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(Article begins on next page)

VR Legs: Design Requirements for Adaptive Comfort in VR Games

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Consumer VR players describe developing “VR Legs,” a gradual, self-regulated tolerance to cybersickness built across repeated play. Drawing on an exploratory online survey of 104 headset owners, this article reframes cybersickness as a longitudinal user experience and derives requirements for adaptive, safety-constrained comfort in VR game engines.

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or many Virtual Reality (VR) newcomers, the first obstacle is not learning how to interact

with a virtual world but learning how to remain inside it. A few minutes of artificial locomotion, smooth rotation, fast visual motion, or visually complex content may be enough to trigger nausea, dizziness, disorientation, headache, sweating, eye strain, or general discomfort. For researchers, this problem is usually discussed as CyberSickness (CS); for users, it is often the reason why an otherwise compelling technology becomes difficult to enjoy.

CS remains one of the most persistent barriers to sustained VR use¹. Standardized instruments such as the Simulator Sickness Questionnaire (SSQ) are widely used to quantify its symptoms², while testbeds and mitigation techniques have been developed to evaluate and reduce discomfort^{3,4,5}. These efforts mostly address CS as a condition to be measured or reduced during controlled exposure. However, VR is not experienced as a sequence of isolated laboratory trials: people return to applications over time, adjust comfort settings, take breaks, and gradually learn what they can tolerate.

The idea that repeated exposure may reduce CS symptoms is not new. Adaptation and habituation have been discussed in CS research for decades⁶, and recent studies continue to show that symptoms may decrease through repeated exposure^{7,8,9}. What remains less developed is the connection between these formal approaches and the adaptation practices already circulating in consumer VR communities, where users commonly refer to the development of tolerance to CS-provoking VR experiences as developing “VR Legs”. The expression describes a gradual, self-regulated adaptation process shaped by repeated exposure, comfort settings, breaks, application choice, and user-to-user advice.

This article investigates VR Legs as a community-derived user-experience construct rather than as a clinically validated measure of habituation. Specifically, it addresses three questions:

RQ1: How widely is the term VR Legs recognized among active VR users?

RQ2: What behavioral, software-based, environmental, and application-specific practices do users associate with developing VR Legs?

RQ3: How can these practices inform the design and evaluation of adaptive comfort mechanisms in VR games and game engines?

The article contributes by distinguishing adaptation practices from perceived tolerance, characterizing the strategies reported by 104 VR headset owners, and translating these observations into requirements for reversible comfort adaptation in VR game engines. The survey does not establish the causal effectiveness of the reported strategies; instead, it identifies recurring user practices that can motivate controlled longitudinal studies.

VR LEGS AS USER-DRIVEN ADAPTATION

The expression VR Legs builds on the analogy with “sea legs”: just as people may gradually adapt to motion at sea, VR users may gradually become more comfortable with immersive virtual environments (VEs). In this article, VR Legs denotes the user-reported development of tolerance to CS-provoking VR experiences through repeated and self-regulated exposure. The concept is expressed not only as reduced discomfort, but also as increased confidence, longer or more demanding sessions, and willingness to engage with content that previously caused symptoms.

One of the earliest explicit uses of the term in relation to VR is commonly attributed to Andreas Aronsson, who described VR Legs as tolerance developed through controlled exposures of increasing intensity and duration¹⁰. This early description already links VR Legs to three elements that remain central in later community discussions and in the survey responses: repeated exposure, gradual increase in challenge, and symptom-regulated pacing. After its introduction, the expression appeared in online discussions, community knowledge bases, and user-facing guides. The *XinReality* VR/AR/XR Wiki included a dedicated page on VR Legs¹¹, while VR Heaven proposed progression from comfortable or room-scale applications to teleportation, snap turning, and eventually smooth locomotion¹². The *Half-Life 2: VR Mod* website warns that some vehicle sections require “strong VR legs” despite available comfort options¹³. Rather than offering formal scientific definitions, these examples show how users and communities describe adaptation in practical terms: start from tolerable experiences, stop or reduce intensity when symptoms increase, use breaks or other supports, and gradually attempt more demanding locomotion or content.

