0.69$, $p < 0.001$, see Table 3. Based on this evidence, we were confident in using the adapted VR Pursuit Scale in study 2.

Table 3. Correlations between study 1 variables.

	<i>M</i>	<i>SD</i>	1	2	3	4
1. Gender	0.33	0.47				
2. Age	26.10	8.20	0.14			
3. VR Pursuit	2.95	0.70	0.24 *	0.26 *	0.93	
4. Intimidation with VR	2.60	0.86	−0.29 **	−0.17	−0.69 ***	0.88

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Note. Gender $n = 86$. All other variables $n = 90$. Gender coded as 0 = female, 1 = male. Cronbach's alpha measures of reliability are shown across the diagonal in bold italics.

4.2. Study 2

A total of 45 individuals completed study 2. This created 15 teams, each composed of 3 participants. A summary of sample demographics is provided in Table 2. The following results should be interpreted with caution due to the small sample size. These values are intended to describe the current sample rather than making generalizable conclusions.

We used seven insufficient effort responding items following guidance from [56]. Individuals had to answer at least three of the questions correctly to be retained in the final dataset. Responses from all 45 participants were retained in the final sample for analysis.

The three variables from the pre-survey were compared across conditions to ensure both samples were reasonably similar prior to the intervention. Results showed that there were no significant differences between the pre-survey variables by condition. We can reasonably assume that the participants in both conditions were similar with regard to their responses to the pre-survey prior to the VR activity.

Prior Knowledge. A *t*-test showed prior knowledge of airline pilots was not significantly different $t(43) = -0.34, p = 0.74, 95\% \text{ CI } [-0.75, 0.54]$ between participants in the control condition $n = 21, M = 1.48, SD = 0.84$ and the experimental condition $n = 24, M = 1.58, SD = 0.93$.

Time Monitoring. A *t*-test showed that time monitoring was not significantly different $t(43) = -0.57, p = 0.57, 95\% \text{ CI } [-0.46, 0.25]$ between participants in the control condition $n = 21, M = 4.08, SD = 0.65$ and the experimental condition $n = 24, M = 4.18, SD = 0.73$.

VR Pursuit. A *t*-test showed having a predisposition toward VR pursuit was not significantly different $t(43) = -0.33, p = 0.74, 95\% \text{ CI } [-0.37, 0.27]$ between participants in the control condition $n = 21, M = 2.85, SD = 0.66$ and the experimental condition $n = 24, M = 2.90, SD = 0.51$.

4.2.1. Hypothesis Testing

Hypothesis 1 (H1) stated that VR pursuit would be significantly related to the study outcomes. Results partially supported this hypothesis as there was a significant correlation between VR pursuit and presence (H1a), task motivation (H1c), and perceived effectiveness (H1d). The remaining variables were not significantly correlated with VR pursuit; embodiment (H1b), knowledge sharing (H1e), and VR discomfort (H1f). All study correlations are shown in Table 4.

Table 4. Correlations between study 2 variables. (It is important to note that although gender is presented within Table 4 as a *Mean* and *Standard Deviation*, gender was collected as a categorical variable in this study and categorical variables by nature are not represented this way.)

	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7	8	9
1. Gender	0.47	0.50									
2. Age	26.40	6.58	0.07								
3. VR Pursuit	2.88	0.51	0.27	0.12	0.87						
4. Presence	3.32	0.79	<0.01	0.04	0.34 *	0.71					
5. Embodiment	2.83	1.04	−0.08	0.19	0.26	0.69 ***	0.85				
6. Task Motivation	3.81	0.53	0.05	0.06	0.30 *	0.58 ***	0.27	0.86			
7. Perceived Effectiveness	3.90	0.65	0.16	0.11	0.30 *	0.44 **	0.40 **	0.38 **	0.87		
8. Knowledge Sharing	3.54	0.65	0.02	0.28	0.23	0.36 *	0.25	0.32 *	0.77 ***	0.79	
9. VR Discomfort	2.40	0.98	0.05	−0.30 *	−0.18	−0.39 **	−0.30 *	−0.54 ***	−0.39 **	−0.35 *	0.83

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Note. Gender $n = 43$. All other variables $n = 45$. Gender coded as 0 = female, 1 = male. Cronbach's alpha measures of reliability are shown across the diagonal in bold italics.

Hypothesis 2 (H2) stated that the mobile platform condition would be related to better study outcomes. Results did not support this hypothesis as there were no significant differences between the two platform conditions on any of the outcome measures, see Figure 3.

