Exploring How Purpose of Activities Shapes Older Adults' Engagement with Extended Reality

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Abstract

As extended reality (XR) systems are increasingly used to support activity, participation, and play in later life, it is important to understand how older adults make sense of these experiences beyond usability alone. Engagement with XR may depend not only on activity design, but also on how users understand the purpose of the activity. In this ongoing study, we observed three older adults across six weeks of gameplay with two XR experiences: a mixed reality (MR) exergame centered on exercise and movement, and an augmented reality (AR) game centered on entertainment and leisure. We explored how participants interpreted effort, difficulty, success, frustration, and continued participation across these contexts. Preliminary findings suggest that activity purpose may have influenced how participants made sense of XR affordances. In the wellness context, bodily effort and movement feedback appeared to support purposeful participation by connecting gameplay to health maintenance and bodily capability. In the leisure context, interaction barriers seemed more salient when they disrupted enjoyment, control, and successful play. These early findings point to the relationship between effort, affordances, and activity purpose as a useful direction for understanding older adults' motivation and meaning-making for XR.

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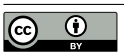

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1 Introduction

Extended reality (XR) technologies are increasingly being explored for older adults across health, rehabilitation, cognitive engagement, social participation, and entertainment contexts [7, 8, 13, 20]. However, older adults' engagement with XR cannot be understood only through usability, novelty, or game quality [2, 10, 18]. XR often requires users to coordinate bodily movement, spatial attention, device handling, social visibility, and unfamiliar interaction techniques. These affordances and demands may be interpreted differently depending on what users understand the activity to be for [2, 11]. This is especially important in later life, where technology use may be evaluated in relation to broader concerns such as mobility, independence, confidence, bodily capability, and meaningful participation [10, 11]. Building on the prior work, the research question we are looking to answer is the following:

How does the stated purpose of XR gameplay shape older adults' interpretations of effort, interaction barriers, and engagement across wellness and leisure contexts?

In this ongoing study, we observed three older adults (aged 65 and older) across six weeks of weekly gameplay with two XR experiences introduced under different activity purposes: a mixed reality (MR) exergame centered on exercise and movement (*ARWell Pro*), and an augmented reality (AR) game focused on entertainment or leisure (*Angry Birds AR*). We examined how participants approached each activity, interpreted difficulty, responded to success and failure, and made sense of the purpose of each XR experience over time.

Our preliminary findings suggest that activity purpose may shape how older adults interpret XR gameplay and its affordances. In the wellness context, bodily effort and movement feedback appeared to support purposeful participation by connecting gameplay to health maintenance and bodily capability. In the leisure context, interaction barriers seemed more consequential when they disrupted enjoyment, control, and successful play. These early patterns suggest that older adults' XR engagement may depend not only on system design, but also on how XR affordances are interpreted in relation to what users understand the activity to be for.

2 Background

2.1 XR and Older Adults

Researchers are increasingly exploring how XR, including AR and MR, can create interactive experiences for older adults across health, rehabilitation, social, cognitive, and leisure contexts [7, 8, 13, 20]. These technologies can make activities more interactive by combining digital content with movement, feedback, and playful environments [4, 16]. However, older adults' XR experiences are shaped not only by novelty, enjoyment, or general usability, but also by whether the interaction feels comfortable, understandable, and sustainable [11, 12]. This is important because older adults may bring diverse movement ranges, visual needs, technology experiences, and levels of confidence into XR environments.

2.2 Purpose Framing in XR Experiences

XR experiences are shaped not only by their technical features but also by how they are introduced, explained, and understood [10, 18]. The stated or implied purpose of an XR activity may guide users' expectations and shape how they interpret the experience [14]. This relationship is especially important in XR because participation often involves coordinating bodily movement, spatial attention, virtual objects, sensor-based feedback, and device-mediated interaction [5, 19]. How users understand an XR activity's purpose may shape how they interpret difficulty, effort, success, and whether continued participation feels worthwhile [2, 6, 17].

Prior works discussed in 2.1 and 2.2 suggest that XR holds promise for older adults, but less is known about how the stated purpose of XR activities shapes older adults' motivation and meaning-making during use. Existing work often emphasizes usability, engagement, health outcomes, or enjoyment, while less attention has been paid to how older adults interpret XR affordances in relation to what they understand the activity to be for.

