Case Report

A Case Series of Virtual Reality-Based Social Interactions for Adolescents with Psychiatric Disorders in a Television Program: Insights from NHK's Project Aliens

Junichi Fujita[1], Mizuho Takayama[1], Emi Kamono[2], Satoru Shinoda[2], Hiroyuki Yamaguchi[3], Tomoko Moroga[1], Mio Ishii[1], Tomoyuki Miyazaki[4]

1. Department of Child Psychiatry, Yokohama City University Hospital, Japan; 2. Department of Biostatistics, Graduate School of Medicine, Yokohama City University, Japan; 3. Department of Psychiatry, Yokohama City University, Japan; 4. Center for Research and Industry-Academia-Government Collaboration, Yokohama City University, Japan

Background: Virtual reality (VR) technology is emerging as a tool in mental health care, providing a safe space for social interaction and therapeutic engagement. A social VR-based TV program broadcast on Japanese public television offers a virtual environment where adolescents with mental health challenges can engage in peer support using alien avatars, reducing barriers to communication and encouraging emotional expression.

Objective: This case series aimed to document the psychological trajectories of adolescents with psychiatric disorders participating in a social VR-based television program.

Methods: A single-center case series was conducted with three adolescents with psychiatric disorders (aged 15, 18, and 19) who participated in the social VR-based TV program. The study focused on examining patient-reported outcomes (including psychological measures and qualitative experiences) and clinical observations across program participation and broadcast viewing. Psychological measures, including the Japanese versions of the UCLA Loneliness Scale, the Resilience Scale, and the Patient Health Questionnaire-9, were assessed at three time points: baseline, pre-broadcast, and post-broadcast. Qualitative analysis of participant dialogue explored themes of self-disclosure, emotional expression, and social dynamics.

Results: Participants showed improvements in loneliness, resilience, and depressive symptoms after participating in the social VR program, as indicated by psychological measures and patient-reported

 doi.org/10.32388/730TBA.2

outcomes. Qualitative analysis suggested that the structured facilitation embedded in the program enabled participants to express positive and negative emotions, promoting self-reflection and mutual support.

Conclusions: This case series suggests that structured social VR programs can provide a supportive platform for emotional exploration and psychological growth among adolescents with psychiatric disorders. The combination of avatar-based interaction and therapeutic facilitation may offer a novel approach to engaging young people in mental health care, particularly during waiting periods for traditional psychiatric services.

Corresponding author: Junichi Fujita, jun1182@yokohama-cu.ac.jp

Introduction

Virtual reality (VR) technology has emerged as an innovative therapeutic tool in mental health care, particularly for individuals with social anxiety, depression, and related conditions[1]. While VR-based exposure therapy and cognitive behavioral interventions have been well-documented[2], VR environments are increasingly being utilized as therapeutic spaces providing safe gathering places for group therapy settings or social skill training for individuals with mental health challenges. However, the therapeutic potential of social VR environments—spaces where users can interact through avatars—remains largely unexplored[3][4]. In Japan, various VR-based social participation programs have been implemented, notably addressing school refusal—a significant educational challenge in which students do not or cannot attend school due to psychological, emotional, physical, or social reasons, excluding illness, financial difficulties, or COVID-19-related concerns—affecting over 240,000 students in 2021[5].

Building on these developments, Japan's public broadcaster (NHK) developed *Project Aliens*, an innovative television program that provides a VR environment where adolescents interact through alien avatars[6]. Participants communicate in a virtual space using alien avatars, which provides a psychologically safe medium for self-disclosure and fostering connections based on shared experience. Therefore, the *Project Aliens* series offers a compelling model for VR-based social experiments with clinical relevance. By lowering barriers to self-expression and creating a supportive VR-based environment, the series aims to help participants confront personal and interpersonal challenges in ways that may be less achievable in conventional therapeutic settings. This social VR-based approach aligns with broader explorations into

the metaverse's potential for mental health care, where users can interact within a customizable, immersive environment that offers emotional safety and flexibility, critical for therapeutic engagement among young people. Each episode of *Project Aliens* explores a unique theme, including social stigma, family dynamics, and self-identity. Thus, it can be recommended as a tool for fostering emotional growth and social connection.

Among children and adolescents, barriers to seeking and accessing mental health services remain significant challenges, with the most prominent barriers being social stigma and individual factors such as limited mental health knowledge[7]. While peer support has shown promise in promoting recovery among young people with mental health conditions[8][9][10], traditional face-to-face interventions often face barriers related to social anxiety and stigma[11]. Social VR-based platforms may address these challenges by enabling anonymous, avatar-based interactions[12][13]. However, the psychological impact of structured, VR-based peer support programs for adolescent psychiatric patients remains poorly understood. To address this gap, this case series investigates the impact of participating in *Project Aliens* on adolescents' psychological well-being, specifically, by examining changes in loneliness, depression, resilience, and patterns of emotional expression during VR-based interactions.

Methods

Study Design

This single-center, observational case series evaluated the psychological effects of participation in *Project Aliens*, a Japanese public television program utilizing social VR-based peer dialogue among adolescents with psychiatric disorders.

Participants meeting the inclusion and exclusion criteria were enrolled after providing consent for both program participation and study involvement. Changes in psychological indicators were assessed through data collection before recording and after broadcast.

Participants

Eligible participants are child and adolescent psychiatric patients receiving care at Yokohama City University Hospital who met the following criteria:

Inclusion Criteria

1. Aged 11-19 years at the time of consent
2. In a stable mental health condition as assessed by their primary care physician
3. Both the participant and their family must fully understand the purpose of the NHK program *Project Aliens* and agree to appear on the show
4. Written consent for participation in the study must be obtained

Exclusion Criteria

1. Presence of intellectual disabilities that may interfere with understanding the program or study
2. Imminent risk of self-harm or suicide
3. Suspected cases of abuse by family members
4. Severe depression, as indicated by a score ≥21 in the Patient Health Questionnaire-9 (PHQ-9)
5. Deemed unsuitable for participation based on clinical judgment by the primary care physician

Recruitment

Participants were recruited from the Department of Child Psychiatry at Yokohama City University Hospital. Between March 14 and April 12, 2024, 15 adolescent patients receiving outpatient care were invited to participate. After follow-up reminders, 10 patients expressed interest, and 3 were selected by NHK producers in alignment with the program's thematic and logistical needs. Participants were selected based on three primary criteria: (1) alignment with the program's thematic focus, requiring participants to share personal experiences and perspectives relevant to the show's themes; (2) logistical feasibility, including availability for filming and compatibility with the production schedule; and (3) technical feasibility, to ensure that participants could effectively engage with the 2D metaverse environment. The selected participants included 1 male and 2 females, aged 15, 18, and 19 at the time of filming.