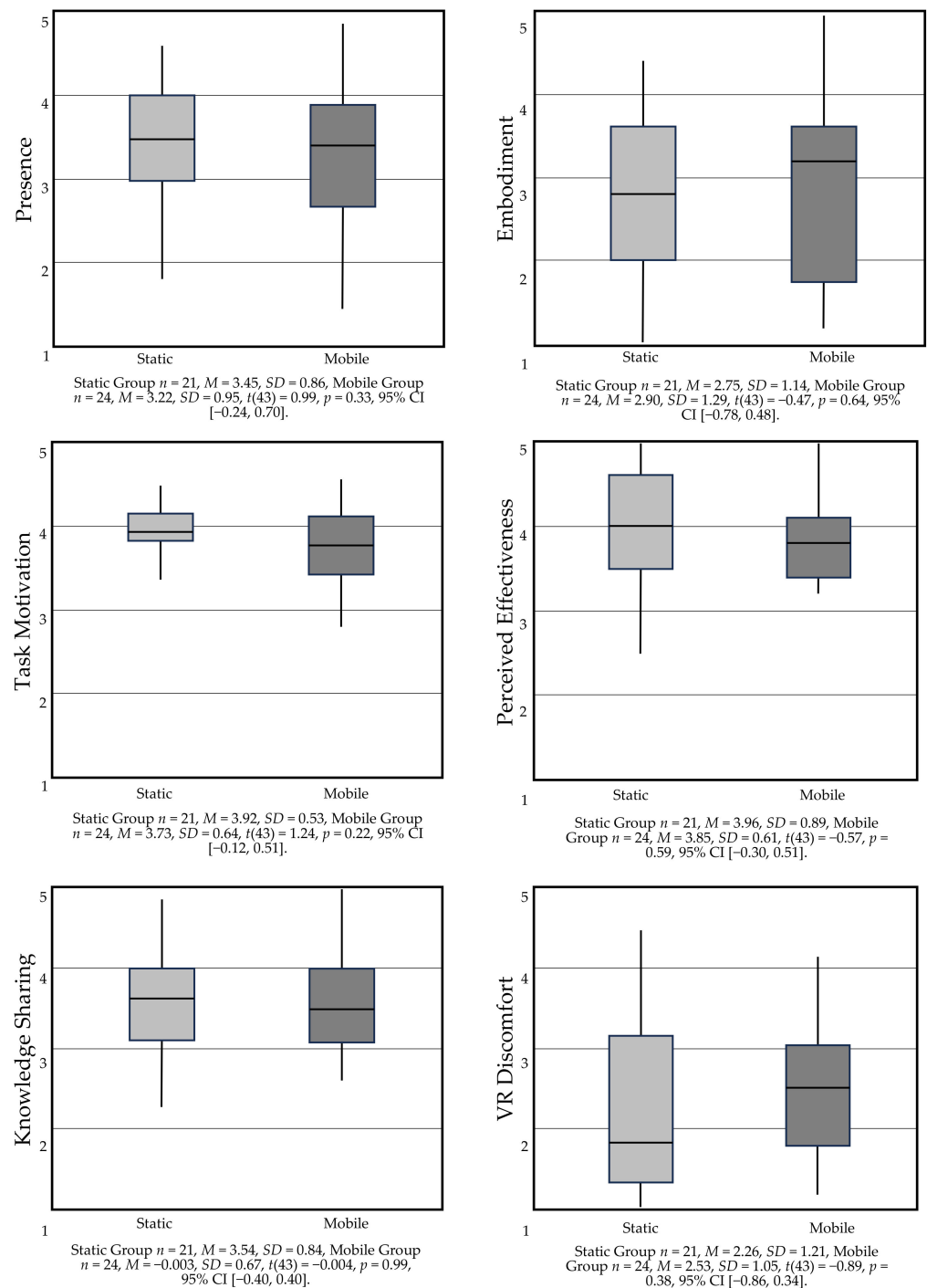


Figure 3. Boxplots of outcome variables by condition.

4.2.2. Additional Analyses

The correlation table of study 2 variables shows the critical impact of both presence and embodiment on the other VR outcomes. We sought to further understand these relationships. We considered that presence and embodiment might possess mechanisms through which VR pursuit impacts other relationships. To test this, we evaluated both presence and embodiment as moderators of the relationships between VR pursuit and the other study outcomes; task motivation, perceived effectiveness, knowledge sharing, and VR discomfort. Results showed that three of these tested moderations were significant. All three significant interaction terms demonstrated the same trend; there is a potential

benefit of lower presence and lower embodiment for high VR pursuit individuals, which is in opposition to what we predicted, see Figure 4.

