VR Onboarding Procedures for Multiple Collocated Users: See-Through Tutorials and Group Transitions

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Figure 1: Transitions of our onboarding framework: (left) *collective* transition triggered by touching a magic table, (center) *sequential* transition triggered by walking through a magic door, (right) *individual* transition triggered by opening a magic box.

Abstract

Making virtual reality (VR) more accessible for novice and non-digital users has largely focused on single-user solutions, such as tutorials, tooltips, and visual guidance cues. While structured onboarding protocols have proven effective, they do not scale well for multiple collocated users due to varying assistance needs, different learning speeds, and guidance preferences. Additionally, the sudden isolation upon entering VR can cause disorientation, particularly in group settings where users may lose awareness of their physical and social surrounding. This paper proposes a novel onboarding framework that extends traditional procedures with four phases: 1) entering video see-through mixed reality after putting on the HMD, 2) interactive tutorials in mixed reality, 3) adaptive group transition strategies into VR, and 4) structured exit mechanisms. In our implementation of the framework, we explore three concepts for group transitions: individual, sequential, and collective. In a user study with 36 participants, we collected feedback on our mixed-reality onboarding approach and evaluate the usability, co-presence, agency, and continuity of our three proposed transition techniques and compare it to the common direct transition into virtual reality. Our results indicate a clear preference for onboarding through an additional mixed reality stage and provide valuable insights into advantages and trade-offs of the different group transition strategies.

Index Terms: Virtual Reality, Mixed Reality, See-through, Transitions, Collocation, Onboarding Tutorials, Accessability

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1 Introduction

Creating accessible virtual reality (VR) applications requires consideration of different physical, sensory, and cognitive user needs. Despite continuous efforts towards improving the intuitiveness of user interfaces, onboarding multiple users into a VR application is still a major challenge. Although accessibility of individual components, such as tooltips, instructions [21], and simplified locomotion [47] have already been addressed, a holistic perspective on onboarding [12, 24, 48] has only recently been considered. These approaches emphasize the importance of aligning tutorials, guidance cues, and intuitive interactions to support a smooth transition into immersive experiences. However, existing research primarily addresses single-user contexts and does not account for collocated multi-user scenarios, as commonly found in public settings such as museums [39, 50], escape rooms, or outreach events.

Putting on a head-mounted display (HMD) for the first time can be both fascinating and overwhelming [48]. Describing this abrupt transition through the lens of Milgram's Reality-Virtuality Continuum [33] means jumping directly from the real to the virtual environment. This transition can already be challenging for individual users, as the sudden change can induce a high mental load, making it difficult to recall controls and may also cause disorientation [6], especially for novice users. To reduce mental load, existing onboarding protocols suggest introducing controls systematically before donning the HMD [3, 12]. Although effective, these approaches are prone to the "wow effect", where users rush through the explanations in anticipation of the immersive experience [12]. In collocated multi-user scenarios, these challenges are further exacerbated, as users may not only face individual disorientation but also experience a sudden loss of awareness of the physical and social surrounding upon putting on the HMD. This can lead to feelings of isolation and disrupt group cohesion, complicating a coordinated entry into VR.

To address these challenges, we propose a novel onboarding framework for collocated social virtual reality experiences that is inspired by more gradual transitions through Milgram's continuum, such as the "magic book" concept of Billinghurst et al. [8]. It first introduces users to a video see-through mixed reality stage to avoid abrupt environment changes. This intermediate phase allows all users to become familiar with their devices and controls while still seeing each other and the real environment before fully immersing the group. More precisely, our framework is structured in four phases: 1) Displaying video see-through mixed reality after putting on the HMD, 2) offering instructions and interactive tutorials in mixed reality, 3) smoothly transitioning into the virtual environment, and 4) providing partial or full transitions out of VR (see Figure 2).

While instructions and tutorials are application-specific, in our implementation of the framework, we focus on exploring three categories of group transitions (collective, sequential, and individual) and implement one concrete transition technique for each category (see Figure 1). Such transitions for collocated groups are largely unexplored [23] as prior work has focused only on a variety of individual transition techniques [14]. The explored visual styles such as fades, dissolves, and cuts, as well as metaphors such as lenses and portals, are serving as inspiration for group transitions.

To evaluate our framework and the transitions, we conducted a user study (N=36) with participant triads, comparing our mixed reality onboarding procedure to the conventional direct approach of simply putting on an HMD to enter VR. Using a counterbalanced within-subjects design, we examined the proposed group transitions in terms of overall preference, usability, and co-presence. Additionally, we explored dimensions such as connectedness, agency, and continuity, and collected qualitative feedback to better understand the strengths and trade-offs of each transition strategy.

Our work is motivated by onboarding challenges observed first-hand during the introduction of visitors to a shared VR experience, developed in collaboration with a local museum. Varying technical backgrounds and different assistance needs led to asynchronous entry, with faster adopters beginning to explore while others struggled to recall controls, ultimately fragmenting the group experience. These observations led to the development of our framework and its integration into an interactive VR application featuring two escape room-inspired tasks (painting and scaling) along with two specifically designed tutorials. Our user study aims to answer the concrete questions whether our framework improves the experience of onboarding groups into VR, and which of the proposed group transition strategies–collective, sequential, or individual–offers the most effective and engaging entry experience for diverse user groups.

To the best of our knowledge, this paper presents the first comprehensive multi-user onboarding concept for collocated VR scenarios and provides the following main contributions:

- A novel onboarding framework for multiple collocated users, using a mixed reality stage and four distinct phases.
- A categorization of group transition strategies–collective, sequential, and individual–along with an exploration of their respective design spaces.
- Evidence from a user study (N=36), revealing a significant improvement in overall rating, continuity, and connectedness of group transitions over a traditional put on approach.
- Practical recommendations for designing group transitions and onboarding procedures for collocated VR experiences.

2 Related Work

Our see-through onboarding phases build on prior research in VR onboarding and guidance as well as transition strategies. To contextualize our approach, we review relevant work from both domains, highlighting key insights and limitations that informed our work.

2.1 VR Onboarding

Despite continuous efforts to create intuitive interfaces, entering virtual environments for the first time and interacting with them remains a persistent challenge [12, 27, 39], one that necessitates efficient onboarding processes. Following Renz et al. [38], we define onboarding as the collection of techniques and features designed to help novice users understand and operate a digital system.