Program Description

This study documented the participants' experiences during their involvement in *Project Aliens*, a 45-minute late-night special program on Japanese public television. Episode 8 of the series, titled "A Healing Field Trip," was recorded on July 13-14, 2024, and broadcast on October 27, 2024. Participants joined the *Project Aliens* virtual world remotely from their homes, connecting through personal computers rather than VR headsets.

The program offered a VR-based journey through three distinct stages: (a) Cityscape, (b) Spaceship and Spaceport, and (c) Moon, as shown in Figure 1. This staged progression—from an open urban setting to an enclosed spaceship and, finally, to an expansive lunar landscape—was designed to gradually foster trust, emotional connection, and self-disclosure. In particular, the enclosed spaceship setting encouraged focused conversations and deeper engagement, whereas the openness of the moon symbolized emotional release and perspective expansion, reinforcing participants' psychological progression.

This approach was rooted in the belief that meaningful dialogue and the breakdown of preconceptions requires a carefully structured process of interaction. Each stage was designed to not only support psychological transition but also create an environment where participants could engage in progressively deeper conversations while feeling psychologically safe.

The virtual environment was created by an artist renowned for distinctive illustrations, three-dimensional artwork, and youth-oriented video projects that have received national and international recognition[14]. To further support participant comfort and engagement, the program incorporated environmental audio elements, such as ambient nature sounds and underwater acoustics, aimed at fostering an immersive, calming atmosphere. These auditory cues were included to reinforce a shared sense of presence among participants and elevate their perception of a unique, transformative experience.

Throughout the program, the participants' journey was facilitated by a virtual navigator named Moon Rabbit, portrayed in real time by a professional actress. Moon Rabbit guided the three participants on their virtual trip to the moon. Unlike a pre-scripted AI system, Moon Rabbit engaged dynamically with the participants, responding to their interactions and guiding them through each stage of the journey. Its role was carefully designed to foster psychological safety, manage transitions, and encourage peer support and self-reflection. This approach was developed in collaboration with mental health professionals to ensure that it aligned with therapeutic principles. Moon Rabbit is the white character shown in Figure 1.

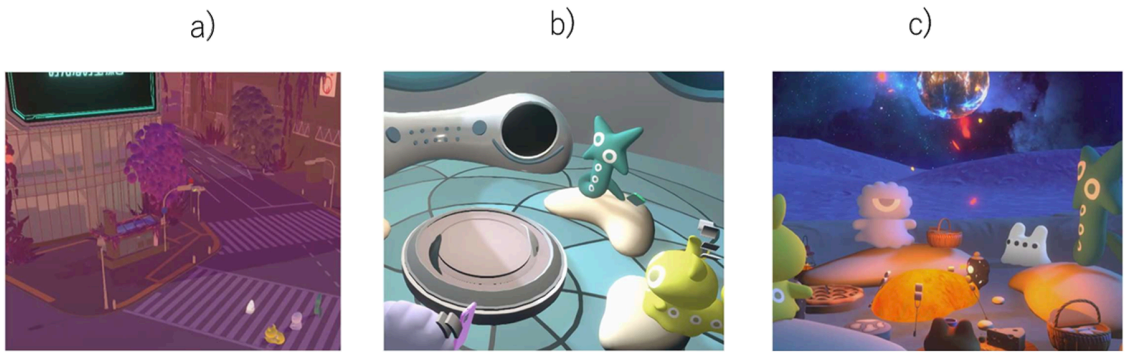

Figure 1. Sequential Stages of the VR-Based Therapeutic Journey. The figure depicts three sequential therapeutic environments: (A) Cityscape: designed to facilitate initial collaboration and trust formation; (B) Spaceship and Spaceport: structured for deep reflection through narrative sharing; and (C) Moon: focused on personal growth and future orientation. The Moon Rabbit (white figure) functions as the therapeutic facilitator, guiding structured activities and maintaining psychological safety throughout the program. This facilitation was crucial in creating a supportive environment that enabled meaningful participant interaction and emotional expression. Alien 1 is named Ramune, colored green, Alien 2 is named Puchi, colored purple, and Alien 3 is named Maruhachi, colored yellow.

(a): Cityscape: *Discovering Life Through Each Other's Treasures*

The journey began in a virtual recreation of Shibuya City in Tokyo, a lively urban environment popular among young people. The participants collaborated in a treasure hunt to locate hidden "treasures" within the city. This activity encouraged teamwork and provided an initial opportunity for participants to share personal insights, building trust and familiarity within the group.

The urban setting was intentionally chosen as a familiar yet dynamic social space where participants could ease into interactions. For those from rural areas, it introduced them to a different social environment. The open nature of the cityscape provided a sense of exploration and informal engagement, helping participants gradually become comfortable in the setting before transitioning to deeper discussions.

(b): Spaceship and Spaceport: *Discovering We're Not Alone: Sharing Worries and Finding Connection and A Letter to Myself: Embracing the Past, Encouraging the Future*

In this stage, the participants boarded a spaceship heading to the moon. Here, they encountered narratives from former participants, or "senior aliens," who shared their transformative journeys. The

participants also shared personal photos and discuss their daily struggles, fostering deeper self-reflection and mutual understanding.