AN OPERATIONAL DEFINITION OF VR LEGS

VR Legs is operationalized as a user-reported construct with two distinct dimensions: the adaptation process, encompassing practices used to regulate repeated exposure, and the perceived outcome, reflecting reported improvements in tolerance, confidence, or ability to engage with demanding content. Table 1 summarizes these dimensions and potential behavioral and symptom outcomes for their validation.

TABLE 1. Components of the VR Legs construct and candidate measures for its validation.

Component	Working definition	Candidate measurements
Adaptation process	Practices used to regulate repeated VR exposure	Session duration, frequency, breaks, setting changes, locomotion mode, content intensity
Perceived outcome	User-reported increase in tolerance or confidence	Self-rating, willingness to continue, perceived recovery, reported ability to use demanding content
Behavioral outcome	Observable change in VR use	Longer sessions, return rate, fewer interruptions, progression to more intense scenarios
Symptom outcome	Measured change in CS	SSQ or comparable scores, recovery time, physiological or postural measures

VR Legs therefore should not be used as a synonym for experimentally verified habituation. Rather, it connects subjective symptoms, adaptation practices, application demands, and perceived progress. Objective validation would require longitudinal symptom and behavioral measurements.

Scientific work has long examined CS adaptation through repeated exposure^{6,7,8,9,14}. Howarth and Hodder, for example, exposed participants to the same VE across ten sessions and found reductions in CS symptoms¹⁴, while other work comparing active visual training and passive exposure indicated that a single habituation session may be insufficient for adaptation¹⁵. Unlike these controlled approaches, VR Legs describes self-regulated practices in which exposure intensity, settings, breaks, and application context may change over time.

SURVEY METHOD AND USER-REPORTED FINDINGS

Participants

The survey was conducted in October 2024, and responses were received between October 8 and October 10, 2024. It was distributed through VR-related online communities, including *r/virtualreality*, *r/oculus*, *r/SteamVR*, and the VR and AR section of *AVForums.com*. The survey link was also shared through the research team's Discord and Steam contacts. Recruitment posts introduced the survey as an academic project on strategies to manage CS in VR and invited experienced VR users to participate voluntarily.

Eligibility required participants to be at least 18 years old and provide informed consent. Respondents were informed about the survey purpose, the meaning of CS and VR Legs, and the voluntary nature of participation. They could skip questions or withdraw at any time. No personally identifying information was required. The full information and consent text is provided in the supplementary material.

A total of 104 submissions were received, all of which met the inclusion criteria and were retained for analysis. All 104 valid respondents reported owning a VR headset. Manual screening of the responses identified no duplicates. Optional email addresses provided for follow-up were removed from the dataset before analysis.

The survey was conducted as an anonymous questionnaire within a broader structured study approved by the Ethics Committee of Politecnico di Torino on January 31, 2025 (Protocol No.

39423/2025), and, owing to its preliminary nature, did not require separate ethics approval under the University's institutional procedures.

Instrument and Analysis

The questionnaire contained 12 closed-ended items, 2 Likert-scale items, and 4 open-ended questions, excluding the optional email field for follow-up contact. The complete questionnaire and the distributions of the two Likert-scale items are provided in the supplementary material. Some optional or open-ended questions were not answered by every participant; missing or unusable responses were handled at the item level, with denominators reported where applicable.

Open-ended answers were analyzed through two complementary descriptive coding procedures. Responses concerning strategies for developing VR Legs were segmented into individual practices and grouped into recurring strategy families. Responses concerning VR applications were coded by application category, considering each reported title separately and assigning multiple categories where appropriate. In both analyses, responses could contribute to multiple categories, so counts are not mutually exclusive. These descriptive groupings should not be interpreted as independently validated constructs.

Study Results

The survey targeted active VR users. Respondents reported a mean VR-use frequency of 1.90 (SD = 0.82) on a four-point Likert scale ranging from 1 (*Every day*) to 4 (*Rarely*), indicating predominantly regular VR use. Table 2 summarizes the main findings. Given the self-selected, community-based sample, the reported frequencies should not be interpreted as prevalence estimates for the broader VR-user population.

VR Legs were widely recognized in this sample: 96 respondents were familiar with the term. CS was also common, with 97 respondents self-reporting symptoms occasionally or frequently. Most respondents had also encountered or tried strategies for developing VR Legs (Table 2). Respondents mostly encountered the term through community-oriented channels, especially social media or Reddit, video platforms, online gaming forums, and in-game experiences, supporting the interpretation of VR Legs as a bottom-up concept circulating through user communities rather than formal CS research alone.