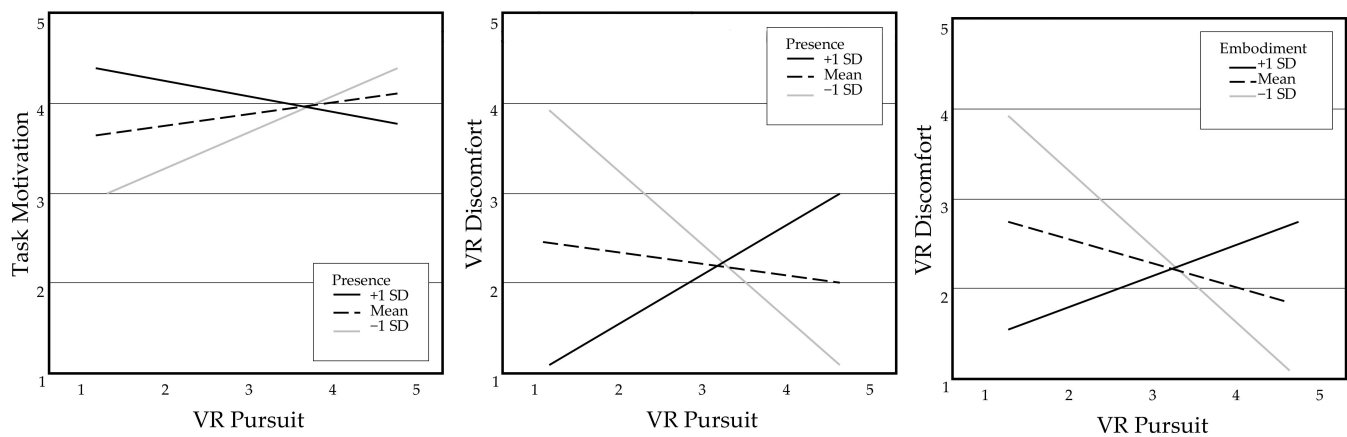


Figure 4. Plots for three significant additional analyses interaction terms.

The additional analyses multiple regression results showed a significant main effect of VR pursuit on task motivation ($b = 1.48$, $SE = 0.53$, $p < 0.01$), indicating that participants with a greater predisposition toward VR showed higher levels of task motivation when compared to those who demonstrated lower predispositions toward VR. There was also a significant main effect of presence on task motivation ($b = 1.49$, $SE = 0.44$, $p < 0.01$), indicating that higher presence was similarly associated with higher task motivation. However, these effects were qualified by a significant interaction between VR pursuit and presence ($b = -0.40$, $SE = 0.15$, $p < 0.01$). This means that the effect of VR pursuit on task motivation depended on the level of presence the individual experienced. Specifically, having a lower level of presence was more effective for individuals with higher levels of VR pursuit, whereas having a higher level of presence was more effective for individuals with lower levels of VR pursuit in terms of experiencing the highest degree of task motivation.

The additional analyses also showed a significant main effect of VR pursuit on VR discomfort ($b = -3.49$, $SE = 1.08$, $p < 0.01$). This indicated that greater VR pursuit showed lower VR discomfort. There was a main effect of presence on VR discomfort ($b = -3.29$, $SE = 0.90$, $p < 0.001$), indicating similarly that higher presence was associated with lower VR discomfort. The significant interaction between VR pursuit and presence ($b = 1.00$, $SE = 0.31$, $p < 0.01$) showed that having a lower level of presence was more effective in producing lower VR discomfort for individuals with higher VR pursuit, whereas higher presence was more effective for individuals with lower VR pursuit.

Similarly, the additional analysis results showed two main effects where greater VR pursuit ($b = -2.11$, $SE = 0.80$, $p < 0.05$) and higher embodiment ($b = -2.12$, $SE = 0.75$, $p < 0.01$) were both associated with lower VR discomfort. However, a significant interaction between VR pursuit and embodiment ($b = 0.65$, $SE = 0.25$, $p < 0.05$) showed that lower levels of embodiment were more effective for individuals with higher levels of VR pursuit, whereas higher levels of embodiment were more effective for individuals with lower levels of VR pursuit.

All of these results may be explained by the degree of stimulation the individual is experiencing. Those who are predisposed to VR experiences may already be feeling a heightened level of excitement for the experience. Feeling more presence or embodiment in the experience might lead to a tipping point where the individual is overloaded and overwhelmed by the experience. For example, a study on the use of immersive VR in higher education highlights that while improving immersion and embodiment can enhance the experience, it may also lead to overstimulation and increased cognitive load, which may negatively impact learning [57].