The spaceship, a deliberately enclosed environment, was designed to foster focused, structured conversations. The transition from an open cityscape to a confined space created a sense of intimacy, encouraging self-disclosure and deeper emotional engagement. At the spaceport, participants undertook the final task of the journey: writing letters to themselves. These self-reflective letters explored past challenges, present struggles, and aspirations for the future. Reading these letters aloud allowed participants to express self-compassion and find closure. This transitional stage, just before reaching the moon, offered participants an opportunity to consolidate their thoughts and prepare for the final phase of the journey.

(c) Moon: "*Sharing Painful Pasts, Stepping Toward the Future*"

The final stage took place on the Moon, representing a safe space for introspection and transformation. Participants reflected on their experiences, shifting the focus from their past to envisioning their future. This phase highlighted the progress they had made throughout the journey.

The moon was chosen for its vast, open landscape, symbolizing emotional release and perspective expansion. In stark contrast to the confined spaceship, the moon represented liberation and psychological progression. The openness of the moon encouraged participants to engage in forward-looking discussions, marking a symbolic transition from structured reflection to envisioning new possibilities in their lives.

Case Presentations

Case 1: Alien 1: Ramune

A 19-year-old male ("Ramune") grew up in a socioeconomically disadvantaged family with significant mental health comorbidity. His father had bipolar disorder, his mother experienced depression and asthma, and his sister was diagnosed with autism spectrum disorder (ASD) and bipolar disorder. Diagnosed with ASD and a learning disability at age 8, the patient demonstrated communication difficulties, experienced persistent bullying, and subsequently developed severe social anxiety disorder, leading to extended periods of social withdrawal. Prolonged periods of housebound behavior further isolated him. Telemedicine during the COVID-19 pandemic enabled him to reconnect with psychiatric care, leading to improvements in his emotional stability. By the time of his participation, Ramune was

attending a vocational training facility and a youth support center but remained hesitant about interpersonal interactions. Ramune is the green character in Figure 1.

Case 2: Alien 2: Puchi

A 15-year-old female (“Puchi”) presented with a history of exposure to high academic pressure. The patient developed major depressive disorder with psychotic features at age 11, coinciding with preparation for private school entrance examinations. Subsequently, she developed body dysmorphic disorder, exacerbated by social media exposure, which led to familial discord and suicidal behavior. Despite progress, Puchi continued to experience fatigue and emotional fragility. Puchi is the purple character in Figure 1 .

Case 3: Alien 3: Maruhachi

An 18-year-old female (“Maruhachi”) presented with a history of severe academic and familial stressors. By age 15, her rigorous schedule led to severe weight loss, panic attacks, and eventually hospitalization for generalized anxiety disorder and an eating disorder. After one month of inpatient nutritional rehabilitation and antidepressant treatment, she regained physical health but continued to struggle with social isolation and reintegration into school life. Maruhachi is the yellow character in Figure 1.

Outcome Measures

Primary Outcome Measures

The primary outcome measure of this study was the longitudinal progression of each participant, assessed from baseline (study registration) through pre-broadcast and post-broadcast evaluations. This case series aimed to document individual trajectories by examining changes in self-reported experiences (patient-reported outcomes; PROs) and clinical observations.

To capture subjective experiences, PROs included self-reported loneliness, resilience, and depressive symptoms, as well as open-ended reflections on interpersonal relationships, emotional states, and coping strategies. These qualitative data were supplemented with psychiatrist assessments, based on routine consultations and medical records, to provide a clinical perspective on participants’ psychological status.

Secondary Outcome Measures

1. Psychological Measures:

    1. The Japanese version of the 3-item Short-form UCLA Loneliness Scale (UCLA-LS3-J SF-3): The UCLA-LS3-J SF-3 is a concise tool developed for the rapid assessment of loneliness. This scale has been validated in various contexts, including among mothers with infants and toddlers, demonstrating its versatility and robustness in capturing loneliness across different populations. The 3-item version is derived from the 10-item version, with a high correlation to the original UCLA Loneliness Scale Version 3. It has shown adequate reliability and validity in Japanese studies, making it particularly suitable for brief interventions[15]. The total score on the UCLA-LS3-J SF-3 ranges from 3 to 9.
    2. Resilience Scale, short form (RS-14): The RS-14 is a validated tool for assessing resilience, which is conceptualized as the capacity to recover from adversity. Its reliability and validity have been established in Japanese populations, including its psychometric equivalence to the original RS. The short form reduces respondent burden while maintaining robust internal consistency and test-retest reliability[16]. The total RS-14 score ranges from 14 to 98.
    3. PHQ-9: This measure was selected because assessing treatment efficacy through PHQ-9 score changes is commonly recommended and widely accepted in clinical research, including in Japan[17]. The PHQ-9, a self-administered questionnaire comprising nine items, evaluates the presence and severity of depressive symptoms within the past two weeks, based on DSM-IV criteria for major depressive disorder. The total PHQ-9 score ranges from 0 to 27, with higher scores indicating more severe depressive symptoms.

       Assessments were conducted at three time points: baseline (study enrollment), interim (4-10 days pre-recording), and final (4-10 days post-broadcast). For all evaluations, participants completed the questionnaires at home on paper. The completed questionnaires were then either returned during their next outpatient visit or sent by mail. This schedule was consistently applied for all three measures to ensure data reliability and consistency.

2. Speech data: Speech data were collected from participants during the program's metaverse-based interactions.

Data Analysis

To analyze the primary outcomes, we created a structured summary table outlining the longitudinal progression of each participant from baseline (study registration) to post-broadcast. This table summarizes participants' qualitative self-reports at three time points (baseline, pre-broadcast, and post-broadcast), capturing their experiences of loneliness, emotional responses, and coping strategies. As an ad-hoc analysis, a case-by-case qualitative analysis was conducted to further explore these individual trajectories. This analysis focused on participants' self-reported reflections on loneliness, emotional states, and coping strategies, based on responses to the following open-ended questions: 1) "During the past 10 days, have you felt lonely in your relationships with friends, family, or society?"; 2) "How did you feel at that moment?"; and 3) "How did you cope with this feeling of loneliness?" Thematic patterns were categorized based on predefined domains aligned with psychological scales such as the UCLA-LS3-J SF-3, RS-14, and PHQ-9. The identified themes included: 1) Changes in perceived loneliness (e.g., descriptions of social isolation or re-engagement with peers), 2) Changes in resilience, shifts in coping strategies (e.g., engagement in self-reflection, use of peer support). 3) Emotional responses to program participation (e.g., depressive state, expressions of hope, anxiety, or relief). These thematic categories were aligned with predefined psychological constructs measured by the 1) UCLA-LS3-J SF-3 (loneliness), 2) RS-14 (resilience), and 3) PHQ-9 (depressive symptoms). This alignment was achieved by examining the semantic content of participant narratives in relation to established dimensions of the respective psychological scales. Two independent researchers performed coding, and discrepancies were resolved through discussion. In addition, clinical observations from psychiatrists' records were reviewed to assess changes in participants' social engagement and emotional regulation. The goal was to identify patterns of psychological adaptation throughout the program.

