‘In That Small Space with Just the Two of Us’: User Experiences with Cumpa in a Robotic Counseling Center

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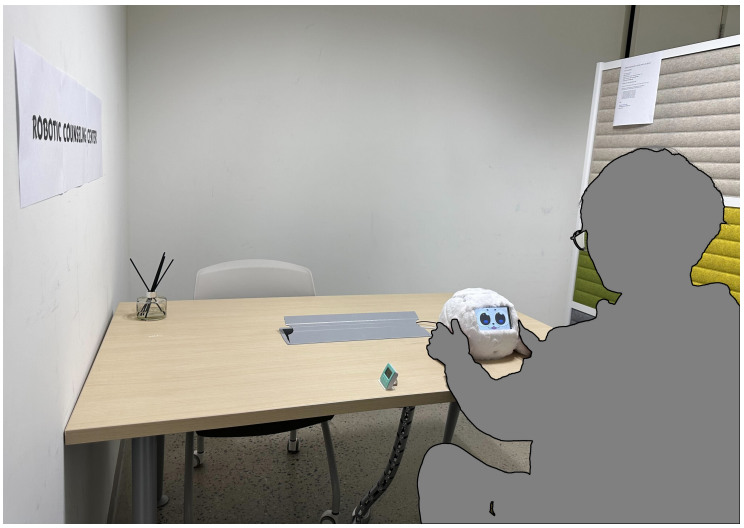

Fig. 1. Image of the robotic counseling center.

The growing demand for mental health support has highlighted the limitations of traditional counseling accessibility, increasing the usage of digital mental health interventions. There has been a rising interest in using robots to support mental health due to their benefits in engagement and rapport. Capitalizing on the

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opportunity of placemaking for designing a feasible robotic digital mental health intervention, our study explores the Robot Counseling Center (RCC) and its robotic counselor, Cumpa, designed to improve mental health accessibility and user engagement. A two-week field study with 20 participants evaluated RCC's impact on their mental health, engagement, and sense of place within a counseling environment. Results indicate that RCC positively influences emotional awareness and engagement. Our findings provide insights into the role of social robots in mental health interventions and offer design implications for developing robotic counseling centers as supportive, effective spaces, contributing to building better places and interactive systems.

CCS Concepts: • **Human-centered computing** → **User studies**; • **Computer systems organization** → **Robotics**.

Additional Key Words and Phrases: human-robot interaction, social robot, digital mental health intervention

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1 Introduction

Since the outbreak of the COVID-19 pandemic, there has been a significant increase in depression rates, leading to a global deterioration in mental health [85]. Consequently, the number of individuals seeking mental health counseling or therapy has been steadily increasing [81]. However, traditional mental health counseling faces resource limitations. The demand for counseling far exceeds the supply of qualified counselors, resulting in low accessibility for those in need [3]. To address the issue of accessibility, various digital mental health interventions (DMHIs) using mobile applications and conversational agents have been actively developed for mental health care [42, 45, 115]. Research indicates that these digital interventions are vital in providing real-time support and personalized treatment [106], contributing to overcoming the accessibility limitations of traditional face-to-face therapy [36].

With advancements in technology, there has been a growing attempt to utilize social robots to care for people's mental health [38, 122]. Robot-based mental health interventions offer the advantage of increasing user engagement and participation [37, 110]. Numerous studies in the human-robot interaction (HRI) field have explored methods for building rapport between robots and humans, demonstrating that such rapport formation is effective in mental health interventions [5, 51, 107]. However, social robots, such as NAO and Pepper, are often expensive and require maintenance [14, 20, 74]. Consequently, many robot-based mental health intervention studies have been conducted in laboratory settings using the aforementioned commercial robots, leading to lower accessibility compared to existing DMHIs [37]. This scenario raises an important question: How can we utilize social robots as DMHIs to enhance accessibility while maintaining high engagement, as if they were used in private spaces?

In this work, we aim to explore an alternative strategy as opposed to traditional HRI research by building a robotic counseling center. Currently, institutions such as schools and government organizations are making efforts to increase accessibility to mental health care through placemaking initiatives like establishing counseling centers and meditation rooms [77, 80, 114]. Capitalizing on this opportunity, we explore the concept of a **Robotic Counseling Center (RCC)**. To this end, we developed **Cumpa**, a robotic counselor for mental health support. By integrating an accessible robotic system within established, private spaces dedicated to mental health care, we aim to enhance user engagement without incurring high purchase and maintenance costs associated with traditional robotic interventions. Specifically, our research aims to answer the following questions:

- RQ1: Does the RCC effectively promote users' mental health?
- RQ2: How does interaction with the RCC impact users' daily lives and foster a sense of place as a supportive counseling environment?
- RQ3: How do the RCC's design and interactions influence user engagement and rapport building?

To answer the following questions, we conducted a two-week field trial with 20 participants and evaluated the effectiveness and user experiences of the RCC. We analyzed the conversation logs, coded user engagement behaviors from the video data, and compared mental health self-assessment results before and after the user study. Furthermore, we analyzed the semi-structured interview data to gain in-depth insights into their experiences in the RCC.

By exploring the concept of the RCC via a field trial, we made the following contributions. First, we offered field-based insights on how an actual robotic counseling center can be perceived and experienced by real users. Our specific focus on the relationships among users, Cumpa, and the center helped us show how these interactions contribute to establishing RCC as a safe, private, and supportive place for mental healthcare through processes of placemaking. Second, we identified user engagement and interaction patterns across the different components of the RCC and provided new insights for integrating robotic systems into mental health interventions on a university campus. Third, we discussed several practical implications for designing RCC and proposed directions for future research. These include how RCC can be applied to current on-campus counseling centers and how RCC can be further developed to support cooperative work among the clients, counselors, and developers.

2 Related Works

2.1 Digital Mental Health Intervention and Engagement

Conversational agents like chatbots are among the rapidly expanding technologies in digital mental health interventions (DMHIs). These conversational interventions have proven effective in addressing various mental health challenges, such as depression, anxiety, and stress [34, 42] by adapting existing therapies like Cognitive Behavioral Therapy (CBT) [29] and Acceptance and Commitment Therapy (ACT) [90]. The personalized interactions and empathetic responses were identified as key factors contributing to their effectiveness [42]. For example, Reflection Companion [63] offers a reflection tool for physical activity that provides mini-dialogues personalized to the user's goals. These adaptive dialogues were reported to increase motivation and behavior change. Peltola et al. [90] evaluated chatbot scripts situated in an ACT-based online therapeutic program to study user behaviors and preferences on conversational styles. The friendly, empathetic, encouraging features, such as a chatbot's self-disclosure and inquiries about the interlocutor, were generally perceived positively.

A consistently emphasized factor underlying the effectiveness of DMHIs is user engagement, which has gained sustained attention in mental health research [54]. Therapeutic engagement is defined as a reciprocal interaction between a therapist and a client [97]. This helps the clients to be able to openly disclose the thoughts, feelings, and personal history relevant to treatment [82]. Low intervention engagement, for example through low intervention uptake and high drop-out, may lower the potential impact of interventions [27, 104, 121]. For instance, studies show that approximately 40% of participants drop out before completing a quarter of the intervention, with only 0.5% to 28.6% completing the entire program or continuing its use [30, 56]. Addressing these challenges, recent studies have explored strategies such as personalizing content, tailoring intervention delivery to user preferences, and integrating supportive elements like reminders and gamification to sustain engagement and improve outcomes in DMHIs [47].