Several studies have explored learning sessions as a means to facilitate onboarding and emphasize the need for continued research in this area [3,12,26]. However, only a few works have approached this problem space in a systematic way and proposed overarching frameworks for onboarding [7,48]. Whittaker [48] emphasizes that onboarding is highly context-dependent and presents a framework to help designers identify key factors for shaping specific user experiences. Bharti et al. [7] investigated onboarding journeys in systems like SteamVR and Google Earth, and suggest a set of "facilitator" to improve onboarding strategies.

Common onboarding features include interactive (video) tutorials with tooltips and written or audible instructions [10,21,32,43]. In this context, Bozgeyikli et al. [10] and Kao et al. [21] have shown that animated and spatial instructions combined with text were preferred over verbal instructions or only written instructions. While these studies demonstrate that tutorials can accelerate user adaptation to VR, they do not address how such methods can be effectively implemented in multi-user environments.

Another common approach, especially in on-site VR demonstrations, involves verbal onboarding procedures, where an instructor provides an introduction before users enter the immersive experience [40]. This method can be applied to multiple users simultaneously, as the instructions are delivered collectively. However, once users enter VR, the isolation caused by the HMD often makes non-verbal guidance difficult, necessitating additional methods such as mirrored views to support instruction [44,49].

Chauvergne et al. [12] conducted expert interviews with VR instructors and reinforced these observations. Their findings revealed that users often attempt to skip instructions in favor of immediate interaction—a phenomenon referred to as the "wow effect." They also proposed several guidelines for instructor-based onboarding, including: 1) allocating sufficient time to explain hardware and controls, 2) providing instructors with a mirrored view of the user's experience, and 3) recognizing that observing an instructor perform a task does not guarantee that users can successfully replicate it.

Bimberg et al. [9] further examined responsibility-sharing between instructors and learners, finding that shared responsibilities with an expert best balance engagement and challenge.

Building on these insights, our proposed onboarding framework incorporates these approaches while focusing on multi-user scenarios. Integrating the see-through feature into onboarding enables users to put on HMDs as a first step without experiencing immediate isolation or overwhelm. This approach helps mitigate the wow effect and establishes a shared visual space for guided instructions and interactive tutorials with shared responsibilities.

2.2 Transitions

As we propose incorporating a mixed reality stage before fully entering the virtual environment, we explored transition techniques that are intuitive and minimize user overwhelm. Early research on transitions along the Reality-Virtuality Continuum [33] has examined how different qualities of Milgram's domains can be leveraged [8, 16]. Steinicke et al. [42] found that a gradual transition into virtual environments enhances a user's sense of presence and results in more natural movement behaviour. Further, smooth transitions helped users to create more awareness of the virtual environment [45], reduce disorientation [22] and improve virtual body ownership [20].

Building on these insights, research has explored various transition styles and metaphors for transitions from real to virtual environments or scene changes within virtual environments [14,19,34]. Feld et al. [14] showed that transition preferences vary depending on task and context. Additionally, "in-between" spaces, such as digital replicas of the physical room, can create smoother transitions by mitigating depth perception conflicts caused by differing room sizes [35]. While much research focuses on entering VR, the process of returning to the physical world is equally important. Pre-

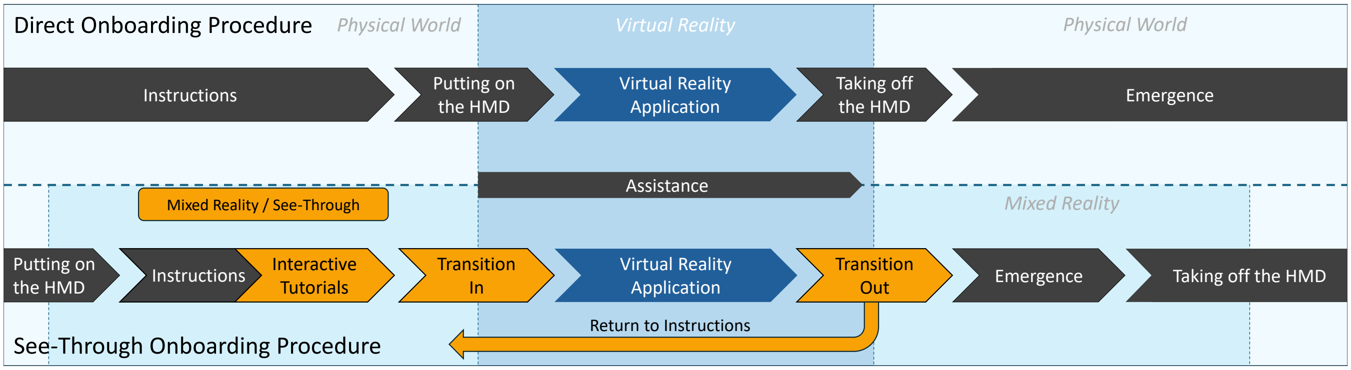


Figure 2: Visualization of a direct onboarding and our suggested see-through onboarding procedure. Orange boxes indicate new phases.

vious studies have examined outro-transitions and their impact on experience, presence, and comfort [18, 22].

Overall, prior work suggests that smooth transitions into and out of VR are a key design principle for cross-reality systems [4]. However, these studies have not addressed collocated multi-user scenarios. Investigating how groups transition, whether individually or collectively, is essential for our onboarding framework to identify effective approaches for moving users from the see-through phase into the virtual environment.

Transitions and see-through onboarding are crucial not only because transitions can enhance presence, spatial awareness and comfort but also because they may reduce mental load by introducing distractors progressively. Additionally, it remains unclear whether putting on an HMD after receiving instructions might trigger the doorway effect [37, 46], potentially reducing knowledge retention.

3 Multi-User VR Onboarding Framework

Traditional VR onboarding (see Figure 2) follows a linear process that starts with instructions from an instructor in the real world [7]. Once the explanation is complete, users are donned an HMD and they are immediately immersed in the virtual environment. At this stage, systems typically provide guidance through tutorials, tooltips, or other visual cues. Following the guidelines of Chauvergne et al. [12], instructors should have a mirrored view of the user's experience to provide real-time feedback and additional support.