To analyze secondary outcome measures, changes in pre- and post-intervention scores were calculated for the psychological measures, including the UCLA-LS3-J SF-3 (loneliness), RS-14 (resilience), and PHQ-9 (depressive symptoms). Descriptive statistics were used to summarize individual trajectories and group-level trends across the three assessment points: baseline, pre-broadcast, and post-broadcast. Given the small sample size, statistical significance testing was not performed, and results were interpreted based on individual-level changes rather than inferential statistics.

Exploratory sentiment analysis of participants' utterances was conducted to capture patterns of emotional expression. Words were categorized into positive and negative terms, and their frequencies were counted to assess emotional dynamics across different stages of the program (Cityscape,

Spaceship/Spaceport, Moon). Initially, text segmentation and morphological analysis were attempted using MeCab (https://taku910.github.io/mecab/), a widely used Japanese text analysis tool. However, existing sentiment dictionaries did not adequately capture the context-specific emotional expressions in this study. Therefore, a custom lexicon was developed to classify words into sentiment categories. The distribution of emotional expressions was analyzed across different program stages (Cityscape, Spaceship/Spaceport, and Moon) to identify shifts in emotional dynamics. The frequency of positive and negative words was calculated, and sentiment distributions were aggregated for each scene to illustrate emotional transitions across the program's stages. The analysis was performed using R version 4.4.2, with custom scripts utilizing the *dplyr, ggplot2*, and *stringr* packages for text processing and visualization. Sentiment classification was performed using a stepwise approach to systematically categorize words and phrases based on their emotional valence. The process involved three steps: removal of neutral elements, sentiment categorization, and validation and refinement.

First, neutral elements such as proper nouns (e.g., place or object names), conjunctions, auxiliary verbs, and particles were identified and excluded from the analysis to focus on emotionally meaningful content. Second, the remaining words and phrases were categorized into three sentiment categories: positive, negative, or neutral. Positive expressions included words indicating happiness, encouragement, or social connection (e.g., *fun, excited, relieved*), whereas negative expressions encompassed terms associated with distress, anxiety, or isolation (e.g., *worried, lonely, frustrated*). Ambiguous words (e.g., *different, interesting*) were assessed in context before classification. Additionally, commonly used expressions that do not convey strong emotional valence, such as acknowledgments, and greetings, were also categorized as neutral. For instance, frequently used words such as hello, and indeed appeared frequently in the dataset but lacked a clear positive or negative emotional connotation.

Finally, to ensure consistency and accuracy, two independent researchers manually reviewed the classification. Any discrepancies were resolved through discussion and consensus. This rigorous process ensured a standardized, reproducible approach to sentiment categorization.

All available data were analyzed without imputation. No missing responses were reported for psychological measures, as participants completed and returned all self-reported questionnaires as instructed. For qualitative responses, minor transcription gaps were resolved through researcher consensus, ensuring accurate thematic analysis. Due to the small sample size, inferential statistical analysis was not conducted.

Ethical Considerations

This study complies with the Declaration of Helsinki. Ethical approval was obtained from the Yokohama City University Ethics Committee (Approval No F240600003). Detailed explanations of the study's purpose, methods, potential risks, and benefits were provided to the participants and their legal guardians. Written informed consent was obtained from all participants, and the assent of minors aged 16 or older with sufficient capacity for independent decision-making was also obtained.

The participants and their families provided explicit consent for appearing on the NHK television program *Project Aliens* through an agreement with the broadcaster. The research team only had access to transcriptions of the publicly broadcasted content from the program and did not have access to unedited interactions within the VR space. Additionally, the study utilized only predefined outcome measures, including primary and secondary outcomes. Personal data were anonymized using unique identification codes, ensuring confidentiality. The correspondence table linking codes to individual identities was securely stored at the research institution and was inaccessible to unauthorized personnel.

Participants were informed of their right to withdraw from the study at any time without consequences, and that their data would be excluded unless anonymized and aggregated. These measures ensured the protection of participant privacy, confidentiality of data, and compliance with ethical standards throughout the study.

Results

Primary Outcome Measures

A case-by-case analysis of patient trajectories, based on structured evaluation as shown in Table 1, revealed key psychological and social changes.

Participant	Timepoint	Loneliness (PRO)	Resilience (PRO)	Depression (PRO)	Psychiatrist Observation
Alien1	Baseline	Feeling disconnected when unable to talk to online friends	Distracts self with videos and games	No specific episode	Limited social engagement
	Pre	Feeling excluded when unable to join conversations	Watches videos to change mood	No specific episode	Limited social interaction skills
	Post	No specific episode	Interacting with various people was meaningful and enriching	No specific episode	Developed better coping strategies and became more socially engaged
Alien2	Baseline	Felt abandoned and lonely when a classmate stopped interacting after a seating change	No specific episode	I felt overwhelmed by loneliness and sadness	Emotional distress, avoidance tendencies, and negative thought patterns
	Pre	No specific episode	No specific episode	Felt anxious about participating in the program	Anxiety about social interaction
	Post	Talking with other participants who shared similar struggles helped me realize that I was not alone	Expressing sadness and loneliness to others provided relief to myself	Felt warmth from kind program staff, reducing isolation	Reduction of loneliness, improvement in coping skills, and alleviation of interpersonal distrust
Alien3	Baseline	After missing school, pressure from my family to return caused tension, and I also became isolated from my friends	Retreating to my room provided me with a sense of comfort	However, I still felt distressed, as if I had no place to belong	Social isolation, depressive state, and avoidance behavior
	Pre	Continued school absence has resulted in prolonged feelings of isolation	I tried going outside	Feelings of depression and hopelessness persisted	Despite improvements in proactive coping strategies, the depressive symptoms remained
	Post	I started spending time and chatting with my friends after school	I stopped avoiding tasks due to perfectionism and realized that taking-action matters. Now, I've learned to accept my imperfections	At first, I struggled to connect with my new classmates. Now I feel sad to part ways with them	Enhanced coping strategies, relief from depressive symptoms, and reduced feelings of isolation