3 Method

The study included six weekly gameplay sessions. In each session, participants played both *ARWell Pro* (exergame) and *Angry Birds AR* (entertainment/leisure game). Every other week, they also participated in a focus group discussion. In total, participants completed six gameplay sessions and three focus group discussions.

3.1 Participants

Following Institutional Review Board (IRB) approval, we partnered with a local senior center that offers recreational and social programs for older adults. After discussing the goals and study structure with the center staff, the center agreed to support recruitment and host the study sessions. We were provided with a space with a television display that was made available so that participants could complete the activities in a group setting while seated. Recruitment materials were posted within the facility, and a sign-up form was placed at the front desk. The form asked interested people to provide their names and phone numbers. Eligibility criteria required participants to be at least 65 years old and willing and able to take part in light seated activities, hold a tablet in their hand, and interact with it with the other hand.

Three people signed up for the study. We contacted them with the date and time of the first session and the subsequent sessions and began the study in a group-based setting as scheduled. At the beginning of the first session, participants reviewed and signed an informed consent form describing the study purpose, activities, data collection procedures, and compensation options. They could choose either a one-year paid subscription to *ARWell Pro*, valued at $99.99, or an $80 gift card. Participants also completed a brief demographic questionnaire about age group, comfort with smartphones or tablets, experience with digital games and AR/MR, and any physical, vision, hearing, or movement-related concerns that could affect participation. Additional participant information is reported in Table 1.

3.2 Probes

In this study, we used *ARWell Pro* [1], a tablet-based exergaming system that guides users through individual movement activities with on-screen instructions. Although *ARWell Pro* is intended for solo tablet use, we mirrored the tablet display on a larger screen so participants could view the activities more clearly and engage in the sessions within a group setting. The system offers more than 52 activities; however, for safety reasons, we selected only activities that could be completed while seated. This resulted in a set of 24 seated activities that primarily involved upper-body movements, including the arms, shoulders, neck, and head. Before each activity began, the system performed a body scan and then used motion-tracking technology to detect participants' movements during gameplay.

For the entertainment context, we used *Angry Birds AR* [15], a single-player augmented reality game presented from a first-person perspective. We selected the game because it offers a relatively accessible introduction to AR gameplay. Players begin by using a smartphone or tablet camera to scan their surroundings and identify a suitable flat, textured, and non-reflective surface for placing the virtual environment. The game provides visual guidance through on-screen prompts and an indicator bar showing whether the surface is appropriate. Once the AR island and wooden tower are placed, players locate pigs within the structure and use a slingshot mechanic to launch birds at the towers, aiming to knock them down and progress through levels. Although *Angry Birds AR* can be played by physically moving around the 3D objects or using on-screen buttons to rotate the view 360°, we instructed participants to use the buttons so they could play while seated. The complete list of study activities is provided in Table 2 in Appendix A.

3.3 Procedure

In each weekly session, participants first completed three seated *ARWell Pro* activities of their choice. They were given a printed list of available seated activities, excluding those that required standing, and could decide both the activities and the order of participation. Participants sat facing a large TV screen with enough space between seats to move their arms comfortably during gameplay. The tablet was placed on a stand between the participants and the TV, allowing it to track the upper-body movements of the participant currently playing. We repositioned the tablet as needed to capture

Table 1: Demographic Information of Participants.

Participants codename	Age group	Gender	Comfort with using smartphones or tablets	Experience with digital games	Experience with AR/MR	Physical, vision, hearing or movement -related concerns
P01	75-79	Female	Somewhat	A little	None	Some
P02	75-79	Female	A little	None	None	Some
P03	75-79	Female	Not at all	None	None	A little

one participant at a time. While the tablet tracked the active participant's movements, its display was mirrored on the TV, allowing the rest of the group to observe the gameplay. The first author facilitated the sessions by supporting activity selection, adjusting settings, resolving scanning issues, and clarifying instructions when needed.

After completing the exergame activities, participants played *Angry Birds AR*. Because the tablet was connected to the TV by wire, we placed a chair near the screen, and participants took turns playing while seated. As with the exergame, the mirrored display allowed the rest of the group to observe the active player's gameplay. Each participant was given up to three attempts, with three birds per attempt, or continued until they completed three consecutive levels. We recorded the levels completed by each participant in our research notes. Figure 1 in Appendix B illustrates the seating arrangements for both *ARWell Pro* and *Angry Birds AR*.