To measure the engagement level of the users, various studies in digital health interventions (DHIs) employ subjective measures of engagement by using survey data such as the WAI-SR scale [11, 52, 88]. Moreover, in prior studies that collected log data or sensor data, usage counts were utilized as the measure for engagement [91]. Recent research has expanded engagement measurement to include multidimensional approaches. For example, frameworks now incorporate behavioral metrics such as frequency and intensity of use, cognitive indicators like goal-aligned reflection frequency, and socio-affective measures such as emotional disclosure on message boards [118]. Additionally, psychophysiological data (e.g., gaze activity and emotional arousal) and ecological momentary assessments have been employed to capture real-time user interactions [103].

While these approaches provide a comprehensive view of engagement in digital and mobile contexts, they may not fully capture the nuances of user interaction in embodied, spatially grounded environments. The RCC setting requires a reconsideration of engagement metrics, as it differs from traditional mobile-based interventions in that users interact with both the robotic agent (Cumpa) and the physical space (the center). Given this unique environment, our study aims to assess engagement with objective measurements and behavioral indicators of user interaction with Cumpa. We adopt behavior coding in Joranson et al.'s work, where the seal robot Paro was used in nursing homes for group therapy sessions [55]. By applying this coding scheme, we aim to capture behavioral dynamics within the RCC and contribute to a deeper understanding of engagement in RCC contexts.

2.2 Robotic Agents for Mental Health Care

Social robots are emerging as promising applications in mental health domains for increasing user engagement and participation [102]. Embodiment, defined as the physical presence of a robot with a tangible body, offers several advantages over disembodied or virtual agents. The primary benefit is enhanced social presence, which fosters trust, engagement, and emotional connection [7, 71, 125]. For instance, interactions with physically present robots were more effective than those with video-displayed agents, as users perceived them as more credible and relatable [7]. Furthermore, nonverbal interactions such as gestures and touch represent another important therapeutic potential of embodiment. Physical forms improved communication clarity and emotional resonance [99], and touch interactions have been shown to reduce negative emotions [57, 100].

These advantages spurred the development of various robots for mental health care, including humanoids [17, 117] and animal-shaped robots [122]. Specifically, many pet-like robots have been developed to replicate the psychological, cognitive, and socio-emotional benefits of pet-assisted therapy without the related inconveniences of caring for real pets [69, 79]. These social robots not only positively impact social interaction and emotional state [37] but also effectively build a positive therapeutic alliance with individuals as nonjudgmental tools that encourage interaction and provide emotional support [52]. Uchida et al. [117] hypothesized that robot agents could help dissolve mental barriers between clients and the robot itself, encouraging deeper self-disclosure on sensitive topics. In their study, they compared humanoid robots and human counselors and found that robots can draw out self-disclosure as compared to humans in encouraging clients to open up about negative topics.

Building upon these prior efforts in designing robot-assisted therapies and leveraging therapeutic robots for diverse populations, we explore the concept of an unmanned robotic counseling center. Rather than deploying robots in homes or general-purpose healthcare settings, a dedicated center can address well-documented barriers like space constraints, hardware fragility, and the need for specialized setup or supervision [14, 74]. This can ultimately extend the current robotic therapy research into more scalable and user-centered models of care. Moreover, prior HRI studies focused on interactions in uncontrolled, everyday places, primarily for enhancing robot performance or

acceptance [75]. Therefore, we highlight the need for exploring the concept of a robotic counseling center within the mental health domain. To address this gap, we explored the feasibility and user experiences of a robotic counseling center as a dedicated place designed for therapeutic human-robot interactions.

2.3 Placemaking and Sense of Place

In CSCW and HCI, place is a socially and emotionally meaningful construct [39]. Unlike abstract spaces, places are experienced through an individual's sense of place, shaped by emotional ties and opportunities for meaningful interaction [21, 35]. Placemaking, which is the process of defining spaces with meaning through relationships and practices, is thus crucial to understand how people engage with environments [26, 33]. A foundational view in this area is the relational perspective, which sees place as emerging from social practices rather than fixed features [23, 41]. Dourish distinguished physical space from socially meaningful place, noting how digital technologies mediate this transformation [28]. For example, Østerlund showed how hospital wards become meaningful through collaborative practices [86]. Harrison and Tatar described place as a "semantic tangle" of people, actions, and locations [40]. This view is illustrated in studies showing how low-SES families form bonds with local spaces like basketball courts [98], or how migrants develop emotional ties to urban areas through lived experiences [35].

From this perspective, technology-mediated places must be understood contextually. In recent years, digital placemaking has gained prominence, with Dourish suggesting technologies can turn transient "non-places" (e.g., airports) into meaningful ones [28]. Projects like Journeys & Notes foster community in transit spaces [24], while digital tools support migrant placemaking [35]. Here, affective connections like comfort and belonging are key to developing a sense of place. Agrawaal et al. further showed how navigation tools surface cultural layers to deepen emotional ties [2]. Extending this, Lynch et al. explored robotic placemaking, emphasizing how robots in public spaces gain meaning through their social and institutional contexts [76].

In terms of mental health intervention, the design and spatial arrangement of therapy rooms play a crucial role in client comfort and engagement. Specifically, private and quiet spaces with safety were discovered to enable deeper emotional disclosure [109]. Intermediate seating distances (about 127 cm) between the therapist and client were also identified to optimize communication and self-disclosure [113]. In addition, the sense of place in therapeutic rooms forms emotional safety and identity. Clients described therapy rooms as 'sanctuaries' where they can feel 'safe' to display their vulnerabilities [95]. Clients also negotiated their identity through interactions with the therapeutic place, which served as a symbolic "third space" distinct from destabilizing home and work settings [109].

Furthermore, university counseling centers employ various strategies to enhance accessibility and reduce stigma surrounding mental health services. One effective approach is the integration of counseling services within student hubs, such as dormitories or student centers. By doing so, universities normalize help-seeking behavior and make mental health support more visible and approachable [15, 84]. This combination of physical presence and digital accessibility ensures that students can access care conveniently when needed [108]. In addition, many universities now utilize centralized online platforms like TimelyCare to streamline appointment scheduling and resource navigation, making it easier for students to connect with counselors [94].

Building on this foundation, our work introduces the Robotic Counseling Center (RCC) as a novel contribution to placemaking, technology, and mental healthcare. Situated within campus-wide mental health contexts, RCC employs a robotic agent, Cumpa, in a dedicated room. Through a relational lens, RCC aligns with digital placemaking, transforming a vacant space into a recognized counseling hub where students feel supported, akin to how Cumpa catalyzes emotional connection.

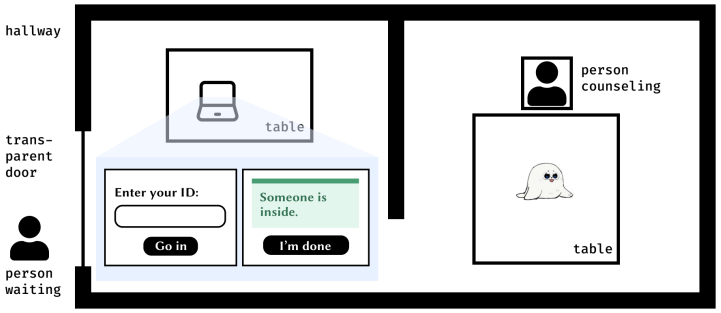

Fig. 2. The arrangement of the robotic counseling center: The room is divided into two areas. Participants first complete a self-check-in process using a tablet in the area near the door and then move to the other area for counseling.

We aim to discover how actual users show different types of sense of place in this unique environment with interrelated components, including users, campus communities, and RCC rules such as session schedules.