Table 1. Longitudinal Psychological Changes in Project Aliens Participants. Longitudinal changes in psychological status for the three adolescent participants. Data were collected at three time points: baseline (study registration), pre-broadcast, and post-broadcast. Each participant's subjective experiences and clinical observations are categorized into four domains: loneliness, resilience, depression (PRO: Patient-Reported Outcome), and psychiatrist observation. Psychiatrist observations were documented during routine clinical consultations at each time point.

Patient Reported Outcomes (PROs)

The participants described changes in their experiences of loneliness, emotional responses, and coping mechanisms across the three time points (baseline, pre-broadcast, post-broadcast).

- Alien 1: Initially, he reported feeling left out in social communication. Post-broadcast, he found the experience of talking to various people meaningful and enriching. From a psychiatrist's observation, his social engagement had increased.
- Alien 2: Initially, she felt isolated, and experienced sadness and loneliness. Post-broadcast, she was able to express her feelings directly to a friend, which provided relief. From a psychiatrist's observation, post-broadcast, her loneliness decreased, coping skills improved, and interpersonal distrust was alleviated.
- Alien 3: Initially, she described feeling severe loneliness due to being unable to attend school and lacking communication with family. Post-broadcast, she reported positive social interactions, noting

that she had been spending more time with friends. From a psychiatrist's observation, her coping strategies improved, depressive symptoms were alleviated, and her feelings of isolation decreased.

Secondary Outcome Measures

Psychological Measures:

Figure 2 demonstrates changes in individual scores and group means across three psychological domains:

- Loneliness (UCLA-LS3-J SF-3): Scores increased slightly for Alien 1 (+2) and Alien 2 (+1), whereas Alien 3 remained stable.
- Resilience (RS-14): Resilience improved across participants, with the largest increase observed in Alien 3 (+24).
- Depression (PHQ-9): Depression scores decreased for all participants, with Alien 3 showing the most significant reduction (-7).

Each psychological measure exhibited different patterns of change across the three time points as shown in Figure 2:

- Loneliness (UCLA-LS3-J SF-3): The group mean increased from 6.3 at registration to 7.0 pre-broadcast and then remained stable at 7.3 post-broadcast.
- Resilience (RS-14): The group mean increased from 56.0 at registration to 58.7 pre-broadcast, followed by a more substantial rise to 70.7 post-broadcast.
- Depression (PHQ-9): The group mean decreased from 7.7 at registration to 6.3 pre-broadcast, and then further dropped to 4.0 post-broadcast.

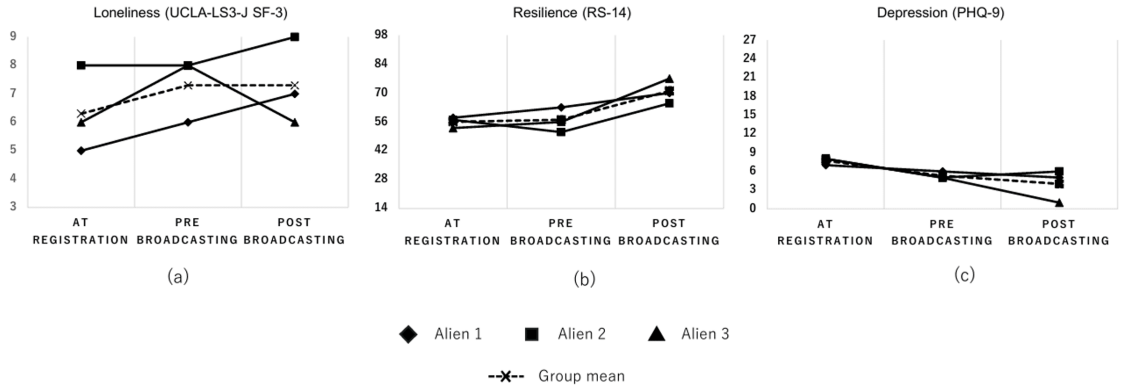

Figure 2. Longitudinal Changes in Psychological Outcome Measures. Visualization of individual trajectories and group means across three time points for: (A) Loneliness (UCLA-LS3-J SF-3, range 3–9), (B) Resilience (RS-14, range 14–98), and (C) Depression (PHQ-9, range 0–27). Each participant's scores were measured at three points: registration, pre-broadcasting, and post-broadcasting. Alien 1 (diamond), Alien 2 (square), and Alien 3 (triangle) are represented by different markers. Group mean trends, indicated by × markers and dashed lines, illustrate the overall trajectory of changes in loneliness, resilience, and depressive symptoms among participants.

Sentiment Analysis of Speech

The sentiment analysis, conducted as a secondary outcome measure, revealed distinct emotional dynamics across the program's stages. Positive expressions dominated Scene a, whereas Scenes b and c reflected more balanced emotional expressions, indicating deeper emotional engagement.

Figure 3 illustrates the sentiment distribution across different scenes, providing a visual representation of how the participants' emotions varied during each scene of *Project Aliens*. Scene a contained 48 total emotional expressions: 18 negative (37.5%) and 30 positive (62.5%). Scene b contained 115 total emotional expressions: 64 negative (55.7%) and 51 positive (44.3%). Scene c contained 68 total emotional expressions: 29 negative (42.6%) and 39 positive (57.4%).