We conducted focus group discussions during Weeks 2, 4, and 6 to capture participants' experiences, challenges, accessibility concerns, and desired improvements over time. The biweekly focus group schedule allowed participants sufficient time to develop familiarity with the games and reflect meaningfully on their experiences, while minimizing the risk of fatigue or redundancy across sessions. The semi-structured format also allowed us to ask follow-up questions based on participants' comments and our observations during gameplay.

Throughout the six-week study, we took observational notes during each session. With participants' consent, we also audio- and video-recorded the gameplay and focus group discussions.

3.4 Data Analysis

We prepared the session data by transcribing and cleaning the audio recordings, then cross-checked the transcripts against our observational notes to contextualize participants' actions and comments. The research team read through the materials several times to become familiar with participants' gameplay interactions, reported experiences, and recurring patterns. We began the analysis with in vivo coding [9] to retain participants' own wording and interpretations, and then used reflexive thematic analysis (RTA) [3] to develop higher-level themes across the dataset.

4 Findings

Across six weeks of observation, we found preliminary evidence that older adults' engagement with XR gameplay was shaped not only by game design, but also by how each activity was framed. The MR exergame was introduced as exercise, while the AR game was introduced as entertainment. This distinction appeared to shape participants' expectations and how they interpreted effort, difficulty, and success.

Participants tended to approach the MR exergame as a wellness activity rather than only as a digital game. Because exercise is commonly associated with maintaining mobility, strength, and well-being in later life, physical effort in the MR exergame seemed easier to interpret as meaningful. Physical barriers (e.g., unstable shoulders), imperfect movement, or partial success did not necessarily reduce engagement because participants understood the activity as beneficial for the body. As P03 noted:

> "I did not realize I had been moving for that long. But you can definitely feel it in your arms." [P03]

Similarly, P02 explained:

> "As long as I am getting some movement with it, I am good." [P02]

In this context, XR may have become meaningful because it offered participants a way to move, test what their bodies could do, and participate in a socially supported exercise setting.

In contrast, the AR game was framed as leisure and appeared to be evaluated more directly through fun, ease, and control. Participants enjoyed moments of success, such as clearing levels or hitting targets. However, when they had issues with device handling, aiming, screen visibility, or unclear game mechanics, frustration became more consequential. P01 described the physical burden of the handheld setup:

> "I think holding the tab [for playing the game] is the biggest issue for me, as my left shoulder is not that stable." [P01]

These early observations suggest that XR's affordances may be interpreted through the purpose of the activity. In the wellness context, bodily effort and movement feedback appeared to support purposeful participation, while in the leisure context, enjoyment depended more on control, clarity, and successful interaction.

5 Discussion and Limitations

Our preliminary findings suggest that the stated purpose of XR activities may shape how older adults evaluate and continue engaging with the technology [10, 11]. XR interaction often involves bodily movement, device handling, spatial interpretation, unfamiliar controls, and social visibility [19, 20]. For older adults with diverse physical abilities, technology experiences, and comfort levels, these demands may be evaluated in relation to later-life concerns such as staying active, maintaining confidence, preserving independence, managing bodily changes, and participating meaningfully with others [10, 11]. As a result, the value of XR activities may depend not

only on what the system allows users to do, but also on what they understand the activity to be for.

Our findings also point to the importance of considering how XR affordances are interpreted within specific activity contexts. Movement, feedback, challenge, and social visibility are not inherently motivating or challenging; their meaning may shift depending on the purpose attached to the experience. In the wellness context, bodily effort and imperfect performance could be understood as part of doing something beneficial, making difficulty more acceptable. In the leisure context, interaction barriers seemed more disruptive because they interfered with the activity's expected source of value: enjoyment, control, and successful play.

These claims should be interpreted as preliminary. Our analysis is based on three older adults in one community-based group setting, where facilitator support and peer observation may have shaped participants' motivation and sensemaking. In addition, activity purpose and XR modality were intertwined: the wellness-oriented activity was also a hands-free MR exergame, while the leisure-oriented activity was a handheld AR game. Therefore, we do not claim that activity purpose alone explains participants' responses. Rather, our findings suggest that stated purpose operated within specific XR configurations to shape expectations, interpretations of effort, and willingness to persist.