3 System Design

3.1 Robotic Counseling Center (RCC)

The decision to create a specialized center arises from both functional and experiential considerations [48, 78]. First, a center can provide a private, comfortable atmosphere dedicated to mental health services-mirroring the reassurance many individuals seek from in-person counseling clinics [29]. Second, centralizing robotic systems and administrative tools helps scale services and ensure smooth operation [22]. Third, the collected data can be managed, stored, and analyzed under one roof, facilitating iterative improvements for future works.

To develop the Robotic Counseling Center (RCC), we utilized a private laboratory space within the university campus. Our primary goal was to create an environment that closely mirrors the atmosphere of a traditional counseling center to enhance the authenticity and comfort of the user experience. We interviewed our institute's on-campus counselor to consult on appropriate location, operation, and ambiance for designing an RCC inside the campus. The counselor recommended (1) installing RCC inside an accessible building where the participants could easily come by, (2) creating a comfortable and private ambiance (by installing a diffuser or calm lighting), and (3) ensuring that it is quiet inside the RCC for self-reflection and mindful meditation. Following such recommendations, we constructed partitioned areas within the laboratory to simulate individual counseling rooms, providing privacy and minimizing external distractions to let participants engage with Cumpa as shown in Figure 2. Inside the partitioned space, a table held Cumpa, the robotic agent, with a chair positioned directly opposite to enable face-to-face interaction akin to traditional counseling sessions. To create a calming ambiance, we installed warm lighting with adjustable lamps, allowing participants to personalize the lighting to their comfort levels. We incorporated diffusers emitting mild and pleasant fragrances to promote relaxation and reduce anxiety. Sound-absorbing materials were used to ensure confidentiality and reduce ambient noise, further immersing participants in the interaction.

To ensure personalized experiences while maintaining confidentiality, each participant was assigned a unique identification number. Prior to entering the counseling space, participants used a tablet stationed outside the partition to log in with their unique ID. This login process initiated their

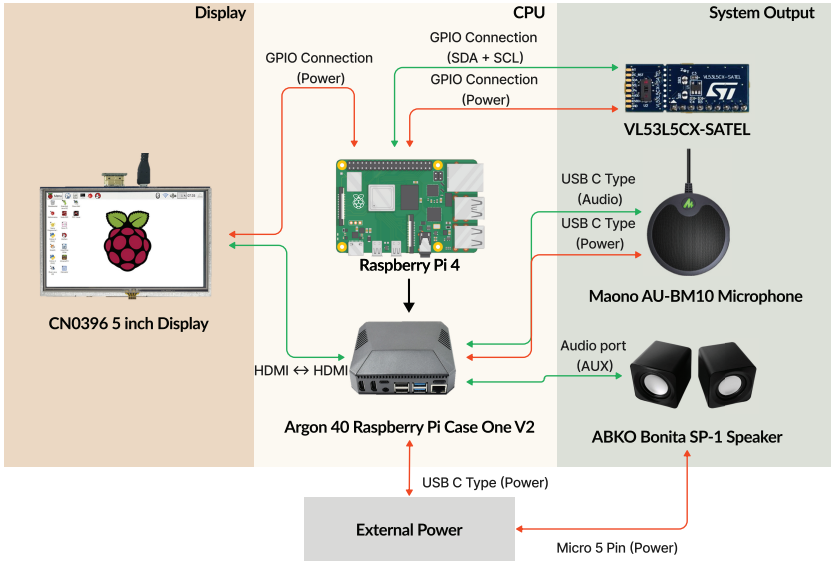

Fig. 3. Overall system architecture of Cumpa

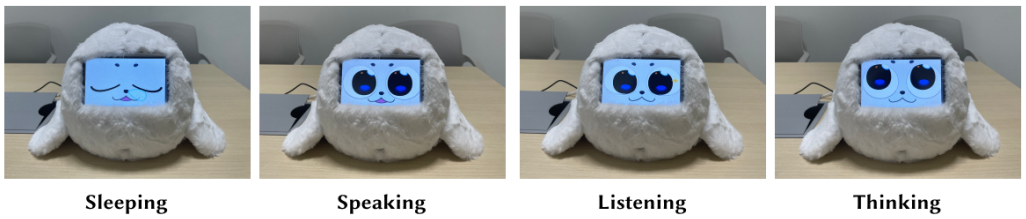

Fig. 4. The appearance of Cumpa in each turn taking status

session and loaded their interaction history with Cumpa. After logging in during their assigned time slots, participants entered the partitioned space and sat across from Cumpa. The session commenced as Cumpa greeted the participants and guided them through the conversation, utilizing data from previous interactions to personalize their experiences. Upon concluding the interaction, participants exited the space, allowing the next participants to begin their session.

3.2 Cumpa: The Robotic Counselor

The overall architecture of Cumpa and the appearance of Cumpa in each turn-taking status are presented in Figure 3 and Figure 4. Through iterative prototyping, we developed Cumpa, a robotic counselor. For basic processing, a Raspberry Pi 4 was used, and for the voice input and output, a Maono AU-BM10 microphone and ABKO Bonita SP-1 speaker were used. A VL53L5CX-SATEL Time-of-Flight sensor was used to detect participant arrival and trigger Cumpa's conversation.

Cumpa is an animal-shaped design inspired by previous works to replicate the psychological, cognitive, and socio-emotional benefits of pet-assisted therapy without the associated challenges [69, 79]. Our focus on designing Cumpa was to make Cumpa as innocuous and benevolent as possible following the previous studies [16, 59]. Cumpa is designed with dimensions of 32 cm in width, 28