In scene a, the participants frequently expressed positive emotions, such as excitement and curiosity, using terms like "cute" or "fun." These findings suggest that the design of the initial VR environment successfully engaged participants and reduced their apprehension. However, as the journey progressed to Scene b, more complex emotional responses emerged. Participants used words such as "painful" and "anxious" while mentioning "courage" and "challenge," indicating the difficulties they faced and their

ability to confront them. By Scene c, the focus shifted to closure as reflected in expressions like “finish” or “miss you,” and optimism, as reflected in expressions such as “hope” or “wish.”

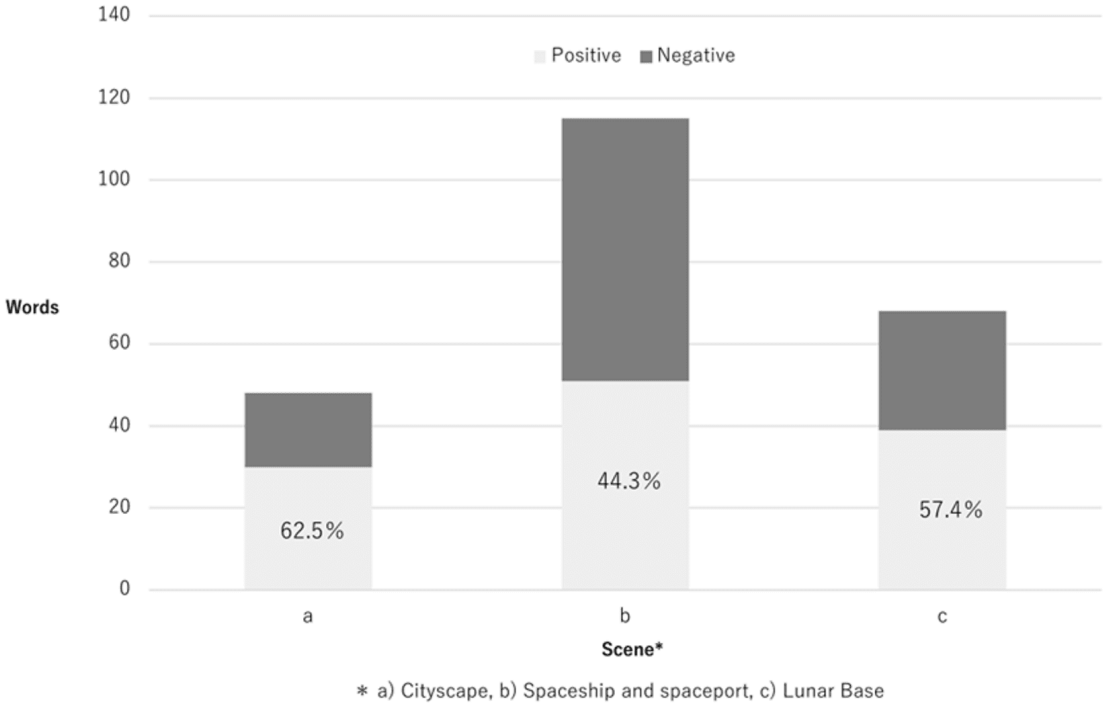

Figure 3. Quantitative Analysis of Emotional Expression Patterns. Temporal distribution of emotional expressions categorized by valence (positive/negative) across program stages. Frequencies represent word-level sentiment analysis of participant utterances. Scene a) Cityscape shows predominantly positive expressions during initial interactions, Scene b) Spaceship and spaceport demonstrates increased emotional complexity with both positive and negative expressions, and Scene c) Moon reflects a shift toward resolution and hope. * indicate word frequency counts.

Discussion

This case series examined the psychological impact of *Project Aliens*, an innovative VR-based television program on Japanese public broadcasting, demonstrating its therapeutic potential for adolescents with mental health challenges. The program provided a unique social VR-based experience, offering a safe space for emotional expression and peer support through structured facilitation and immersive virtual environments. The findings indicate potential improvements in psychological well-being, including reduced loneliness and depressive symptoms and enhanced resilience. These improvements were

observed in the psychological measures as well as PROs throughout the duration of the program, from recording through broadcast viewing. Social VR-based programs like *Project Aliens*, which create immersive spaces for dialogue, peer support, and emotional processing, may pave the way for new mental health interventions. Within this psychologically safe VR environment, the participants could openly express positive and negative emotions while sharing their recovery journey and adverse experiences through mutual empathy[12][13].

A key factor in the program's efficacy was the structured facilitation of participant engagement. The program design —featuring warm colors, relatable visual elements, and playful alien avatars—fostered a sense of safety and accessibility, reducing communication barriers. While realistic avatars can enhance trust in virtual environments[18], research suggests that non-humanoid avatars, such as animal avatars, may promote self-disclosure and intimacy by reducing self-presentation anxiety[19]. This aligns with *Project Aliens*' approach, where the alien avatars may have encouraged freer self-expression and deeper emotional dialogue. Online self-disclosure, although different from face-to-face interactions, has been recognized as a valuable preliminary step for highly anxious adolescents transitioning to offline communication[20].

This social VR-based program actively encouraged participant-led interactions while ensuring their psychological safety. Previous studies have shown that online peer support groups enhance emotional regulation and coping strategies[21]. Additionally, structured VR-based learning environments have been found to boost engagement, self-efficacy, and emotional expression[22]. Likewise, virtual therapeutic spaces require structured facilitation to sustain meaningful interactions and maximize psychological benefits[23][24]. In *Project Aliens*, facilitation was embedded into the program's design, helping participants build trust and develop communication skills.

The quantitative findings indicate improvements in resilience and reductions in depressive symptoms among participants. Along with these measurable changes, the participants' reflections provided valuable qualitative insights. Many reported feeling less isolated and more encouraged to face challenges positively. While these subjective accounts were not part of formal outcome measures, they complemented the quantitative data, offering a broader understanding of the program's impact. The structured VR environment facilitated collaborative engagement, mutual support, and sharing of emotional experiences, fostering a strong sense of solidarity among participants. While this study did

not directly measure changes in social attitudes, previous studies suggest that VR experiences can enhance interpersonal engagement and emotional connections[25][26].