6 Conclusion and Future Work

In this ongoing study, we examined how older adults engaged with two XR gameplay experiences introduced under different stated purpose: an MR exergame framed around exercise and movement, and an AR game framed around entertainment. Our preliminary analysis suggests that activity purpose may have shaped how participants interpreted effort, difficulty, success, and continued participation. In the wellness context, bodily effort and movement feedback appeared to support purposeful participation by connecting gameplay to health maintenance and bodily capability. In the leisure context, interaction barriers seemed more consequential when they disrupted enjoyment, control, and successful play. These early findings suggest that older adults' XR engagement may depend not only on usability or game design, but also on how XR affordances are interpreted in relation to what users understand the activity to be for. Future work will extend this analysis to examine how activity purpose interacts with social participation, physical comfort, technology confidence, and XR modality over time. We also plan to include more participants across multiple groups to explore whether these patterns hold across different older-adult populations and settings. More broadly, future work should investigate how different ways of introducing XR activities shape older adults' motivation, meaning-making, and willingness to adopt XR in everyday and community-based contexts.

References

[1] Augment Therapy. n.d.. ARWell Pro. https://www.augmenttherapy.com/arwellpro. Accessed: 2025-06-01.

[2] Yesoda Bhargava and Veeky Baths. 2024. Experience of youths and older people with virtual reality games for cognitive assessment: Inductive thematic analysis and insights for key stakeholders. *JMIR XR and Spatial Computing (JMXR)* 1 (2024), e59197. doi:10.2196/59197

[3] Virginia Braun and Victoria Clarke. 2012. Thematic analysis. (2012).

[4] Joanne Carroll, Louise Hopper, Aaron Mark Farrelly, Richard Lombard-Vance, Panagiotis D Bamidis, and Evdokimos I Konstantinidis. 2021. A scoping review of augmented/virtual reality health and wellbeing interventions for older adults: redefining immersive virtual reality. *Frontiers in Virtual Reality* 2 (2021), 655338. doi:10.3389/frvir.2021.655338

[5] Yumiao Chen and Ying Hu. 2025. Ergonomics evaluation of gestures interaction for the elderly in extended reality. *International Journal of Industrial Ergonomics* 107 (2025), 103749. doi:10.1016/j.ergon.2025.103749

[6] Lee Cheng, Wing Yan Jasman Pang, and Anthony Kong. 2025. A virtual reality game for older adults' immersive learning: L. Cheng et al. *Scientific Reports* 15, 1 (2025), 22195. doi:10.1038/s41598-025-07354-2

[7] Michael Joseph Dino, Chloe Margalaux Villafuerte, Justin Pimentel, Patrick Tracy Balbin, Joyline Chepkorir, Janet Lopez, Gerald Dino, Ma Lucita Alonzo, Aura Ydda Alyne Tuiza, Dan Lester Bacalzo, et al. 2026. Gamification features in extended reality applications for health of older adults: a systematic review. *BMC Digital Health* 4, 1 (2026), 26. doi:10.1186/s44247-026-00262-z

[8] Soraia Ferreira, José Marmeleira, Jesus Del Pozo Cruz, Nilton Leite, Alexandre Bernardino, Ana Moradell, and Armando Raimundo. 2025. Effects of an exercise program with augmented reality on functional fitness and physical activity of community-dwelling older adults. *Frontiers in Sports and Active Living* 6 (2025), 1447866. doi:10.3389/fspor.2024.1447866

[9] Ajay Gupta. 2024. Codes and coding. In *Qualitative methods and data analysis using ATLAS. Ti: a comprehensive researchers' manual*. Springer, 99–125. doi:10.1007/978-3-031-49650-9_4

[10] David Healy, Aisling Flynn, Owen Conlan, Jenny McSharry, and Jane Walsh. 2022. Older adults' experiences and perceptions of immersive virtual reality: systematic review and thematic synthesis. *JMIR serious games* 10, 4 (2022), e35802. doi:10.2196/35802

[11] Marjan Hosseini, Roanne Thomas, Lara Pilutti, Pascal Fallavollita, and Jeffrey W Jutai. 2024. Acceptance of physical activity virtual reality games by residents of long-term care facilities: A qualitative study. *Plos one* 19, 6 (2024), e0305865. doi:10.1371/journal.pone.0305865

[12] Yijun Li, Irina Shiyanov, and Beate Muschalla. 2024. Older adults' acceptance of a virtual reality group intervention in nursing homes: Pre-post study under naturalistic conditions. *JMIR Human Factors* 11 (2024), e56278. doi:10.2196/56278