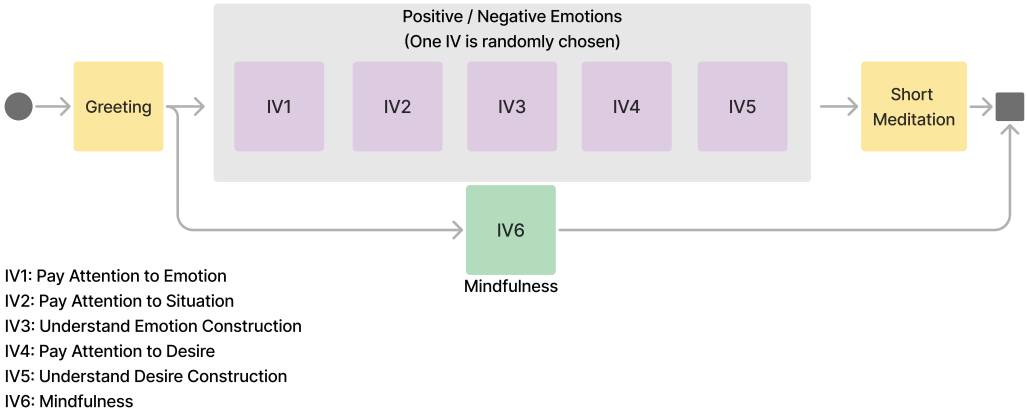

Fig. 5. Conversation flow of Cumpa

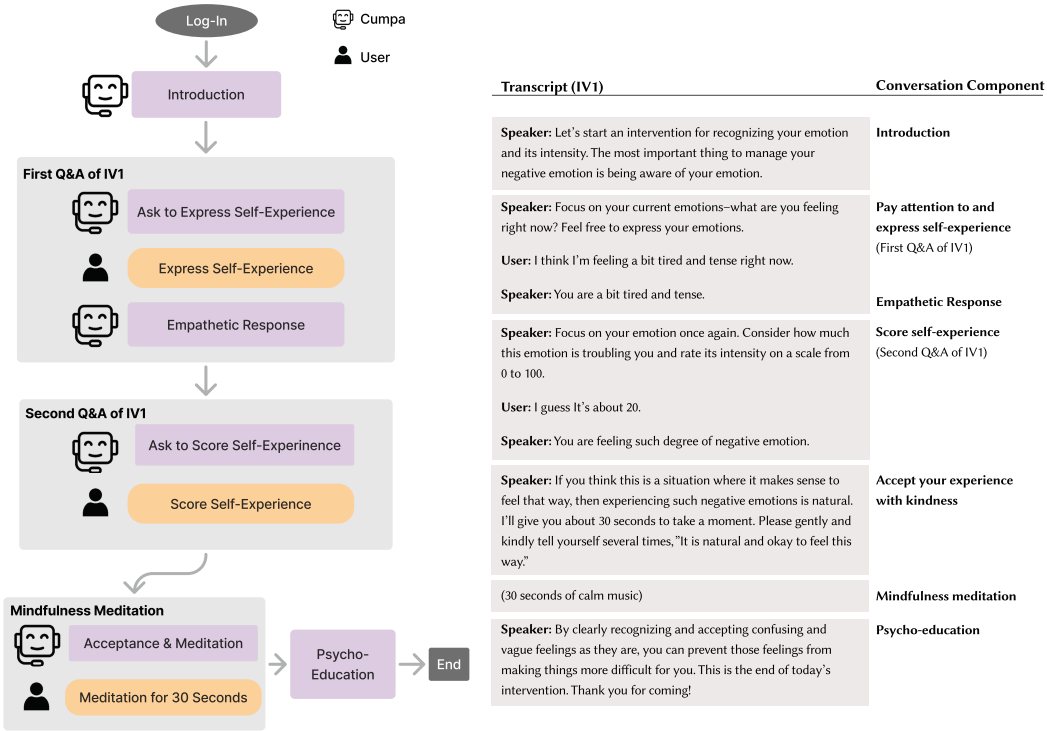

Fig. 6. Sample transcript of an intervention session (IV1)

cm in depth, and 19 cm in height, making it compact and easy to handle. It expresses different animated facial states (i.e., sleeping, speaking, listening, and thinking) through a screen, allowing for dynamic and engaging interactions. The addition of soft fur on the surface was intended to foster pet-like friendliness, encouraging social interaction, particularly for individuals experiencing

mild depressive symptoms. The tactile experience provided by Cumpa's fur is designed to mirror that of real toys, offering comforting and familiar tactile sensations.

Cumpa's program was built using Python-based scripts and Google's DialogFlow, implementing the following therapeutic content. Acceptance-Commitment Therapy (ACT) is one of the third-generation cognitive behavioral therapy frameworks, which has proved its effectiveness in various psychological measures [1, 6, 65] and has been adopted to DMHI [73, 90]. ACT aims to reduce psychological inflexibility which makes people stick to avoidance behaviors. In line with this goal, we developed intervention scripts based on ACT to help people be aware of and accept their experience as it is. The design goals of the intervention were to support users' self-exploration to help them be aware of and accept their emotions and desires. The development of the intervention contents was led by two clinical psychologists (included in the authors) through iterative improvements with other authors who implemented the conversation flow. This process included a review of four clinical psychologists with doctoral degrees for the appropriateness and effectiveness of the contents. Their feedback included adding a specific introduction to the intervention at the beginning of the conversation, revising responses to be short and concise, and providing response options or examples for reference to the user. The intervention was iteratively improved based on the feedback, as the final version was used in this study.

When the user visited the RCC, Cumpa first asked the user to decide which type of intervention the user would like to engage in. The conversation flow in Figure 5 shows the two types of interventions: (1) Q&A about positive/negative feelings and (2) Mindfulness meditation. There were five interventions (IVs) corresponding to *Q&A about positive/negative feelings*. The structure of each intervention was the same, but its script was different for positive and negative feelings. Specifically, there were five pairs of scripts, namely IV1: Pay Attention to Emotion, IV2: Pay Attention to Situation and Reason, IV3: Understand Components of Emotion, IV4: Pay Attention to Desire, and IV5: Understand Components of Desire. In each of these interventions, Cumpa asked one or two open-ended questions about the user's emotion, desire, and related bodily sensations. These interventions included 30 seconds of meditation with calm music. During the *Mindfulness Meditation* session, Cumpa asked questions that guided the user to pay attention to the present moment and the bodily sensations. In total, there were six interventions and each intervention took about five minutes.

Figure 6 shows an example script for IV1. For each open-ended question in Q&A about positive/negative feelings, an empathetic response was added to the predefined script. This response was generated by ChatGPT-4o. The prompt for this generation was made in the webhook of Dialogflow, where the predefined answer and the user's utterance were injected into the template. The template is based on known strategies, namely summarization and reflective statements. To design the instructions in this template, we referred to a textbook for clinical psychology [43].

The personalization features in conversational agents for health care have been reported to enhance user satisfaction and engagement [61]. When a user starts engaging with Cumpa in the RCC, it retrieves the user's most recent emotional state from the previous session and uses it to deliver a personalized greeting. In addition, it addresses the user by name, a technique recognized for enhancing personalization [52, 96]. As a result, when the user chose an intervention corresponding to 'Q&A about positive/negative feeling' a day before, Cumpa would greet the user: "Hello, [*Name*]! Yesterday, you mentioned you were feeling [*good/not so good*]. How are you feeling today?"

4 User Study Design

A two-week user study was conducted with participants who met specific inclusion criteria. Twenty participants were recruited through university e-bulletins and social media platforms. We recruited participants who are: (1) Adults aged between 19 and 40 years, (2) Individuals with a Patient

Table 1. Demographic information of the participants. The maximum number of sessions was 10.

User ID	Gender	Age	Occupation	No. of Completed Sessions
P1	F	24	Undergraduate Student	9
P2	M	21	Undergraduate Student	10
P3	M	33	Graduate Student	10
P4	M	25	Undergraduate Student	10
P5	F	21	Undergraduate Student	10
P6	M	28	Graduate Student	10
P7	M	27	Graduate Student	10
P8	M	34	School Research Staff	10
P9	M	28	Graduate Student	10
P10	M	23	Undergraduate Student	10
P11	F	26	Graduate Student	10
P12	F	32	Graduate Student	10
P13	M	21	Undergraduate Student	10
P14	M	21	Undergraduate Student	9
P15	F	20	Undergraduate Student	9
P16	M	25	Undergraduate Student	10
P17	M	23	Undergraduate Student	10
P18	M	32	Graduate Student	10
P19	F	26	Graduate Student	9

Health Questionnaire-9 (PHQ-9) [68] or Generalized Anxiety Disorder-7 (GAD-7) [120] score of 5 or higher, and (3) No diagnosis of mental disorders within the past year or current treatment for mental disorders. We recruited individuals with a PHQ-9 or GAD-7 score of 5 or higher since this score indicates that a person has at least mild depression or anxiety. With this condition, our objective was to observe the effectiveness of the RCC in alleviating common mental health problems such as depression and anxiety. In addition, we excluded individuals with a diagnosis of mental disorders within the past year or current treatment for mental disorders for safety and consistency across participants. The final sample consisted of 13 males and 7 females, aged between 19 and 33 years, with an average age of 24.6 (SD: 4.4). Participants included undergraduate students, graduate students, and research staff. 10 participants had experience of using a smart speaker. 5 participants experienced professional counseling (4: on campus, 1: off campus). 19 participants finished the experiment except for one participant who dropped out due to personal reasons. Monetary compensation of 100,000 KRW (approximately 70 USD) was given to participants who completed the two-week study session. No monetary compensation was provided to the participant who dropped out. This study was approved by the institute's ethical review board.