While effective for individuals, this approach does not scale well for multi-user, collocated scenarios. Although traditional instructions can be received by multiple users simultaneously, users cannot actively practice controls before immersing themselves in VR. Even when users enter VR at the same time, differences in instruction recall can lead to asynchronous readiness, requiring instructors to repeat controls for individuals. Additionally, mirrored views [12] become impractical in multi-user settings. As a result, current onboarding techniques are ill-suited for scenarios where groups transition into VR together while maintaining spatial and social awareness.

To address these challenges, we propose a structured multi-user onboarding framework that leverages see-through capabilities for a gradual transition into VR. Instead of immediate immersion, users first enter a see-through phase to maintain spatial and social awareness (see Figure 3a), followed by instructions and interactive tutorials in this shared space (see Figure 3c). They then transition into VR (see Figure 3d), and finally, we offer partial or full transitions out of VR to support user needs. The steps we propose operate orthogonally to the onboarding framework proposed by Chauvergne et al. [12] and enable customized onboarding procedures across all dimensions of their eight categories. In the following subsections, we outline our decisions and explore the design space for each step of the onboarding process.

3.1 Entering the See-through Phase

In see-through mixed reality, users can still see and communicate with each other, maintaining spatial awareness and social presence. Therefore, we propose that onboarding begins with users putting on HMDs and immediately entering see-through mode instead of full VR immersion. While some users may require assistance, this step can be performed in parallel for multiple users, preventing delays where some remain isolated in VR or without a device. This approach also helps mitigate the "wow effect", as users engage with the hardware immediately instead of first going through a set of instructions. This first phase allows a natural introduction to the hardware and sets the stage for instructions.

However, several technical considerations must be addressed to ensure a smooth experience. The application must be running and responsive when users put on the HMD, preventing interruptions or system standby during donning. Additionally, all devices must be properly aligned to ensure a shared and synchronized view among users. These factors are critical for maintaining consistency and avoiding disorientation before entering the next onboarding phase.

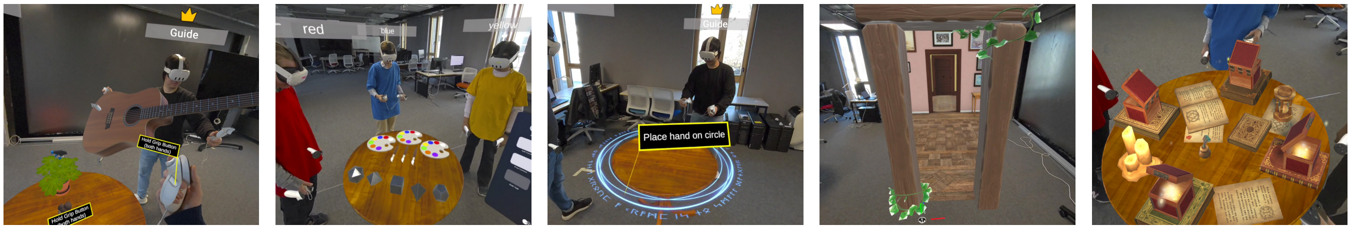
The design space of this phase evolves around which virtual elements (e.g., name tags, avatars, content, controllers) should be visible in see-through mode. When augmenting the real world with these elements, correct depth layering is essential to avoid perceptual conflicts. For example, a name tag displayed at a distance should not visually overlap real entities that are physically closer to the viewer. Ensuring accurate depth placement is essential to avoid visual discomfort and breaks in immersion.

3.2 Instructions and Interactive Tutorials

Once users have entered the see-through phase, the onboarding process continues with instructions and interactive tutorials. An advantage of see-through is that the instructor can explain controls while still pointing at users' controllers, maintaining a shared physical reference. Unlike traditional onboarding protocols that rely solely on verbal explanations, this approach integrates virtual elements into the real world, leveraging mixed reality to enhance guidance.

The instructor can introduce interactive elements and toggle visual cues or tooltips to support explanations. Following the findings of Bimberg et al. [9], responsibility for interactions can be shared between users and the instructor, allowing for an observable and adaptable onboarding experience. If needed, key controls can be introduced step by step, with users testing them in real-time on interactive objects. This approach reinforces learning while accommodating different learning speeds without isolating slower users.

The design space of this phase includes varying responsibility settings, group tutorials, or individual tasks that each user must complete. Additionally, difficulty levels or mini-games can be incorporated to keep advanced users engaged while waiting.



(a) Guide shows scaling tutorial. (b) Users learn in the paint tutorial. (c) Magic table transition. (d) Magic door transition. (e) Magic box transition.

Figure 3: Visualizations of tutorials and three magic-themed group transition strategies: c) collective, d) sequential, and e) individual.

3.3 Group Intro-Transition

Once instructions and tutorials are completed, users can transition into the virtual environment. The design space for this phase includes various transition styles and speeds, which should align with the application context, as shown in previous work [14]. Due to the prior introduction phase, where users become immersed and familiar with the controls, we assume that a well-designed transition technique will not lead to confusion or overwhelm. Additional factors, such as sound effects, haptic feedback [28], or gesture-triggered transitions [13], may further enhance presence and engagement.

A key design consideration for multi-user onboarding is determining how groups transition into VR. Since multiple group transition strategies can be envisioned, we propose to categorize them into *collective*, *sequential*, and *individual* transitions, based on the degree of user agency and the timing of entry. We believe that each category has distinct advantages and trade-offs in terms of user agency, coordination, and group cohesion. Additionally, in collocated settings, physical relation towards other users need to be indicated for fully immersed users to avoid physical collision between the users.

1. **Collective transitions** may be the most straightforward option for novice users, as they can be triggered by an instructor, ensuring a synchronized transition. However, this approach limits individual agency and may require users who learn faster to wait. While waiting can be seen as a drawback, it also helps maintain group cohesion and prevents fragmentation. From a collocation perspective, this transition is easier to design, as all users enter VR simultaneously, allowing real-world positions to be seamlessly replaced by avatars.

2. **Sequential transitions** enable staggered entry through door or portal metaphors [23, 41], enabling users to observe others transition before transitioning themselves. This approach provides users with agency to decide when to enter VR and naturally prevents collocation issues, as spatial separation is maintained through the portal. However, this technique may be time-consuming and could risk fragmenting the group if users transition at significantly different paces.