Reported strategies were grouped into recurring families, including gradual exposure, comfort settings, physical grounding, symptom-regulated pacing, application selection, and external aids or preparation. Individual responses could contribute to multiple families.

TABLE 2. Summary of exploratory survey results.

Survey item	Result
Owned a VR headset	104/104 (100.0%)
Familiar with the term VR Legs	96/104 (92.3%)
Self-reported experiencing CS occasionally or frequently	97/104 (93.3%)
Had heard of strategies to prevent CS or develop VR Legs	90/104 (86.5%)
Self-reported attempting to develop VR Legs	77/104 (74.0%)
Self-reported having developed VR Legs	85/104 (81.7%)
Considered developing VR tolerance important for long-term VR use	85/104 (81.7%)

The UpSet plot in Figure 1 summarizes the frequencies and co-occurrences of strategies among the 82 respondents with at least one coded strategy family. Gradual exposure was the most frequent family (72 respondents), encompassing repeated practice, short initial sessions, and progressively more demanding content. Physical grounding was also common (47 respondents mentioning standing while playing), alongside symptom-regulated pacing, comfort settings, and external aids or preparation.

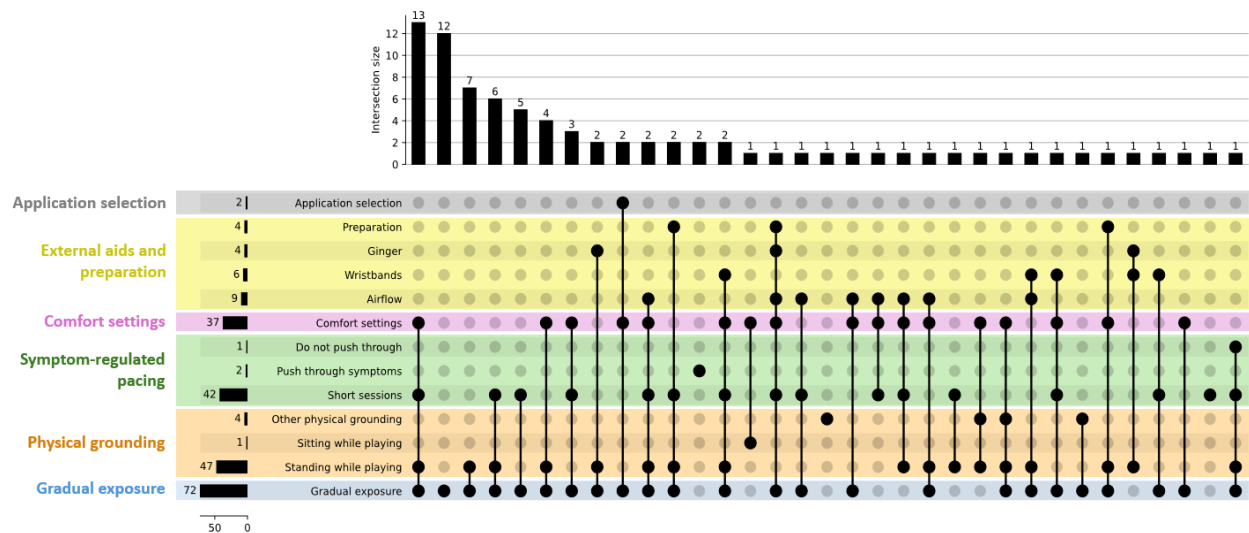


FIGURE 1. User-reported strategies for developing VR Legs.

Among respondents with at least one coded strategy family ($n = 82$), 16 mentioned one family, 16 mentioned two, 23 mentioned three, and 27 mentioned four or more. Thus, 66 respondents mentioned at least two families, suggesting that VR Legs are approached through user-assembled routines rather than isolated comfort settings. These routines included software options such as teleportation, snap turning, and vignettes, alongside physical grounding, short sessions, and external aids. For example, airflow from a fan was mentioned by 9 respondents, wristbands by 6, ginger-based remedies by 4, and preparatory routines by 4. These reports do not establish the effectiveness of individual strategies. Some responses also emphasized stopping or reducing exposure before symptoms become severe, highlighting the importance of symptom-regulated pacing.