[13] Jennifer A Margrett, Kaitlyn M Ouverson, Stephen B Gilbert, L Alison Phillips, and Neil Charness. 2022. Older adults' use of extended reality: a systematic review. *Frontiers in Virtual Reality* 2 (2022), 760064. doi:10.3389/frvir.2021.760064

[14] Chinenye Ndulue and Rita Orji. 2025. The impact of persuasive framing on the perceived effectiveness of a game for behaviour change. *International Journal of Human–Computer Interaction* 41, 8 (2025), 4873–4887. doi:10.1080/10447318.2024.2355390

[15] Rovio Entertainment Oyj. 2019. Angry Birds AR: Isle of Pigs. Apple App Store. https://apps.apple.com/us/app/angry-birds-ar-isle-of-pigs/id1456120259 Version 1.1.2, updated August 9, 2019.

[16] Xiacheng Song, Nazlena Mohamad Ali, Mohamad Hidir Mhd Salim, and Muhammad Yudhi Rezaldi. 2025. A literature review of virtual reality exergames for older adults: enhancing physical, cognitive, and social health. *Applied Sciences* 15, 1 (2025), 351. doi:10.3390/app15010351

[17] Carolina Wannheden, Terese Stenfors, Andreas Stenling, and Ulrica von Thiele Schwarz. 2021. Satisfied or frustrated? A qualitative analysis of need satisfying and need frustrating experiences of engaging with digital health technology in chronic care. *Frontiers in public health* 8 (2021), 623773. doi:10.3389/fpubh.2020.623773

[18] Raelene Wilding, Barbara Barbosa Neves, Jenny Waycott, Evonne Miller, Tabitha Porter, Jacqueline Johnston, Wendy James, Stefany Brajanovski, Josephine Wilson, Steven Baker, et al. 2024. Introducing virtual reality to older adults: a qualitative analysis of a co-design innovation with care staff. *Archives of gerontology and geriatrics* 125 (2024), 105505. doi:10.1016/j.archger.2024.105505

[19] Zhiqing Wu, Duotun Wang, Shumeng Zhang, Yuru Huang, Zeyu Wang, and Mingming Fan. 2024. Toward Making Virtual Reality (VR) More Inclusive for Older Adults: Investigating Aging Effect on Target Selection and Manipulation Tasks in VR. In *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems* (Honolulu, HI, USA) *(CHI '24)*. Association for Computing Machinery, New York, NY, USA, Article 24, 17 pages. doi:10.1145/3613904.3642558

[20] Dezijian Zhou, Anastasia Globa, and Rebecca McLaughlan. 2025. A Systematic Review of XR, Spatial, and Physical Interaction in Remote Communication for Emotional Well-Being in Older Adults. In *International Conference on Human-Computer Interaction*. Springer, 427–448. doi:10.1007/978-3-031-92707-2_28