3. **Individual transitions** offer the highest level of agency, allowing users to enter VR at their own pace and ensuring they are comfortable before fully immersing. However, to maintain social awareness, solutions such as ghost avatars [50] are necessary to inform transitioned users about those who remain in mixed reality, preventing spatial desynchronization.

We believe that each strategy may be suited to specific contexts and that additional transition approaches could be worth exploring. By designing flexible intro-transitions, we aim to reduce cognitive load, enhance user comfort, create group awareness and preserve social presence—all crucial factors in onboarding scenarios and multi-user virtual experiences.

3.4 Partial or Full Outro-Transitions

After full immersion in the virtual environment, users may need to return to mixed reality for various reasons. Novice users might struggle with forgotten controls or interface navigation, requiring external guidance. In such cases, cut-outs or transparent windows [25] between the instructor and the user can facilitate rich face-to-face communication without fully exiting the virtual experience. This allows for quick clarification while minimizing disruption.

For users who wish to fully exit, the transition should be smooth and seamless, preventing abrupt disconnection from the experience. Additionally, individual exits should be clearly indicated to other users to maintain continuity for those who remain in VR. However, during the mixed reality stage users should be instructed to wait for all other users such that they can take off the HMD at the same time to avoid collisions. Alternatively, users need to be guided towards a safe location where they can take off their HMD individually.

The design space of outro-transitions follows similar considerations as intro-transitions, balancing individual agency, group coordination, and spatial awareness to ensure a structured and intuitive transition back to mixed reality.

4 System Implementation

Based on the presented onboarding phases, we developed a multi-user Unity application for the Meta Quest 3 [1] using Netcode. To support the see-through capabilities required for our onboarding and group transitions (collective, sequential, and individual), we integrated the Meta XR Core SDK [29] and the Passthrough API. Additionally, we employed the Mixed Reality Utility Kit [30] with the Spatial Anchors API [31].

To ground the onboarding framework in a practical context, we chose a social museum scenario inspired by the need for group onboarding in cultural and educational settings. The scenario consists of two simple escape room-style tasks designed to foster collaboration and maintain users engaged in tasks while they experience the transitions. Our tasks include a two-handed scaling activity and a painting task involving a brush and a color palette. The virtual environment replicates a historical museum room of approximately 4.5 m x 4.5 m. A round table that originally stands in the room, can already be displayed in the see-through stage and served as a starting point for instructions and tutorials. We limited navigation to physical movement within the room since the virtual room was smaller than the workspace where the study was performed.

We chose VR controllers over hand tracking to provide haptic feedback. To keep interactions intuitive and accessible, the application only supports poke and grab actions (using only one button).

To maintain consistency across all transition modes, we used only one visual style based on a dissolve shader, accompanied by a magical theme to enhance the immersive quality of the transition. In the following sections, we present our group transition techniques in detail, along with parameter choices derived from a pilot study.

Figure 4: Different stages of the dissolve shader.

Figure 5: Two participants during the painting task.

4.1 Collective Transition

The collective transition aims to bring all group members into the virtual environment simultaneously, ensuring a synchronized start and maintaining group cohesion. Various triggering and control methods are available, including guide-controlled transitions, group consensus-based triggers or combinations of both. For our application, we selected an interactive approach that requires all users to touch a virtual object together.

This design choice aligns with the magical theme of our escape room setting and is inspired by the teleportation concept of the ”port key” from the Harry Potter series. We chose the round table at the center of the room as the transition trigger, since it remains visible in see-through mode. To guide users, we displayed a magical circle around the tabletop and provided a tooltip to indicate the interaction area. Additionally, when users placed their hands within the circle, the controllers started to vibrate to enhance the experience. The advantage of this interaction design is that all users can non-verbally communicate their readiness by placing their hands on the tabletop.

To maintain experimental control, the guide retained the ability to trigger the transition manually, ensuring that group entry into the virtual environment could be supervised and managed as needed. When the transition is triggered, the surfaces of virtual elements and avatars are gradually faded over period of four seconds, using a noise texture in the dissolve shader (see Figure 4).

4.2 Sequential Transition

Door or portal transitions are a well-established metaphor that has been evaluated in single-user studies [14, 19]. Since this transition naturally supports multiple users without requiring major adjustments, we included it as a baseline method. It provides a clear affordance and allows users to observe others as they transition, making it particularly suitable for multi-user settings.

To match the magical theme of our scenario, we selected a decorated door model with climbing vines. The placement of the door was controlled by the guide to ensure consistent positioning.

Once a user moved their head through the door, their avatar gradually dissolved over a period of four seconds. After all users have entered the virtual space through the door, the guide could close the door to end the transition.

4.3 Individual Transition

The individual transition offers users the highest level of agency but carries the risk of separating the group. To align with the magical theme of our experience, we provided each user with a small box that triggered the transition when opened. Similar to the other transitions, the dissolve process took four seconds and was accompanied by a particle effect. The guide controlled the appearance of the magic boxes, which were placed on the round table.

Since users can transition independently from one another, we implemented a system to maintain spatial awareness and prevent collisions. Users who had already transitioned into VR appeared as transparent avatars to those still in the see-through mode. Conversely, users who remained in mixed reality were represented as transparent avatars at their real-world positions for those already in VR. This visual feedback helped ensure that both groups could maintain awareness of each other’s locations.

4.4 Pilot Study

We tested our three transition implementations in a counterbalanced pilot study with six participants (three dyads) to verify the suitability of the transition parameters and ensure the robustness of the application. To match the number of tutorials with the number of transitions, we added a simple grab tutorial and an order task alongside the scaling and painting activities. However, we decided to exclude this task from the main study, as it did not provide a comparable level of engagement and risked influencing the transitions.

The pilot study yielded high usability scores according to the System Usability Scale (SUS) [11] and received positive feedback regarding both the tutorials and the transition methods. These results indicated that the application was running reliably and that the chosen transition parameters were well-received by users.

5 Evaluation Methodology

Our evaluation focused on assessing the qualities of the proposed onboarding framework and the group transition strategies. Two central research questions guided this evaluation:

- **RQ1**. Does our onboarding framework improve the introduction of collocated groups into VR?
- **RQ2**. Which group transition strategy is best suited for onboarding, and what are their respective advantages?

The following subsections describe the methodology used to evaluate our onboarding approach and to address these questions.