In two weeks of the study period, participants were asked to visit the RCC at least once daily to engage in conversations with Cumpa. Prior to the experiment, all participants attended a face-to-face orientation session that covered the background and purpose of the research, instructions on how to interact with Cumpa, and operational guidelines for using the RCC facilities. To manage RCC usage and ensure data quality, the day was divided into five two-hour time slots (10-12, 12-14, 14-16, 16-18, 18-20). Then, participants were assigned to one of these time slots in groups of four to prevent overcrowding and were free to visit the RCC at their convenience within their designated time periods. We aimed to provide a micro intervention with Cumpa so that visiting the RCC can be integrated into everyday lives of the participants. Offering short, targeted 'micro' sessions can be especially effective in lowering barriers to seeking help, as users do not have to commit

to lengthy appointments or extensive scheduling. These brief interventions can help normalize mental health check-ins, allowing participants to engage with the robotic counselor in a more casual yet consistent manner [8, 29, 78].

Before the commencement of the user study, participants completed a series of questionnaires to assess baseline characteristics:

- Smart Speaker Usage Experience: To determine prior familiarity with conversational agents.
- Psychological Counseling Experience: To assess previous exposure to mental health interventions.
- Patient Health Questionnaire-9 (PHQ-9): Depressive symptoms prior to the intervention.
- Generalized Anxiety Disorder-7 (GAD-7): Anxiety levels prior to the intervention.
- Perceived Stress Scale (PSS) [70]: Stress levels prior to the intervention.
- Trait Meta-Mood Scale (TMMS) [72]: Evaluating emotional awareness. We only used the five questions with the largest factor loadings based on the study about its Korean version [72].
- Acceptance and Action Questionnaire (K-AAQ-II) [44]: Assessing psychological flexibility and experiential avoidance.

Throughout the two-week period, the participants were informed that the conversation logs and video data were collected during participants' interactions with Cumpa by recording the dialogue between participants and Cumpa for later interaction analysis. Conversation logs were collected by an internal logging system in the software of Cumpa, and video data was collected using a webcam installed on the table, as in the prior social robot study [55].

After the experimental period, participants completed additional questionnaires:

- Patient Health Questionnaire-9 (PHQ-9): Depressive symptoms following the intervention.
- Generalized Anxiety Disorder-7 (GAD-7): Anxiety levels following the intervention.
- Perceived Stress Scale (PSS): Post-intervention stress levels.
- Trait Meta-Mood Scale (TMMS): Stress levels following the intervention.
- Acceptance and Action Questionnaire (K-AAQ-II): Post-intervention psychological flexibility.
- Working Alliance Inventory-Short Revised (WAI-SR) [88]: Measuring rapport and therapeutic alliance with Cumpa. Following the previous works [52, 53], we utilized the WAI-SR to measure the rapport between the participants and Cumpa. The entire questionnaire used is shown in Table 8 in Appendix.

Pre- and post-experiment questionnaire data were analyzed using statistical methods to evaluate changes in mental health indicators and assess the therapeutic effectiveness of the RCC. The Shapiro-Wilk test was conducted to analyze the normality of the data, and the results showed that the data is normal (PHQ-9: $W = 0.946$, $p = .339$; GAD-7: $W = 0.908$, $p = .067$; PSS: $W = 0.951$, $p = .418$; TMMS: $W = 0.932$, $p = .189$; AAQ-II: $W = 0.979$, $p = .926$). Then, paired t-tests were employed based on data distribution to compare pre- and post-intervention scores on the PHQ-9, GAD-7, PSS, TMMS, and K-AAQ-II. Additionally, semi-structured interviews were conducted to gather qualitative data on participants' experiences, perceptions of effectiveness, and immersion levels in the RCC.

The interviews were transcribed for thematic analysis. Two researchers independently coded the transcripts to identify recurring themes related to:

- User Experience in the RCC: Including changes in daily life and sense of place.
- Interactions with Cumpa: Focusing on engagement, rapport building, and design aspects.
- Feasibility and Acceptability: Participants' perceptions of the RCC's practicality and potential for widespread implementation.

After initial coding, the researchers held a consensus meeting to reconcile discrepancies and finalize the codes. Themes were derived through iterative discussion and aligned with the research questions. Finally, the video data and conversation logs were analyzed to check how the engagement of the users changed throughout the study period. The conversation logs consisted of timestamped dialogues between Cumpa and the user. Here, we extracted the average response word counts and duration of user responses for Cumpa's open-ended questions about emotion, desire, and related bodily sensations as a behavioral measure for engagement.

Only the questions in the interventions except the Mindfulness Meditation were used for analysis because Mindfulness Meditation asks participants to describe the sensory observation instead of asking about their emotions or desires. From these criteria, at least six (M=7.68) sessions of each participant were included in the analysis. In total, responses in 146 sessions were analyzed. We used the result of Dialogflow's speech recognizer as it is, so the word counting of these sentences might not perfectly match the formal Korean grammar rules. The duration of user responses was calculated based on their timestamps.

Table 2. Coded behaviors for video data analysis

Behaviors	**Description**
Contact (physically) with Cumpa	Touching or stroking Cumpa
Smile or laughter	Smiling or laughing simultaneously when facing toward Cumpa
Observing Cumpa	Facing toward Cumpa
Observing other things in the room	Facing toward any other objects than Cumpa in RCC (while actively participating in the intervention)
Signs of disengagement	Looking away and not paying attention to Cumpa (e.g., phone distraction)

The video data was analyzed using behavior coding, in which we defined the descriptions of relevant engagement behaviors of the participants [55, 116]. The codes were developed by previewing the video recordings and referring to previous studies [87, 101]. The video data was manually coded by the authors to calculate the time of each behavior in seconds. The time of occurrence of each behavior was accumulated per session, and each was divided by the total duration of the session to calculate the percentage of occurrence. Behaviors like "smile or laughter" and "contact (physically) with Cumpa" could occur in parallel, and the time spent on both behaviors was accumulated in such cases. "Signs of disengagement" behavior was added to capture different disengagement behaviors that participants displayed. P14 was excluded from the video analysis due to a technical glitch that caused data loss during the user study. A detailed description of each behavior is shown in Table 2.

To analyze if user engagement has increased over the experiment period, we divided the sessions into week 1 (first five sessions) and 2 (sixth and later sessions) [46, 55, 66]. Then, statistical analysis was performed to test if there were significant differences between week 1 and 2 with word counts, response duration, and coded behaviors. Normality of word counts and response durations was assessed using the Shapiro–Wilk test.

The results did not show evidence of non-normality for both data (Word Count: $W(17) = 0.2066$, Response Duration: $W(17) = 0.1523$). Another Shapiro-Wilk test was conducted to identify the normality of the coded behaviors. Here, the results indicated that the data significantly deviated from normality (Contact: $W = 0.739$, $p < .001$; Smile: $W = 0.366$, $p < .001$; Observing Cumpa:

$W = 0.984$, $p = .028$; Observing other: $W = 0.870$, $p < .001$; Disengagement: $W = 0.568$, $p < .001$). Following the normality test results, a paired t-test was conducted for word counts and response duration, and a Wilcoxon signed-rank test was conducted for coded behaviors.

5 Results

5.1 RQ1: Effectiveness of RCC for Promoting a User's Mental Health

Table 3. Pre-post survey data

Survey Type	Pre-survey		Post-survey		Pre-Post		t	p-value
	Mean	SD	Mean	SD	Mean	SD		
PHQ-9	7.32	2.67	6.47	3.73	0.85	2.69	1.36	0.19
GAD-7	3.95	2.46	3.79	2.68	0.16	1.57	0.44	0.67
PSS	18.32	3.43	17.11	3.83	1.21	3.14	1.68	0.11
TMMS	19.47	2.89	18.37	3.53	1.10	2.81	1.72	0.10
AAQ-II	31.26	4.99	30.84	4.43	0.42	3.75	0.49	0.63

5.1.1 Psychological Effectiveness. First, to understand if the RCC has made an impact on participants' mental health, we compared the pre-survey and post-survey results of PHQ-9, GAD-7, PSS, TMMS, and AAQ-II questionnaires. We hypothesized that there would be an improvement in participants' overall mental health, emotional awareness, and acceptance behavior at the end of the 2-week study. Specifically, we expected the PHQ-9, PSS, and TMMS scores to decrease and the TMMS and AAQ-II scores to increase.