A Details of Activities

Activity Name	Description
Air Writing	The player uses hand movements to draw a chosen letter, number, or shape in the air. They can complete the activity with either arm, depending on their preference.
Arm Circles	The player completes arm circles in both forward and backward directions using one or both arms. They can adjust the length of each direction, such as 15, 30, 45, or 60 seconds, and choose a repetition count between 1 and 30.
Ball Pit	The player moves their arms, head, and upper body to guide a virtual avatar toward golden balls within a 60-second period. Leaning to the left or right allows them to shift the avatar sideways.
Candy Town	The player uses seated upper-body movements to guide their virtual avatar through a town and collect candy. Up and down motions with the arms move the avatar forward, while rotating the neck from side to side changes its direction within the MR environment.
Color Ball	The player uses one or both arms to reach for colored balls that matched the ball held in each hand within a 60-second period. They can shift their digital avatar by leaning from side to side and select the ball speed, such as slow, medium, or fast.
Cookie Ball	The player moves a virtual avatar by leaning from side to side and attempts to strike airborne targets before time ran out. They can choose the difficulty setting, such as easy, medium, or hard.
Deep Breathing	The player follows an on-screen shape, such as an infinity symbol, triangle, square, or star, while synchronizing their arm movement with guided breathing. They are able to select which arm they prefer to use.
Fetch	The player uses either their left or right arm to toss a virtual ball for "Olo", a puppy-like character, to fetch. They can select the number of throws, from 1 to 10.
Grover's Dance Party	The player completes open-ended movements and is invited to move in whatever way felt comfortable to them. They can set the activity length between 1 and 4 minutes.
IWall	The player shifts their avatar by leaning from side to side and uses hand movements to remove balls before they accumulate at the top of the screen.
Memory Cards	The player uses one or both hands to turn over virtual cards and identify matching pairs. They can select the card set size, such as 4, 8, 12, or 16 cards.
Music Mayhem	The player uses arm movements to reach for moving horns and guitars while avoiding cats. They can set the activity length between 1 and 4 minutes.
Nature Hike	The player moves through a virtual nature setting using the same interaction mechanics as *Candy Town*. Rather than collecting candy, they gather coins and can set the activity length between 1 and 4 minutes.
Obstacle Course	The player leans from side to side to guide a virtual avatar while avoiding obstacles. Each player begins with three lives and loses one whenever they collide with an obstacle. As in *Skiing* and *Surfing*, players can regain lost lives by surviving long enough.
Pickleball	The player guides a virtual avatar by leaning from side to side while competing against a virtual opponent, with the goal of reaching 11 points first.
Pins	The player leans from side to side to aim their avatar and uses a throwing motion to knock down as many virtual bowling pins as possible.
Sequencing Tasks	The player uses one arm to arrange virtual cards in the correct sequence for everyday tasks. They can choose how to move the cards, such as using a hand, finger, or grasp interaction, and select from tasks such as preparing a sandwich or cereal, cooking eggs or a hamburger, brushing teeth, grocery shopping, doing laundry, folding clothes, or getting dressed.
Shoulder Abduction	The player lifts and lowers one or both arms to uncover a new image on the screen. They can decide whether to use a single arm or both arms and set the number of repetitions between 1 and 30.
Shoulder Flexion	The player moves one arm at a time upward and downward in front of their body. They can choose the left arm, right arm, or both arms, and set the number of repetitions.
Skiing	The player guides a virtual avatar by leaning from side to side, moving between flags while avoiding obstacles. Each player begins with three lives and loses one whenever they fail to pass through a set of flags. They can also gain their lives back if they manage to sustain in the game long enough.
Snow Globe	The player leans from side to side to generate a snowstorm within a virtual snow globe.
Star Catcher	The player uses arm movements to steer a flying virtual avatar through hoops before time runs out. Lifting their arms moves the avatar upward, lowering their arms moves it downward, and angling their arms left or right adjusts its direction.

Surfing	The player leans from side to side to steer a virtual surfer, collects hearts, and avoids sharks. Each player starts with three lives and loses one whenever they collide with a shark. As in *Skiing*, players can regain lost lives by staying in the game long enough.
Touch A Fish	The player moves their arms from side to side to reach and touch sea creatures and bubbles within a virtual aquarium. They can set the activity length between 1 and 4 minutes.

Table 2: Overview of the MR exergaming activities used in the study.

B Participants' Seating Arrangements

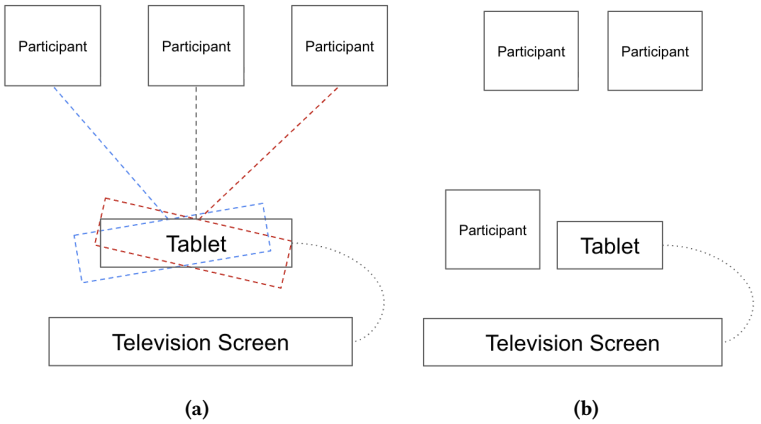

Figure 1: Seating arrangements used during the study sessions. (a) For the *ARWell Pro* exergames, participants sat facing the television screen while the tablet was placed between the group and the screen to track the active participant's upper-body movements. The tablet was repositioned as needed to capture one participant at a time, and its display was mirrored on the television so the group could observe gameplay. (b) For *Angry Birds AR*, participants took turns playing from a seated position near the television while the tablet display was mirrored for group viewing.