5.1 Experimental Setup

The study was conducted in a quiet computer lab with an open area of approximately $10\,\text{m} \times 5\,\text{m}$, allowing participants to move freely without requiring additional virtual navigation. Our standalone application was developed for the Meta Quest 3 using Unity 2022.3 and optimized to run at 72 Hz with the HMD’s native resolution ($4{,}128 \times 2{,}208$). The virtual environment featured a 3D reconstructed model of a historical museum room.

To represent users, we employed simplified avatars consisting of androgynous t-shirts, hand geometry, and heads wearing HMDs. To support user identification and facilitate collaboration, we provided participants with real t-shirts in bold red, blue, or yellow, ensuring their real-world appearance matched the color of their avatar's shirt. While private applications may offer avatar customization or reconstruction from images, such features are typically not feasible in public settings due to time constraints and privacy concerns. We believe our approach provides a quick and effective way for enhancing user recognition and social presence within the application.

5.2 Study Design

To systematically investigate our research questions, we conducted an empirical multi-user study. We employed a single-factor within-subjects experimental design, with *transition technique* as the central independent variable with four conditions: the three mixed reality group transitions—*Collective* (table-based), *Sequential* (door-based), and *Individual* (box-based)—as well as a *Put On* direct transition, which served as the baseline. Our experiment consisted of four runs in which three participants (triads) experienced each of the four transition conditions in a Latin square counterbalanced order.

Although the *Put On* condition differs considerably from the mixed-reality transitions, we included it as a baseline to represent the direct onboarding procedures commonly used in current museum-based VR experiences. Its inclusion was essential for identifying key differences and evaluating the added value of our framework.

We chose a museum-like setting to simulate a realistic onboarding scenario, as museum visits are typically social activities [2, 36] that require onboarding. To reflect the social and interactive nature of public VR experiences, our study required the participant triads to solve escape-room-inspired tasks.

5.2.1 Tasks

The selection of appropriate study tasks required careful consideration. We aimed for interactive tasks that could be split into a simple tutorial for the mixed reality phase and a gamified activity in VR. We initially debated between using four distinct tasks with increasing complexity or using two tasks of comparable difficulty. We selected two tasks with similar levels of difficulty to minimize confounding effects. This allowed us to attribute differences in user experience to the transition techniques rather than task complexity.

Using two tasks, additionally, allowed us to explain one tutorial in the Put On condition (unless presented last), before participants wore the HMDs, thus simulating a conventional onboarding flow and helping with the investigation of RQ1. The drawback of this approach was that each tutorial had to be repeated twice. Potential repetition effects are expected to cancel out across sessions due to the counterbalanced design of the study. With these risks in mind we selected the following two tasks consisting of short tutorials for mixed reality and activities for VR.

Scaling Task: We selected a two-handed *scaling* tutorial, accompanied by a corresponding "find and scale" activity within the virtual environment. In the see-through phase, the guide can initiate the tutorial by spawning various objects (e.g., a guitar, plant, or torch) on the table (see Figure 3a). Participants could move objects by grabbing them with one controller (using the grab button) and scale them by grabbing with both controllers and moving their hands apart. In the virtual environment, the guide could trigger the "find and scale" task, which rearranged objects from the room (such as paintings, furniture, and statues) onto the table in various sizes. Transparent outlines at the original object locations indicated where the miniaturized versions needed to be placed, as well as the correct target size. When participants successfully positioned and scaled an object to match its outline, an accomplishment sound was played together with a little confetti particle effect as feedback.

Painting Task: As a second task, we selected a two-handed *painting* activity, paired with a tutorial of similar structure and complexity. In the see-through phase, the guide could spawn three brushes and color palettes alongside several polyhedral objects on the table (see Figure 3b). Participants could grab a brush and a palette, and apply color to the objects by dipping the brush into the palette and touching the object. In the virtual environment, the guide could start the "guess and paint" task, in which various uncolored objects (such as a butterfly, lemon, and crystal) appeared. The participant triads were required to color these objects appropriately. Each paint interaction was accompanied by a sound cue and a small particle effect to provide visual and auditory feedback.

5.2.2 Measures

To investigate our research questions, we assessed eight subjective dependent variables: preference and helpfulness for RQ1 and overall rating, usability, co-presence, connectedness, continuity, and agency for RQ2. After each condition, participants completed questionnaires that captured these measures and qualitative feedback. **Overall rating** was reported on a 10-point scale, **usability** measured via the SUS [11], and **co-presence** using a scale from the Networked Minds Social Presence Inventory (NMSPI) [17]. **Continuity** was evaluated using items adapted from Husung and Langbehn [19]. **Connectedness** and **agency** were measured using custom 7-point Likert items: "This transition made me feel connected with my peers" and "How much control (agency) did this technique offer you?"

Although we initially planned to record task completion times, variability across group rendered this metric unsuitable for meaningful analysis. After completing all four conditions, participants filled out a final questionnaire, ranking the transitions from most to least preferred, explaining their top and bottom choices, and rating the helpfulness of mixed reality instructions on a 7-point Likert scale.

5.3 Procedure

Participants were welcomed to the laboratory and given a brief introduction to the study. They were informed about the purpose of the research, the data collection process, and their rights as participants, including the option to withdraw at any time. After signing a consent form, each participant was assigned a colored t-shirt to match their in-VR avatar, and the study session began.

Depending on the condition, all three participants were either instructed during the see-through stage or without wearing an HMD. In the see-through stage, the guide explained the controls, spawned the relevant tutorial, demonstrated the interaction once, and then continued to support participants as needed. In the Put On condition, controls were demonstrated in mid-air and explained verbally.

Once participants indicated that they were ready for the transition, the guide explained the upcoming task of the virtual environment and either described the transition procedure or distributed the HMDs, depending on the condition.

After the transition, participants collaboratively completed the assigned task. Once the task was completed, the transition was repeated a second time before participants filled out a questionnaire assessing their experience. The study concluded with a final comparison questionnaire and a brief demographics survey. The entire procedure, including all conditions and questionnaires, lasted between 50 and 70 minutes per session.