Applications mentioned by respondents ranged from room-scale and rhythm games to free-locomotion, simulation, racing, and action titles (Table 3). The most frequently mentioned titles were *Half-Life: Alyx* (12), *VRChat* (10), *Skyrim VR* (8), *Beat Saber*, *Rec Room*, and *Blade & Sorcery* (6 each), and *Pistol Whip* (5). Only two respondents explicitly described application choice or progression as a strategy for developing VR Legs; however, some accounts suggested progression from more comfortable experiences toward titles involving more demanding locomotion or visually intense motion. Since exposure intensity also depends on settings, play style, and session duration, these applications represent heterogeneous adaptation contexts rather than a fixed ranking of difficulty.

TABLE 3. VR application categories ordered by their corresponding occurrences.

VR application category	Occurrences
Action/FPS/Combat	60
Adventure/RPG/Exploration	33
Social/Multiplayer	18
Flight/Space	16
Rhythm/Music	14
Racing/Driving	11
Horror	6
Sports/Sports Simulation	5
Puzzle/Stationary	2

Respondents who reported trying strategies were also asked to rate their overall effectiveness on a 5-point Likert scale ranging from 1 (*Not effective*) to 5 (*Very effective*). Among those providing a rating, 51 selected the highest value and 20 the second-highest. Since respondents often combined multiple strategies, these ratings cannot establish the effectiveness of individual interventions. Moreover, 85 respondents reported having successfully developed VR Legs while 8 were still in the process. Two reported tolerating VR from first use, while one described needing to regain tolerance after time away. These accounts suggest that users perceive VR Legs as developing across repeated sessions and potentially changing with continued use or disuse.

FROM COMFORT OPTIONS TO ADAPTATION SUPPORT

Many VR applications already include comfort settings such as teleportation, snap turning, vignette effects, seated modes, or adjustable movement speed. These options are important, but they are often presented as static toggles that users either enable or disable. The survey findings suggest that comfort management is instead a longitudinal process, in which users combine settings, breaks, and progressively changing exposure according to their symptoms and confidence.

Supporting this process does not mean pushing users toward discomfort or requiring everyone to follow the same progression. Some may prefer teleportation or seated experiences, while others may gradually attempt more demanding locomotion. Comfort mechanisms should therefore support user-controlled, reversible adjustments. Figure 2 presents a conceptual architecture illustrating how these principles could inform longitudinal comfort support in VR game engines.

The architecture is a design implication of the survey and has not been implemented or evaluated.