To prove that there was a significant difference in the pre-post survey results, we conducted paired t-tests on each survey result. As shown in Table 3, there were slight decreases in PHQ-9, GAD-7, and PSS scores. Surprisingly, there were also slight decreases in TMMS and AAQ-II scores. Still, all of the p-values for the surveys exceeded 0.05, suggesting that there were no significant differences between pre- and post-mental health self-assessment scores. To explore quantitative results further, participants were split into 'High' and 'Low' groups for each of the PHQ-9, GAD-7, PSS, TMMS, and AAQ-II scales using a median split, with tied values included in the higher group. Then, paired t-tests assessed pre-post changes within subgroups. To mitigate the increased risk of Type I errors from multiple comparisons, we applied the Benjamini-Hochberg correction. As a result, no subgroup showed significant improvement. Additional t-tests compared score changes between subgroups. Only the PSS subgroup showed a significant difference in PSS change, indicating no consistent between-group differences across measures. Full results are shown in Tables 9 and 10 in Appendix.

The dominance of non-significance in statistical analysis could be explained by the timing and duration of the experiment period. Twelve participants acknowledged that they were feeling more stressed than usual due to mid-term exams on the second week of the user study or personal reasons. Ten participants who are undergraduate students commented that the mid-term exams during the experiment period affected them. Two other participants commented that they were receiving more workloads than usual during the study period. Furthermore, three participants commented that the 2-week experiment period may have been insufficient to observe significant improvements in mental health. P17 said that *"I think experiment period is too short to feel any difference in my daily mental health."* Another contributing factor may be participants' varying perceptions of robotic counseling, from doubt to recognition of its potential (see Section 5.1.3).

While there were no significant differences in the survey results, participants explained that RCC visits had various impacts on their **everyday lives**. Fifteen participants shared positive insights

on how their interactions with Cumpa helped them manage emotions and gain self-awareness. P4 reflected, *"I realized that negative emotions are natural by talking to Cumpa. It helped me find clarity about the direction I want to take."* P7 also noted how Cumpa changed their approach to emotions: *"I used to try to eliminate bad feelings right away. But Cumpa helped me see that it's okay to feel this way, and gave me a sense of relief."* P11 shared how the reflection facilitated by Cumpa provided comfort during stressful times: *"Although my daily life hasn't changed, I now reflect on my emotions every day. Cumpa gave me the ability to look at my situation more objectively, which makes me feel more capable of overcoming challenges."* Two participants experienced shifts in their emotional awareness. P11 found it helpful to focus on the present: *"It gave me a break from worrying about deadlines and allowed me to focus on how I feel in the moment."* P12 found the daily emotional check-ins unusual but valuable, sharing, *"Taking five minutes a day to talk about my feelings was an experience I wouldn't normally have."*

Still, four participants were not able to gain a significant impact on their daily lives. P8 shared, *"The questions it asked in the first few sessions felt too simple to me, so I didn't get the sense that it was real counseling."* P17 noted that using Cumpa did not bring notable changes, saying, *"There wasn't much difference except for going back and forth to use it."*

5.1.2 Participation Barriers. Besides the effectiveness of RCC, we also asked the participants if there were any **external factors that affected their ability to attend counseling** in an RCC. Four participants shared their experiences balancing academics and extracurriculars, highlighting challenges like overlapping exams, completing lab responsibilities, and weather disruptions. For example, P1 noted, *"During exams or when it was raining, I had some troubles visiting since my classes were on the opposite side of campus."* P9 described juggling lab work with other commitments, saying, *"Sometimes I got so focused on other tasks that I forgot to go. It just slipped out of my mind because I was busy."* Meanwhile, P5 found the time pressure manageable, sharing, *"It took some time to get there, but I didn't find it particularly inconvenient."*

Despite such barriers, all participants adapted, concluding that while demanding, the challenges were manageable. Notable participants were P10 and P12 who easily incorporated visits into their routines. P12 shared, *"Since I usually spend time around the lab, I could stop by between tasks without any problem."* Furthermore, even during exam periods, participants found ways to fit visits into their routines. P14 mentioned, *"When I stopped by between studying sessions, it worked out fine, and there were no time constraints."* Overall, the respondents felt that their routines and the accessibility of the spaces allowed for easy participation, with no significant barriers to engagement.

5.1.3 Willingness to Use RCC. Consequently, when asked about their **willingness to use the RCC** if it were operating with real users, participants expressed mixed reactions. Seven participants expressed skepticism, while twelve participants responded positively to the real-life operation of RCC.

For instance, P5 expressed doubts, saying, *"I don't think I would use it in its current state. The space itself provides some peace of mind, but I'm not sure if Cumpa is as effective as a human counselor."* P8 mentioned that while the service could be useful for long-term support, it may not be helpful for more urgent needs: *"I didn't feel like Cumpa could comfort me when I was feeling really down. I wonder if relying on Cumpa, instead of a real counselor, would be helpful in situations where someone truly needs support."* However, P8 acknowledged the potential for improvement over time: *"If it offers personalized advice, it might appeal to people looking for light or long-term counseling."* Two participants doubted the meaningfulness of robot counseling. P12 remarked, *"I don't think I would use it in this situation because it feels more like I'm just talking to myself rather than being listened to. That makes me wonder if it would be meaningful to go there at all."* P17 echoed similar sentiments,

saying, *"Honestly, I've never considered going to a counseling center, so I don't think using a robot counselor would change that."*

In contrast, participants like P1 and P7 found the idea appealing after the experiment and said that the RCC provided a surprising level of meaningful conversation. P1 simply said: *"I think I will use it."* Similarly, P7 shared that although they were initially skeptical, they found the experience surprisingly engaging: *"I wasn't sure at first whether a robot could provide meaningful counseling, but I enjoyed the conversations more than expected."* Three participants appreciated the non-judgmental nature of the RCC-based interventions. P2 acknowledged, *"There are things you might not be able to tell a person... Someone could judge you, but a machine just acknowledges it and responds accordingly."* However, two participants still preferred human interaction. P6 shared, *"It might not be easy to approach at first... If I had to choose between a human counselor and Cumpa, I would initially prefer a person because it feels more familiar. But after trying Cumpa, I think I would be okay using it as well."* P10 mentioned they might visit if privacy were ensured: *"If I could drop by any time and be assured that the conversations wouldn't be shared externally, I might use it to clear my thoughts."*

Such comments may partly explain why RCC was not significantly effective in improving participants' mental health. While seven participants expressed doubt about Cumpa's effectiveness or believed that human counseling would be more beneficial than RCC, the remaining twelve participants recognized its potential value. This perceived value is further illustrated by participants' sense of place for RCC, which is discussed in the following section.