5.4 Participants

The study was conducted with 12 triads resulting in 36 participants (20 male, 16 female) aged between 20 and 37 years ($M = 27.77$, $\sigma = 4.09$) which allowed full counterbalancing of our within-subjects Latin square design. Participants were recruited through the university's mailing lists. In terms of prior VR experience, ten participants reported having none or minimal experience, 17 considered themselves regular to advanced users, and nine identified as VR experts. Regarding gaming habits, 14 participants reported no gaming background, 17 played occasionally, and five described themselves as frequent gamers. Participants received a compensation of 15 euro.

5.5 Hypotheses

Based on the goals defined in our onboarding design and the research questions outlined at the beginning of this section, we derived a set of hypotheses to guide our statistical analysis. The hypotheses reflect our expectations regarding the perceived effectiveness and user experience of each transition strategy. Specifically, we anticipated that our proposed transitions would receive higher ratings and usability compared to the baseline Put On transition. Moreover, we expected Collective to best support co-presence and connectedness.

H1. Overall rating will be lower for *Put On* transition.
H2. Usability (SUS) will be lower for *Put On* transition.
H3. Co-Presence will be higher for *Collective* transition.
H4. Connectedness will be higher for *Collective* transition.

Given that portal-based transitions have demonstrated strong continuity in prior works [19, 34, 41], we hypothesized that this would also be reflected in the Sequential transition. Finally, with regard to agency, we assumed that the Individual transition would be favored, as it offers users the most control.

H5. Continuity will be higher for *Sequential* transition.
H6. Agency will be higher for *Individual* transition.

6 RESULTS

In this section, we present the results of our study gathered from the questionnaires and open-ended feedback.

All participants ($N = 36$) completed each of the four conditions and experienced each transition twice. Questionnaires were administered after each condition, and the final ranking was completed once all conditions had been experienced. This resulted in 36 questionnaire responses per condition. To test our hypotheses, we conducted statistical analyses to examine whether there were significant differences between the transition techniques. We initially considered parametric testing but rejected this approach after Shapiro-Wilk tests indicated that the data were not normally distributed. Therefore, we used the non-parametric Friedman test to examine whether there were significant differences between the transition techniques. If significant effects were found, pairwise differences were assessed using Bonferroni-corrected Wilcoxon signed-rank tests ($p < .008$). The results are presented in Figure 6.

6.1 Preferences and Rating

Figure 7 shows how participants ranked each transition in the final questionnaire. Sequential received the most first-place rankings (16 out of 36). Collective and Individual were most often ranked second and third, while Put On was ranked last 28 times.

For overall rating (on a 10-point scale), Sequential achieved the highest mean score of 9.08 ($\sigma = 1.42$), followed by Collective with 9.00 ($\sigma = 1.43$), Individual with 8.86 ($\sigma = 1.46$), and Put On with 7.08 ($\sigma = 2.78$). A Friedman test revealed a significant effect of transition technique on rating ($\chi^2 = 20.76$, $p = .00012$). Post-hoc Wilcoxon signed-rank tests confirmed that all transitions were rated significantly higher than Put On (all $p < .001$). No significant differences were found between the three mixed reality transitions. We therefore accept **H1**.

6.2 Usability

The mean SUS scores indicated excellent usability for all mixed-reality transitions: Sequential (84.86), Collective (83.52), and Individual (81.99), with Put On (78.89) still falling within the "good" usability range [5]. A Friedman test revealed no statistically significant effect of transition technique on usability ($\chi^2 = 4.91$, $p = .178$). Consequently, we can not confirm **H2**.

6.3 Co-Presence and Connectedness

A Friedman test revealed an effect of transition technique on co-presence based on the six NMSPI items ($\chi^2 = 8.05$, $p = .045$), but no pairwise differences were statistically significant after Bonferroni correction. Thus, we cannot confirm **H3**.

For the connectedness question, a Friedman test revealed a significant effect of transition technique on perceived connectedness ($\chi^2 = 17.40$, $p = .00059$). Post-hoc tests showed that both the Collective ($W = 41.0$, $p = .00029$) and Sequential ($W = 48.0$, $p = .00268$) transitions were rated significantly higher than Put On. Additionally, Collective was rated significantly higher than Individual ($W = 42.0$, $p = .00499$). Since Collective scored significantly higher than both Put On and Individual, but not Sequential, our results provide partial support for **H4**.

6.4 Continuity

A Friedman test showed a significant effect of transition technique on continuity ($\chi^2 = 23.99$, $p = .00003$), based on three questionnaire items. Post-hoc tests showed that all mixed-reality transitions resulted in a significantly higher perceived continuity than Put On (all $p < .001$). No significant differences were found among the three group transitions themselves. These results provide partial support for **H5**, as all group transitions outperformed Put On, but none significantly outperformed each other.

6.5 Agency

Mean agency scores were identical at 6.22 for Put On ($\sigma = 1.38$), Sequential ($\sigma = 1.05$), and Individual ($\sigma = 1.20$), but lower for Collective at 5.28 ($\sigma = 1.86$).

A Friedman test revealed a significant effect of transition technique on agency ($\chi^2 = 8.54$, $p = .036$). Post-hoc tests showed that Individual was rated significantly higher than Collective in perceived agency ($W = 37.0$, $p = .00568$). Additional differences between Sequential and Collective ($W = 74.0$, $p = .02855$) and between Put On and Collective ($W = 56.0$, $p = .02082$) were notable but not significant. These findings provide partial support for **H6**.

6.6 Qualitative Feedback

To further assess the transitions, we analyzed and categorized the qualitative feedback from open-ended questions using axial coding.

Put On: Participants appreciated this transition for its ease of use (Comment Occurrence, CO = 11), its speed (CO = 8), and, in some cases, the sense of control it provided (CO = 4). Several also noted that directly entering VR enhanced the feeling of immersion (CO = 6). Participant Blue 7 (B7) remarked, this is "the default experience we usually have."

Five participants explicitly stated that they disliked this transition. Others found the transition too fast (CO = 8), describing it as "too harsh" or "abrupt." Several noted that the immediacy negatively affected immersion and made the space feel less realistic (CO = 8). Additional comments highlighted confusion (CO = 4) and that the process felt cumbersome (CO = 2). Participant Red 6 (R6) and Yellow 4 (Y4) also pointed out issues with avatars when other users removed their HMDs, stating that "If users remove their headset while I am still in the scene, their body geometry is messed up."