Notably, improvements in resilience and other patient-reported outcomes following the program indicate that these transformations may extend beyond the virtual environment. This process aligns with the *Proteus Effect*[27], where users' self-perception and behavior begin to reflect the traits of their avatars. As participants engaged with their avatars in *Project Aliens*, they likely internalized aspects of their virtual identities, reinforcing self-efficacy, emotional expression, and adaptive coping strategies. These factors may have contributed to the psychological improvements observed post-broadcast.

Limitations

This study has several limitations. First, the small sample size and brief follow-up period limit the generalizability of findings and the ability to assess long-term outcomes. Additionally, the participants' subjective reflections may introduce recall bias, affecting the accuracy of reported psychological changes. Furthermore, the unique nature of this intervention—a television-based VR program—may limit its applicability to broader adolescent psychiatric populations. Additionally, the participants' responses may have been influenced by factors such as feeling excited for participating in media, receiving attention from production staff, and feeling aware of being filmed for public broadcast. These media-related factors may have impacted psychological measures independently of the VR intervention.

All participants were VR novices, which helped minimize the influence of prior VR experience; however, individual differences in VR adaptability (e.g., motion sickness, interface familiarity) may have affected engagement and the overall effectiveness of the intervention. Future studies should account for these variations by implementing standardized conditions, such as screening for VR tolerance and stratifying participants accordingly. Additionally, the participant selection process may have introduced bias. As the participants were selected by NHK producers based on thematic and logistical considerations rather than through random selection, this method could have influenced the study's findings, limiting the generalizability of results.

Future Direction

Despite these limitations, this study highlights the potential of VR-based group psychotherapy and day-care programs for young psychiatric patients. Facilitated VR-based group sessions may serve as an alternative or complementary approach to traditional face-to-face therapy, especially for individuals with

social anxiety or those who experience difficulties in engaging in conventional therapeutic settings. Future research should explore how VR-based group therapy can be integrated into clinical practice and whether it leads to comparable or superior outcomes compared with conventional treatment methods, employing larger, more diverse samples and longitudinal designs. Furthermore, given that *Project Aliens*' positive effects may not be solely attributable to its VR components—given the influence of television production and participant interactions with staff—future studies should employ controlled experimental designs to isolate the therapeutic impact of social VR. Incorporating physiological measures such as electroencephalography and heart rate variability could provide objective insights into participants' emotional and stress responses, further validating the program's impact. By addressing these methodological considerations, future studies could refine the use of social VR as a structured therapeutic tool in psychiatric care.

This case series demonstrates the potential efficacy of structured social VR interventions that integrate innovative design, therapeutic facilitation, and peer support in promoting emotional exploration, resilience, and recovery among adolescents with psychiatric disorders. The findings lay the groundwork for future investigations into social VR-based therapeutic content, offering new possibilities for accessible and effective mental health care.

Statements and Declarations

Acknowledgments

We extend our gratitude to those who contributed to this study. Minori Ito assisted with participant recruitment and study-progress management as a research assistant. Mikiko Yuzawa from Nouvelle Plus Inc. prepared the ethics application documents. Ryo Urabe from NHK provided critical support during the program's production process, facilitating coordination between the research team and the broadcasting staff. We also acknowledge the assistance of OpenAI's ChatGPT and Claude in supporting the drafting and English editing process of this manuscript.

Conflicts of Interest

TM, MT, MI, MT, YM, SS, EK, and MT have no conflicts of interest. JF received research grants from KAKENHI (21K01994). JF also served as a member of an advisory board for the Seisa Yokohama Educational Counseling Center. This study was funded by the Japan Science and Technology Agency (JST)

under the Co-creation Opportunity Formation Support Program (COI-NEXT), FY2022-2031. The funding agency had no role in study design, data collection, analysis, interpretation, or manuscript submission decisions.

Abbreviations

- ASD: Autism Spectrum Disorder
- NHK: Nihon Housou Kyoukai
- PHQ: Patient Health Questionnaire
- PRO: Patient-Reported Outcome
- RS: Resilience Scale
- VR: Virtual Reality

References

1. ^*Fodor LA, Coteț CD, Cuijpers P, Szamoskozi S, David D, Cristea IA. "The effectiveness of virtual reality based interventions for symptoms of anxiety and depression: A meta-analysis." Scientific Reports. 8 (1): 10323. doi:10.1038/s41598-018-28113-6.*
2. ^*Park MJ, Kim DJ, Lee U, Na EJ, Jeon HJ. "A literature overview of virtual reality (VR) in treatment of psychiatric disorders: recent advances and limitations." Frontiers in Psychiatry. 10: 505. doi:10.3389/fpsyt.2019.00505.*
3. ^*Geraets CNW, van der Stouwe ECD, Pot-Kolder R, Veling W. "Advances in immersive virtual reality interventions for mental disorders: a new reality?" Current Opinion in Psychology. 41: 40-45. doi:10.1016/j.copsyc.2021.02.004.*
4. ^*Mosher MA, Carreon AC, Craig SL, Ruhter LC. "Immersive technology to teach social skills to students with autism spectrum disorder: A literature review." Review Journal of Autism and Developmental Disorders. 9: 334-350. doi:10.1007/s40489-021-00259-6.*
5. ^*Ministry of Education, Culture, Sports, Science and Technology-Japan. Current status of school absenteeism and future measures for school absenteeism: summary of the Survey on Student Guidance 2021. Tokyo: MEXT; 2023.*
6. ^*NHK launches new VR documentary series Project Aliens. ITmedia [Internet]. 2022 Sep 13 [cited 2025 Feb 9]. Available from: https://nlab.itmedia.co.jp/nl/articles/2209/13/news183.html [in Japanese].*