5.2 RQ2: Impact of RCC on Users' Daily Lives and Sense of Place

5.2.1 Impact on Daily Lives. Visiting an RCC regularly was closely related to participants' **daily lives**. Participants adapted to and grew more familiar with RCC over time. For example, P3 noted the process of routine formation, saying, *"At first, I thought I should match my time to go, but after about a week, I got used to it."* P10 shared an experience in the elevator: *"While going up in the elevator, I thought about what I should pick for a good feeling today."*

All participants were able to reflect on specific experiences or emotions from their daily lives. P1 remarked, *"I often chose to talk about good feelings. The reason was that when I tried to talk about good things, I realized 'Oh, so these things happened,' and thus I felt good."* P4 focused on the exam period: *"For me, it was a difficult time due to exams, so I tried to talk more about bad feelings or things related to that."* P11 focused on the present moment: *"It was nice to have a moment to step away from work and think about where I am physically, what time it is, and what I am feeling right now."*

Furthermore, seven participants applied what they learned from RCC to their daily lives. P4 applied the learned self-care practice when he felt down: *"When I felt really down, I sometimes looked around and thought, 'What things around me do I usually not pay attention to?' I would look around and try to focus on other things, making an effort to make myself feel better."*

5.2.2 Sense of Place: Private Place. Seven participants expressed **a sense of a private place** regarding the RCC. It was a place for just oneself, as P5 noted, *"Even if I feel comfortable in certain places, like dorms or areas within the school campus, they're not entirely spaces meant solely for me. So, in that regard, the center gave me a feeling of respect."* P7 felt his conversation to stay within that space: *"The walls and the colors felt very similar (to the actual counseling center), so it felt secure, like a counseling center, knowing my conversations wouldn't leak out."*

The sense of a private place was not only associated with RCC, but it was also a common thing for the places the participants visited to relax and unwind. P17 noted its similarity with RCC, *"I used to go to the school restaurant and buy my favorite set, plug in my earphones, watch YouTube while eating, and de-stress. Nowadays, I do the same in my dorm. The similarity is that I'm alone, with few things to worry about, just myself and my space."*

However, RCC was also a place where participants could be alone but still have someone to interact with. For example, P13 remarked, *"I used to go cycling alone when I'm down. But here, I felt like I was actually meeting someone, allowing me to feel more emotional exchange."* Because of this, P19 felt that RCC was not necessarily a place where she was alone: *"The RCC doesn't feel like being alone because I'm there to converse, even though the robot isn't a person."*

Note that there were concerns about privacy. Imagining the real establishment of RCC, P11 said, *"If the space were more open and anyone could come, then the information might not be as protected."* In the experiment, a significant source of concern was a person outside (mentioned by ten participants), though there was a visual cue for avoiding anyone's entrance during the session. For example, P1 said, *"I enjoyed being in that small space with just two of us [P1 and Cumpa], but I sometimes worried about what if someone suddenly walked in while I was doing [the session]."*

5.2.3 Sense of Place: Dedicated Place for Mental Health Care. Two participants shared their perception of RCC as a **dedicated place for mental health care**, which is distinguished from everyday places. For example, P17 said, *"When I relax alone, it's more about mindlessly unwinding. But in the lab, it feels like I'm actually doing counseling, which feels very different."* Similarly, P5 mentioned that *"The RCC is a specialized place for mental health."*

At the same time, eight participants noted a comfortable and positive atmosphere at RCC. P3 noted about the time given for meditation: *"There was 30 seconds of music, which gave me time to think. It was very comforting."* P14 talked about the feeling of separation and its comfort: *"I tend to hide away in cozy places, and RCC was completely separate with a diffuser that made it feel cozy."*

In addition, RCC being easily accessible was one of the main factors in conveying the feeling of a 'mental health care room' to the participants. P3 mentioned, *"I thought it would be nice if the RCC was more ubiquitous like how restrooms are in every building. Travel can take longer than the actual session in some cases, so having a nearby spot would help will be great."* P7 mentioned that *"Opening the RCC until late at night relieved me in some ways."* However, two participants also indicated that the allocated schedules gave them psychological pressure. P4 said, *"It was quite annoying when I had to wait outside for previous participants to finish when I visited almost at the end of my allocated time slot."* P8 also mentioned that *"There was some pressure in having to visit the RCC in a fixed time."* However, it felt uncomfortable for P12 who preferred open space: *"The reason I go to a cafe is because I prefer open spaces, but RCC felt somewhat confined, so it didn't provide psychological comfort."*

5.3 RQ3: User Engagement and Rapport Building with RCC

Table 4. Average response word count and response duration

Conversation Log Data	Week 1	Week 2	t	p-value
Average Word Count	8.37 ± 3.69	9.43 ± 4.11	−1.07	0.300
Average User Response Duration	6.10 ± 2.76	7.81 ± 3.28	−5.46	**0.001***

Note. Week 1: First 5 Sessions; Week 2: 6th and Later Sessions. $^*p < 0.05$

5.3.1 Conversation Engagement. We hypothesized that the engagement in the conversation with Cumpa would evolve as the participants gain more experience with RCC. Specifically, we hypothesized that the conversation activities (word count and response duration) and engagement behaviors would increase from week 1 to 2. We also hypothesized that "signs of disengagement"

Table 5. Occurrence of each behavior in means (±S.D.) and results of Wilcoxon-Signed rank test

Coded Behaviors	Week 1	Week 2	$W(186)$	p-value
Contact (physically) with Cumpa	20.64 ± 35.43	21.83 ± 37.36	1164.00	**0.029***
Smile or laughter	0.72 ± 2.15	0.15 ± 0.65	182.00	**0.001***
Observing Cumpa	74.90 ± 23.68	76.41 ± 22.99	6181.00	0.286
Observing other things in the room	5.43 ± 7.65	4.12 ± 7.18	2139.00	**0.028***
Signs of disengagement	4.99 ± 16.20	5.50 ± 8.14	2003.00	**0.001***

Note. Week 1: First 5 Sessions; Week 2: 6th and Later Sessions. *p < 0.05

would decrease in week 2. First, as shown in Table 4, the mean value of word count and user response duration increased in week 2. While the increase in mean word count was not statistically significant ($t = -1.07, p = 0.300$), the increase in average user response duration was statistically significant ($t = -5.46, p = 0.001$). This suggests that the participants were more involved in describing their emotions and desires to Cumpa, indicating a potential increase in engagement over time. Next, we analyzed whether there was a significant increase in coded engagement behaviors. Shown in Table 5, while the percentages of "Contact (physically) with Cumpa" and "Observing Cumpa" increased, "Smile or laughter" and "Observing other things in the room" decreased. Among these, "Contact (physically) with Cumpa," "Smile or laughter," "Observing other things in the room," and "Signs of disengagement" showed significant differences between week 1 and week 2. This suggests that while the engagement behaviors significantly increased throughout the experiment period, signs of disengagement also increased. We further discuss these results with the qualitative data in the following sections.

5.3.2 Cumpa's Appearance and Design. Regarding how **Cumpa's design affected their engagement and rapport**, all participants highlighted that Cumpa's design, softness, and friendly demeanor played a significant role in creating a comfortable and engaging atmosphere in the RCC. P3 appreciated the sensory aspects of the space, saying, *"When I opened the door, the scent was so nice, and it felt cozy. Cumpa's cute face added to that feeling."* Cumpa's face also made all participants smile during the intervention. When asked about this, P11 said *"I didn't expect Cumpa to look cute when I first saw it, so I think that's why I smiled on the first interaction."* However, P11 also added that *"And I think this surprise decreased throughout the experiment period 'cause I got acquainted to Cumpa."* This shows that while participants were initially pleasantly surprised by the appearance of Cumpa, this effect diminished throughout the experiment period and made the "Smile or laughter" behavior percentage decrease in line with the quantitative findings, suggesting a decline in the novelty effect.