Collective: Participants praised the Collective transition for its immersiveness (CO = 13), describing it as "fluid," "seamless," and "less interruptive." It was also characterized as fun and engaging (CO = 10), with participants calling it "cool," "interactive," and "magical." The collaborative nature of the experience was particularly appreciated (CO = 7); for example, participant B9 described it as a "communal" activity, and Y12 noted, "It feels more connected to other participants when transferring to VR, as we have to put our hand in the same place." Additional positive comments highlighted the usefulness of haptic feedback (CO = 8) and the transition's ease of use (CO = 5), often described as "easy to follow" and intuitive.

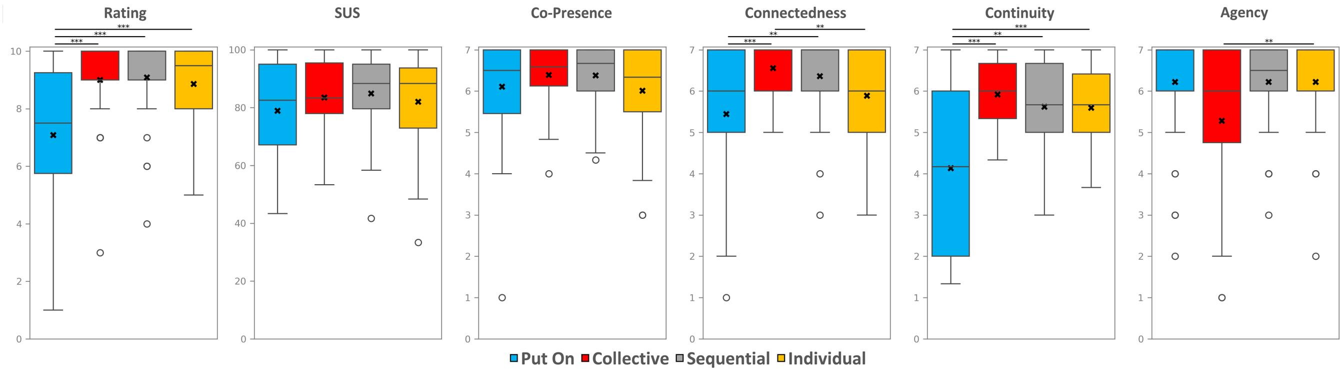


Figure 6: Box plots of our different measures.

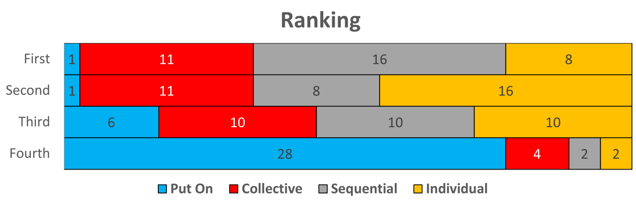


Figure 7: Transition preferences

In terms of negative responses, 17 participants expressed no criticism. Among the remaining feedback, some mentioned issues with the transition duration (CO = 6), describing it as too long, too short, or too slow. Others pointed to confusion or lack of clarity (CO = 5), a reduced sense of control (CO = 4), or felt that the magical theme was overly pronounced (CO = 3).

Sequential: This transition was praised for its realism and the seamless sense of continuity it provided (CO = 16). Participants also highlighted its naturalness and intuitiveness (CO = 4). Additional comments emphasized the ease of use (CO = 7), its interactivity (CO = 5), and the ability to observe others transitioning (CO = 3). A few participants noted unique aspects, such as the preview effect of the door, mentioned by Y6: "The door allowed me to visualize a different space before entering it." Similarly, R4 appreciated that one can "close the door on reality, it felt like magic. lovelyy [sic]."

As negative feedback, some participants mentioned the disappearance of the real body when walking through the door (CO = 5) and the delayed appearance of the virtual avatar. Others found the entry order unclear (CO = 2). Additional individual comments mentioned the single entry point (CO = 1), small door size (CO = 1), discomfort with walking (CO = 1), and excessive use of "magic" (CO = 1).

Individual: The individual transition was appreciated for its visual effects (CO = 10) and its fun, engaging style (CO = 8). It was also described as magical (CO = 5) and easy to control (CO = 7), with R8 stating, "Using a magic box made me feel I was in control and part of a story." The transition was further referred to as smooth (CO = 5), but few participants mentioned its realism (CO = 4).

On the negative side, ten participants reported no criticism. Among the remaining responses, some noted issues with avatar overlays (CO = 3), lack of group involvement (CO = 3), limited realism (CO = 2), and a sense of irreversibility (CO = 1). Three participants described that the style felt either excessive or insufficient (CO = 3).

6.7 Onboarding Observations

Due to counterbalancing, only three of the twelve groups began the study with the Put On condition. Interestingly, in all Put On sessions, at least one participant immediately struggled to engage with the task after putting on the HMD. This observation is supported by responses to the question "How helpful do you find receiving instructions through see-through displays?" which received a high average rating of 6.48 out of 7 ($\sigma = 0.74$), indicating strong agreement on the usefulness of instructions provided in the see-through stage.

7 Discussion

This study explored onboarding procedures for collocated groups entering virtual reality, with a focus on transition strategies that guide users from an intermediate mixed reality stage to full immersion. Our goal was to evaluate whether more gradual transitions, combined with an interactive learning phase, offer a more effective, usable, and socially cohesive onboarding process compared to traditional methods. In addition, we aimed to assess the strengths and trade-offs of different transition strategies.

7.1 Preferences and Diversity in Experiences

Overall, our findings strongly support the benefits of the proposed onboarding framework. All three transition techniques—Collective, Sequential, and Individual—were consistently rated more positively than the baseline Put On transition in terms of overall preference and subjective quality. These results confirm our first hypothesis (H1) and suggest that integrating a see-through phase and gradual transitions can significantly enhance the onboarding experience. This is further supported by the high rating for the helpfulness of receiving instructions in mixed reality (M = 6.48 out of 7).

However, when comparing the group transitions among each other, a more complex picture emerges. The Sequential transition was ranked first by nearly half of the participants (16 out of 36), while the Individual transition received the most second-place rankings (also 16), effectively swapping positions across the top two ranks (see Figure 7). In contrast, the Collective transition consistently received a third of the votes in both ranks which suggests that all transitions were highly valued, but appealed to different user preferences. These varied preferences, along with occasionally contradictory subjective feedback, indicate that personal preference and subtle design factors (such as timing, pacing, or visual effects) can strongly shape how transitions are perceived. This observation underscores the importance of tailoring group transitions to specific scenarios and their intended user experience, aligning with Whittaker's [48] argument that onboarding processes should be adapted to support particular experiential goals.