5. Discussion

Given the new generation of VR technology, there are opportunities to explore the potential uses of VR in research and applied practices [2]. Our study set out to explore VR predisposition as a potential measure for understanding individuals who are naturally inclined towards VR technology. Both study 1 and study 2 provided some evidence for the use of the adapted VR Pursuit Scale [44].

In study 1, we found reliability and validity evidence for the use of an adapted VR Pursuit Scale that appears to measure VR predisposition. In study 2, we set out to understand if VR pursuit could predict meaningful outcomes. We found that VR predisposition was significantly related to presence, task motivation, and perceived effectiveness. We did not find evidence that the environmental feature of having a mobile versus static platform on which the virtual team was performing the activity had an impact on the measured outcomes. These findings provide evidence that individuals who are predisposed towards VR were more likely to feel present within the virtual environment, were more likely to feel motivated toward completing the tasks assigned to them in the VR environment, and were more likely to perceive their own and their group's performance as more effective. VR pursuit was not related to the degree to which individuals felt embodied in the VR avatar, how much knowledge-sharing their group did during the VR task, and whether or not they experienced any sort of physical discomfort while in the VR environment.

Furthermore, we believed that individuals may have experienced the VR environment differently based on discrete design changes to provide visual cues on the passage of time. We placed participants into conditions of completing the activity while standing on a mobile or static platform. We found no significant difference between the mobile and static platform groups across all of our variables. There was no evidence from this study that passive cues of the passing environment were related to the variables we examined.

Our additional analyses showed that presence was a meaningful moderator for the relationships between VR pursuit with both task motivation and VR discomfort, and embodiment was a significant moderator for the relationship between VR pursuit and VR discomfort.

These findings from our additional analyses mean that presence had a larger positive impact on individuals with lower levels of VR pursuit. Those who were not naturally predisposed to using VR but experienced higher levels of presence benefitted from increased task motivation and reduced VR discomfort. In contrast, we found that presence had less impact on individuals with moderate levels of VR pursuit and a negative impact on those with the highest levels of VR pursuit. Specifically, individuals who are naturally predisposed to VR and frequently use VR independently tend to experience lower task motivation and greater VR discomfort when they feel more presence in the VR environment. Our explanation for this phenomenon is that individuals with higher levels of VR pursuit may have higher expectations for their experiences in a VR environment.

This is consistent with previous research in related fields, such as video gaming, which has shown that experienced users often have higher expectations for the narrative, story, and overall user experience [58]. Less experienced users, on the other hand, can have lower expectations, being more lenient with lower-fidelity experiences. These findings suggest that future researchers should be mindful of these differences in VR pursuit and the potential differences in user experience when designing VR studies. If the VR environment has high fidelity, individuals with both high and low levels of VR pursuit may respond positively. However, if the VR experience has lower fidelity, individuals with the least VR predisposition may still respond positively, as long as they feel a strong sense of presence in the environment.

5.1. Limitations

Although we have identified valuable takeaways from the current study, we acknowledge several limitations of our research that could inform and improve future studies.

First, our sample was composed entirely of students with a limited age range. This limitation impacted the external validity of our findings. While we can reasonably generalize the results to other student samples or those within the same age range, we recognize that these results may not extend to other populations, such as working adults, elderly individuals, children, or those with different educational levels. We recommend that future research expand on these questions by including a more diverse sample, such as individuals younger than 18, working adults, or those with disabilities.

Insights from our reviewers were helpful when considering further analyses that might have strengthened this study. We recommend alternate analytic methods such as a path analysis for future research. For those who would like to explore questions in our own study, we can make our data available upon request.

We also recognize that our sample size was smaller than desired. Ideally, we would have recruited our target level of participants for both study 1 and study 2. However, both samples fell short of our target. In study 1, although we initially recruited our target, half of the participants from our sample were excluded due to data quality issues. (There is an awareness of issues with data quality and the ability to recruit reliable participants for VR research, which requires in-person participation due to the use of specified equipment. With the growing preference for participating in studies that are entirely remote, researchers are forced to find creative solutions for the recruitment of participants [59].) We recommend that future research continues data collection for a longer period of time to ensure a sufficient sample size, thereby increasing statistical power and confidence in the results.

A final limitation was our inability to use random assignment due to challenges with participant attendance. We were unable to randomly assign participants to the two conditions. Instead, we collected data for the experimental condition first, followed by collecting data for the control condition. Because we were unable to randomly assign participants to the conditions, our sample may reflect systematic differences. Not being able to randomize participants into groups meant that we could not control for individual differences between those assigned to the experimental condition and those assigned to the control condition. We acknowledge that the lack of random assignment classifies our study as a quasi-experiment. This limitation reduces the validity and reliability of our results.