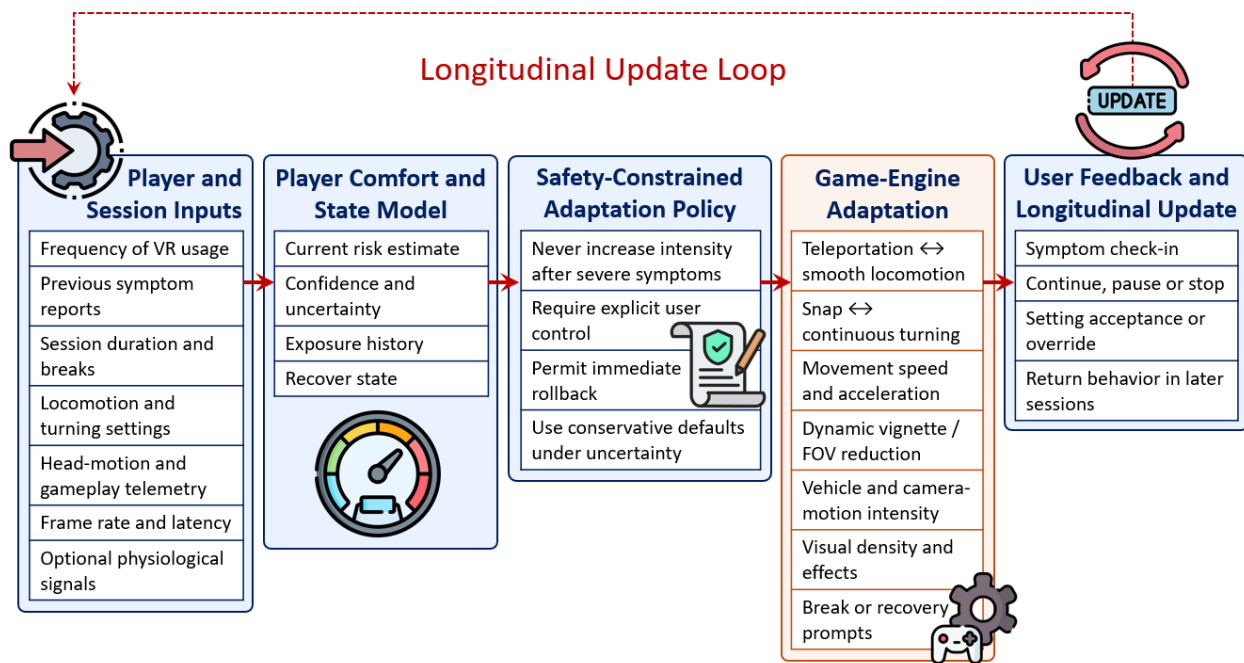


FIGURE 2. Conceptual architecture for longitudinal comfort adaptation in a VR game engine.

Treating VR Legs as a longitudinal user experience also changes how comfort interventions should be evaluated. Beyond immediate symptom scores, studies should consider exposure history, comfort-setting changes, breaks, and progression criteria. These measures would help distinguish perceived tolerance from objectively measured symptom reduction, and isolated comfort settings from broader adaptation routines.

Reversibility is particularly important: users should be able to adjust exposure intensity without penalty according to their symptoms and preferences. Table 4 translates the reported practices into possible game-engine responses, safety constraints, and evaluation measures.

TABLE 4. From user-reported practices to reversible game-engine actions.

User-reported practice	Observable input	Possible engine response	Safety constraint	Evaluation measure
Gradual exposure	Session history, tolerated motion level, symptom check-ins	Offer optional progression from teleportation to smooth locomotion or snap to continuous turning	Never increase intensity automatically after moderate or severe symptoms	Symptom change, progression rate, user acceptance
Symptom-regulated pacing	Session duration, pauses, user discomfort rating	Recommend a break, save progress, reduce motion intensity	User can pause or exit immediately; no reward penalty for stopping	Recovery time, return rate, abandonment rate
Comfort-setting combinations	Current locomotion, vignette, speed, and camera settings	Recommend a personalized bundle rather than one isolated toggle	Changes must be transparent and reversible	Override frequency, comfort rating, task performance
Physical grounding	Seated or standing mode, play-area configuration	Adjust movement profile and camera behavior to selected posture	Do not infer posture without reliable signals or user confirmation	Stability, symptoms, preference
Application context	Vehicle use, rotation, acceleration, visual density	Lower camera acceleration or provide advance warnings for intense sequences	Avoid hidden changes that interfere with gameplay	Symptoms by scenario type, completion rate

Adaptation after disuse	Time since previous VR session	Begin with a conservative profile and allow rapid restoration	Do not assume previously achieved tolerance persists	Time needed to regain prior settings
User autonomy	Overrides and rejected recommendations	Learn preferences or disable adaptation	Explicit consent and permanent manual controls	Trust, acceptance, override rate

LIMITATIONS

The study does not establish that any reported strategy causes adaptation, that perceived improvement corresponds to physiological habituation, or that the observed frequencies generalize to the broader VR-user population. The sample was self-selected from online communities, the data were retrospective, exposure dose was not measured, and no controlled comparison or objective symptom assessment was conducted. In addition, open-ended responses were coded by one researcher; therefore, the qualitative categories should be interpreted as descriptive groupings rather than as independently validated codes.

CONCLUSION

This exploratory study characterizes VR Legs as a community-derived, self-regulated adaptation process involving repeated exposure, comfort adjustments, and symptom-regulated pacing. The reported practices and perceived outcomes do not establish causal effectiveness or objectively verified habituation.

The principal design implication is that VR comfort could be supported longitudinally rather than through static, single-session settings alone. These observations provide a starting point for developing adaptive, reversible comfort mechanisms in VR game engines. Future work should compare fixed and adaptive approaches in prospective longitudinal studies, measuring symptoms, behavior, recovery, user autonomy, and continued engagement.

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