7.2 Usability and Co-Presence

In terms of usability, all transitions showed scores within the high and "excellent" range. However, no significant differences were found among the conditions (H2 not confirmed). This indicates that while users found all transitions easy to use, usability alone may not fully explain their preferences.

Since multi-user onboarding and group transitions have not been systematically investigated before, we were particularly interested in assessing co-presence in our study. While the co-presence scores were high across conditions, the relatively large standard deviations of Put On and Individual suggest that certain transition paradigms may favor social presence more than others. However, the observed differences were not statistically significant, thus not confirming H3.

Notably, this trend was reflected more clearly in the connectedness measure, which showed significant differences between conditions. Both the Collective and Sequential transitions outperformed Put On, and Collective also significantly outperformed Individual, providing partial support for H4. These results suggest that although co-presence may remain relatively stable, transitions involving shared, observable or synchronous interactions can enhance participants' sense of social connection.

7.3 Continuity and Agency

Continuity also emerged as an important factor in transition quality. All three mixed reality transitions were perceived as significantly more continuous than Put On, supporting prior work [34] on the role of gradual transitions in enhancing immersion. While Sequential did not significantly outperform the other two, its high scores are consistent with prior findings on portal-based transitions.

Finally, we observed significant effects on agency, with the Individual transition rated higher than Collective. This reflects a trade-off between individual control and group coordination. While the Collective approach fostered a shared experience, it may have reduced perceived user autonomy. Given the mixed pattern of results, we found partial support for H5 and H6.

7.4 Recommendations for Multi-User Onboarding

The results of our study support several of our initial assumptions and motivate us to emphasize three key design recommendations for onboarding procedures in collocated multi-user settings, particularly in public or social contexts.

First and foremost, we strongly recommend incorporating a mixed reality see-through stage and initiating onboarding by having users put on the HMD and enter mixed reality directly. Although prior work advocates for instructing users in the 'tangible realm' [7], our results clearly indicate that users prefer interactive instructions delivered through tutorials in mixed reality. We believe that our approach reduces the "wow effect," and gives users time to adjust to the hardware and situation before entering full immersion. It also facilitates the integration of shared responsibility between instructors and learners, as emphasized by Bimberg et al. [9]. It may also reduce cognitive load and improve task readiness in multi-user settings.

Second, the varying preferences for the Sequential, Collective, and Individual transitions indicate that no single transition strategy is universally suitable for all users or contexts. Instead, onboarding systems should be tailored to the intended user experience [48], offering multiple transition modes or allowing users or instructors to select the most appropriate strategy based on group composition, familiarity with VR, and desired social dynamics. In particular, we argue that agency and control should be aligned with user experience, offering greater autonomy to more experienced users, while guiding novices through more structured, instructor-led transitions.

Third, the higher connectedness scores of the group transitions (Collective and Sequential) highlight the importance of designing for social cohesion in group onboarding. Transitions that involve others or allow users to observe peers during their transitions may strengthen group presence, shared immersion, and support learning.

7.5 Limitations and Future Work

While our study offers valuable insights, several limitations should be acknowledged. First, the combination of studying group transitions, multi-user onboarding, and co-presence made it difficult to include a repeatable, performance-based task suitable for within-subject comparison. Group dynamics and tutorial-related learning effects further limited the use of objective metrics. As a result, our study is limited to subjective measures. Future studies should quantitatively investigate whether the timing of learning instructions—before, during, or after transitioning into VR—affects instruction recall and cognitive load. A deeper understanding of how shifts in learning context [15], the style and complexity of transitions, and phenomena such as the doorway effect [37, 46] influence cognitive performance is essential for designing effective onboarding procedures in virtual environments.

A second limitation is that we only investigated intro transitions using a single visual style (e.g., magical elements, dissolve shaders), which may have influenced participants' preferences, despite the techniques being carefully designed and thematically consistent. Future research could explore how different aesthetic styles or transition metaphors affect perceived usability, presence, and engagement, and should also investigate outro-transitions [18], as individual exits can pose risks in collocated settings due potential collisions.

Third, although we accounted for users' prior VR experience in our analysis, the study did not systematically vary this factor. Similarly, we kept group size constant, limiting insights into how it might influence onboarding dynamics. Future research could explicitly compare novice and expert users, as well as different group sizes, to better understand how onboarding needs differ and how transition strategies should be adapted accordingly.

Finally, a practical limitation of our implementation of the onboarding framework is that applications must be launched and configured before HMDs are handed to users. Future work should explore more scalable technical solutions to streamline this process in public and multi-user settings.

8 Conclusion

Just like in the real world, virtual reality relies on meaningful social interactions to realize its full potential. While substantial effort has gone into developing immersive multi-user applications, the crucial step of bringing everyone on board has largely been overlooked. Our novel VR onboarding framework for collocated multi-user scenarios, leverages a mixed reality see-through stage and supports three different group transition strategies–Collective, Sequential, and Individual. Through a user study with 36 participants, we evaluated the effectiveness of our approach in terms of preference, usability, co-presence, connectedness, continuity, and agency.

Our results show that all three proposed group transition techniques were preferred over the traditional Put On approach, with the Sequential and Collective transitions being particularly well received. While usability scores were high across all conditions, we observed a trade-off between perceived connectedness and agency. The Collective transition resulted in significantly higher connectedness compared to Individual and Put On, whereas the more self-controlled transitions (Individual and Put On) were rated significantly higher in terms of perceived agency than Collective.

We conclude that incorporating a see-through onboarding phase and offering flexible transition options can improve the onboarding experience for collocated groups entering virtual worlds. This work contributes a group transition framework and design recommendations, which promote further research on collaborative onboarding in social virtual reality.

Acknowledgments

This work is funded by the German Federal Ministry of Research, Technology and Space (BMFTR) under grants 16SV9200 (project BPL) and 16SV9086 (project GROOVE). Lastly, we would also like to sincerely thank all participants for their time and engagement in our user study.

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