5.2. Future Research

To our knowledge, this study is the first to modify an existing validated scale about VR predisposition and to use the adapted scale to explore differences in individual responses to a VR environment. We believe that understanding individual tendencies to pursue VR can be useful for future researchers as it can help understand and predict systematic differences in individual reactions and responses, such as presence [21].

One of the primary findings of our studies was that we found evidence for the use of the VR Pursuit Scale as a meaningful indicator of individual predisposition to VR that could predict how individuals will experience and react to a VR environment. We recommend that future research that involves individuals in a VR environment use this adapted scale, see Table 5, to explore the relationship between VR pursuit and their other study variables. We recommend that future research uses this to evaluate the degree to which someone is predisposed toward VR as this could aid with understanding and interpreting study results.

Secondly, directions for future research should include using an expanded collection of a sample with more variability to improve the generalizability of the results. Researchers [59] have reported challenges with recruiting large, reliable, and diverse samples due to changing expectations from research participants (e.g., access to equipment, motivation to participate, and expectations for remote participation). We recommend a focus on expanded samples that include a variety of people of different ages, genders, ethnicities, locations, etc. Some recruitment efforts may require funding available to ensure a large enough sample is collected to test meaningful differences. VR research has shown that people respond in meaningfully different ways based on demographic information.

For example, one study showed that men reported significantly higher levels of presence compared to women in the sample [60].

Table 5. VR Pursuit Scale adapted from [44].

Subscale	Question
Intentional VR Use	I spend many hours each week using VR. I have searched for information (e.g., magazines or websites) to improve my VR skills. I plan to continue improving my VR skills. I am proactive in seeking ways to improve my VR skills. I deliberately seek out VR experiences. I would call myself a “serious” VR user.
Self-Efficacy with VR	I am good at using VR, compared to others. I am confident in using VR. I have good VR skills. I have a lot of experience with using VR. Based on my knowledge of previous VR usage, I can easily manage VR controls. I can keep up with a VR experience that moves quickly.
Enjoyment of VR	I enjoy VR. VR is fun. I like using VR. I think VR is entertaining.
Prone to VR Immersion	I lose track of time when I use VR. When I use VR, I lose track of my senses (e.g., cannot tell if I am getting hungry or tired). I am fully immersed when I use VR.

Lastly, we would recommend that future research follows the process we have demonstrated of replicating established research methods, practices, and procedures within a VR environment. In the current study, we follow the research process of the hidden profile paradigm. Although other research has replicated portions of this paradigm in VR [61]. To our knowledge, we are the first study to replicate the entire procedure within a VR environment. Other researchers identify replicating other classic methods and procedures to determine the feasibility of conducting these methods within a VR context.

Another example comes from a recent study [62] that replicated a video vignette within the context of a VR video environment. Studies that continue to utilize VR to better understand well-established research practices can help promote the future of VR research and support our understanding of the nuances and conditions under which VR can be utilized.

6. Conclusions

Based on the findings of our study and emerging research in virtual reality (VR), there are opportunities for future studies to be conducted within VR environments. This opens the door for novel types of research, especially those traditionally involving high costs, risks, or resources. For instance, studies requiring the creation of realistic, immersive environments that evoke emotional responses can be achieved through VR, which has previously been shown to effectively elicit a range of emotions from participants [63–65]. This shift offers a more accessible and flexible approach to high-stakes experimental designs.

VR also offers a level of consistency that is not achievable with traditional, in-person methods. Experiments that require precise control over subtle variations often depend on actors or confederates. In VR, pre-recorded audio and avatar movements allow for a uniform experience across participants. The immersive and 3-dimensional aspect of VR offers a more involved experience beyond other pre-recorded options (e.g., traditional video recordings). As VR advances, the potential applications continue to expand, such as

enhancing hybrid work models with VR-based collaborative meetings, enabling virtual onboarding, company tours, and training without travel costs. The immersive nature of VR could mitigate drawbacks from other technologies (e.g., Zoom fatigue [66]).

The future of VR research and application holds exciting possibilities. We are hopeful for the future of VR as this technology could become a key tool for both research and business applications, helping organizations stay competitive while creating stimulating, interactive experiences.

Supplementary Materials: The following supporting information can be downloaded at <https://www.mdpi.com/article/10.3390/virtualworlds3040023/s1>, Table S1: Study 1 materials; Table S2: Study 2 materials.

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