7. ^Radez J, Reardon T, Creswell C, Lawrence PJ, Evdoka-Burton G, Waite P. "Why do children and adolescents (not) seek and access professional help for their mental health problems? A systematic review of quantitativ e and qualitative studies." European Child & Adolescent Psychiatry. 30: 183-211. doi:10.1007/s00787-019-014 69-4.
8. ^Chmielowska M, Mannocci N, Tansel A, Zisman-Ilani Y. "Peer support and shared decision making in Ope n Dialogue: Opportunities and recommendations." Frontiers in Psychology. 13: 1059412. doi:10.3389/fpsyg.2 022.1059412.
9. ^Murphy R, Huggard L, Fitzgerald A, Hennessy E, Booth A. "A systematic scoping review of peer support int erventions in integrated primary youth mental health care." Journal of Community Psychology. 52: 154-18 0. doi:10.1002/jcop.23090.
10. ^Scanlon CL, Toro J, Wang MT. "Socially anxious science achievers: The roles of peer social support and soci al engagement in the relation between adolescents' social anxiety and science achievement." Journal of Yo uth and Adolescence. 49: 1019-1036. doi:10.1007/s10964-020-01224-y.
11. ^Lynch H, McDonagh C, Hennessy E. "Social anxiety and depression stigma among adolescents." Journal of Affective Disorders. 281: 744-750. doi:10.1016/j.jad.2020.11.073.
12. a, bKenyon K, Kinakh V, Harrison J. "Social virtual reality helps to reduce feelings of loneliness and social an xiety during the Covid-19 pandemic." Scientific Reports. 13 (1): 19282. doi:10.1038/s41598-023-46494-1.
13. a, bKarami B, Koushki R, Arabgol F, Rahmani M, Vahabie A-H. "Effectiveness of virtual/augmented reality–based therapeutic interventions on individuals with autism spectrum disorder: A comprehensive meta-anal ysis." Frontiers in Psychiatry. 12: 665326. doi:10.3389/fpsyt.2021.665326.
14. ^Cho, H.. Hikaru Cho's Official Website. Retrieved March 15, 2025, from https://www.hikarucho.com/.
15. ^Arimoto A, Tadaka E. "Reliability and validity of Japanese versions of the UCLA loneliness scale version 3 f or use among mothers with infants and toddlers: a cross-sectional study." BMC Women's Health. 19: 105. do i:10.1186/s12905-019-0792-4.
16. ^Nishi D, Uehara R, Kondo M, Matsuoka Y. "Reliability and validity of the Japanese version of the Resilience Scale and its short version." BMC Research Notes. 3: 310. doi:10.1186/1756-0500-3-310.
17. ^Muramatsu K, Miyaoka H, Kamijima K, et al. "Performance of the Japanese version of the Patient Health Q uestionnaire-9 (J-PHQ-9) for depression in primary care." General Hospital Psychiatry. 52: 64-69. doi:10.101 6/j.genhosppsych.2018.03.007.
18. ^Aseeri SA, Interrante V. "The influence of avatar representation on interpersonal communication in virtual social environments." IEEE Transactions on Visualization and Computer Graphics. 27 (3): 1234-1245. doi:10.1

109/TVCG.2021.3054321.

19. ^*Ichikawa A, Ihara K, Kawaguchi I. "Investigation of how animal avatar affects users' self-disclosure and s ubjective responses in one-on-one interactions in VR space." Asian HCI Symposium 2023 Apr 28; Indonesia. Lankes M, Na J, Iwai D, editors. New York: ACM; 2023. p. 70-75. https://doi.org/10.1145/3604571.3604582.*
20. ^*Towner E, Grint J, Levy T, Blakemore SJ, Tomova L. "Revealing the self in a digital world: A systematic revi ew of adolescent online and offline self-disclosure." Current Opinion in Psychology. 45: 101309. doi:10.1016/j. copsyc.2022.101309.*
21. ^*Bradford NK, Caffery LJ, Smith AC. "Therapeutic alliance and group cohesion in an online support progra m for adolescent and young adult cancer survivors: lessons from "Recapture Life."" Journal of Psychosocial Oncology. 39 (4): 454-468. doi:10.1080/07347332.2021.1881512.*
22. ^*Chen C-Y, Chang S-C, Hwang G-J, Zou D. "Facilitating EFL learners' active behaviors in speaking: a progres sive question prompt-based peer-tutoring approach with VR contexts." Interactive Learning Environments. 29 (2): 2268-2287. doi:10.1080/10494820.2021.1878232.*
23. ^*Redburn J, Hayes B. "Facilitators and barriers to "Positive Outcomes" from cognitive–behavioral therapy, a ccording to young people: a thematic synthesis." Journal of Clinical Psychology. 80 (5): 968–1002. doi:10.100 2/jclp.23653.*
24. ^*Aebersold M, Villarruel A, Tschannen D, et al. "Using a virtual environment to deliver evidence-based inter ventions: The facilitator's experience." JMIR Serious Games. 3 (2): e5. doi:10.2196/games.4293.*
25. ^*Ichino J, Ide M, Yokoyama H, Asano H, Miyachi H, Okabe D. ""I've talked without intending to": self-disclos ure and reciprocity via embodied avatars." Proceedings of the ACM on Human-Computer Interaction. 6: 48 2. doi:10.1145/3555583.*
26. ^*Nikolaou A, Schwabe A, Boomgaarden H. "Changing social attitudes with virtual reality: a systematic revi ew and meta-analysis." Annals of the International Communication Association. 46 (1): 30-61. doi:10.1080/ 23808985.2022.2064324.*
27. ^*Yee N, Bailenson J. "The Proteus Effect: the effect of transformed self-representation on behavior." Human Communication Research. 33 (3): 271-290. doi:10.1111/j.1468-2958.2007.00299.x.*

Declarations

Funding: This study was funded by the Japan Science and Technology Agency (JST) under the Co-creation Opportunity Formation Support Program (COI-NEXT), FY2022–2031. The supporting funding

agency had no role in study design, data collection, analysis, interpretation, or manuscript submission decisions.

Potential competing interests: TM, MT, HY, MI, MT, YM, SS, EK, MT have no conflict of interest. JF received research grants from KAKENHI (21K01994). JF also served as a member of an advisory board for Seisa Yokohama Educational Counseling Center.