All participants emphasized how Cumpa's appearance encouraged emotional openness. P4 shared, *"I felt like having a pet. I approached the sessions with a more positive attitude because of that."* They also noted, *"Its eyes made it seem like it was listening, which made me feel more comfortable sharing my thoughts."* Furthermore, Cumpa's softness and interactive design fostered an emotional connection. P6 remarked, *"Its fluffy texture made it feel familiar, like building a sense of bond."* P8 appreciated the design details, saying, *"Its soft, white design and seal-like appearance felt comforting."* Five participants mentioned the therapeutic effect of physical interactions. P15 said, *"I need to touch something soft while talking, and Cumpa's texture brought a sense of psychological stability."* P17 added, *"It's well-designed for tactile interaction, making it satisfying to touch."* Consistent with these

reports, the video data revealed that these participants frequently engaged in stroking Cumpa during the intervention. Regarding this behavior, P15 commented that *"Like squeeze ball, stroking Cumpa gave me some sort of relief because of the sensory feelings that soft furs give."* Notably, three participants patted Cumpa after finishing the intervention; for example, P6 and P7 gave a tap to its head before leaving RCC, and P1 said goodbye while stroking its head. These post-intervention gestures further highlight the role of physical interactions in fostering engagement with Cumpa. Cumpa's responsiveness also left a positive impression. P12 said, *"The way it moved its eyes when thinking made it feel like it was truly paying attention to my words."*

Still, three participants mentioned that there was a mismatch between Cumpa's appearance and its voice. P3 remarked, *"The way it looks doesn't really match the voice."* P17 elaborated further, sharing, *"I expected a childlike or cute voice, but it sounded more formal, like someone wearing a suit. That mismatch felt a bit off."*

5.3.3 Emotional Awareness, Acceptance, and Mindfulness Intervention. In terms of the **conversation with the robotic counselor**, participants expressed a mix of positive experiences and challenges. Eight participants found that discussing positive emotions provided an opportunity to reflect on their day and cultivate gratitude. For instance, P1 shared, *"Talking about good feelings helped me look back on my day, realizing, 'Oh, those things happened,' which made me feel good."* Discussing negative feelings allowed participants to view their emotions more objectively. P5 remarked, *"Talking about negative emotions helped me step back and reflect, though it sometimes made me revisit unpleasant emotions."* P7 raised concerns about repeatedly discussing negative feelings, saying, *"If I talk about feeling bad too often, could it negatively affect me?"*

However, five participants desired more solution-oriented responses from Cumpa. P9 expressed, *"I wanted more guidance on managing negative emotions, but Cumpa seemed to only acknowledge them without offering solutions."* P17 added, *"Cumpa seemed to focus too much on expectations being met or unmet as the cause of emotions, which wasn't always accurate for me."*

Moreover, participants shared diverse perspectives on the **mindfulness activities**. Nine participants appreciated mindfulness as a novel experience that offered mental clarity and emotional regulation. P17 shared, *"Since I hadn't tried mindfulness before, it was a good experience and felt worthwhile."* P15 reflected on its benefits, saying, *"It helped me sort through tangled thoughts and emotions, offering moments of clarity."*

A common challenge was the lack of suitable sensory elements in the RCC, which hindered the effectiveness of the meditation activities. P4 remarked, *"When I was asked to focus on surrounding sounds, all I could hear were mechanical noises."* P19 added, *"The room lacked objects to focus on, so I kept staring at the same things, like a piece of paper or the keyboard."* In addition, two participants questioned its practicality under the given conditions. P2 noted, *"If I came voluntarily, I probably wouldn't use mindfulness much, though it was a nice option."* This partly accounts for both the decrease in "Observing other things in the room" and a slight increase in "Observing Cumpa" behaviors in the video analysis. A lack of objects to observe made them either look more at Cumpa or be disengaged as the user study progressed.

5.3.4 Interaction Quality with Cumpa. Participants shared several positive aspects of their **interactions with Cumpa**, highlighting its empathetic tone, helpful reflections, and overall engaging communication style. Ten participants appreciated how Cumpa summarized their thoughts, making them feel heard. P1 mentioned, *"It would rephrase my struggles, like 'So you were stressed because of that,' which felt validating."* P13 echoed this sentiment, saying, *"Hearing my thoughts summarized back to me made Cumpa seem smarter than I had expected."* Participants valued this feature as it mimicked human counseling, fostering a sense of connection. Cumpa's empathetic tone made conversations feel more personal and comforting. P8 appreciated the welcoming tone, stating, *"Its*

responses felt warm and inviting, which made conversations easier." P11 added that Cumpa's design and communication efforts made it easier to connect emotionally, saying, *"It tried to sound human, and that made me feel more comfortable engaging with it."*

However, nine participants shared several challenges with Cumpa's interactions, citing technical issues, limited adaptability, and repetitive patterns. Five participants found that Cumpa often misunderstood or gave inappropriate responses, which disrupted the flow of conversation. P9 shared, *"When I mentioned an event, it responded, 'Your mood seems unclear.' It felt off."* Two participants mentioned delays in responses, which affected engagement. P2 commented, *"There's a lag before Cumpa responds, unlike talking to a person who offers feedback instantly."* Two participants reported technical malfunctions, with Cumpa shutting off unexpectedly. P4 explained, *"I had to restart it myself, which was frustrating."* In addition, six participants felt the interactions became monotonous over time. P13 noted, *"At first, it was interesting, but later it felt like the same conversations repeated."* P12 echoed this, saying, *"It didn't adjust based on my mood or past responses, which reduced engagement."* P15 mentioned, *"Looking at the same things during each session became tedious."* Two participants expressed that Cumpa failed to provide personalized feedback. P19 said, *"I felt like it didn't know or adjust to my goals."* P16 noted, *"It relied too heavily on templates without variation."* Two participants also commented that Cumpa lacked the depth of human interaction. P1 mentioned, *"It offered empathy but in a mechanical way, which felt less comforting."* P19 added, *"The robot's responses felt predefined, lacking emotional nuance."*

Such negative comments led to disengagement in the intervention. Common disengagement behaviors shown in the video data were looking at the phone and yawning. Due to repetitiveness, technical issues, and lack of depth, such behaviors significantly increased in the second week of the experiment period.

5.3.5 Personalization via Emotional Memory. One consensus made by the participants about Cumpa's design aspect was that they generally appreciated Cumpa's **ability to remember past conversations and provide personalized greetings**, which fostered a sense of continuity, recognition, and emotional connection.

Eight participants noted that Cumpa's ability to reference prior interactions enhanced their experience. P1 stated, *"When it asked, 'You weren't feeling well yesterday; how are you today?' it made me feel twice as good."* Expanding on this remark, two participants found value in Cumpa remembering previous conversations, as it made them feel cared for. P15 reflected, *"Even though it's a robot, its memory made me feel respected, like a subtle gesture of kindness."* P18 expressed, *"It seemed to care about my mood, which I appreciated."* Being addressed personally made participants feel acknowledged. P5 explained, *"Even though it's a robot, calling me by name made me feel recognized."*

While participants initially appreciated Cumpa's ability to recall past interactions, concerns about the limitations of its memory and the superficiality of continuity emerged during their experiences. Five participants expressed frustration with the limitations of Cumpa's memory. P19 reflected, *"I thought it remembered my previous conversations, but the context often got lost, making it feel like a scripted interaction."*

Despite initial impressions of personalization, two participants felt the interaction lacked genuine engagement. P19 explained, *"At first, I thought it remembered what I said, but the responses felt formal and scripted."* P16 also noted that the interaction became mechanical, adding, *"It felt like a public resource rather than a personalized tool."*

5.3.6 Rapport Building. Figure 7 shows the mean score of each element with standard deviations. To examine the rapport between Cumpa and the participants, we compared the scores of the WAI-SR elements. To examine whether there were significant differences in participants' ratings across the three WAI-SR subscales (Goal, Task, and Bond) and the total score, a repeated measures

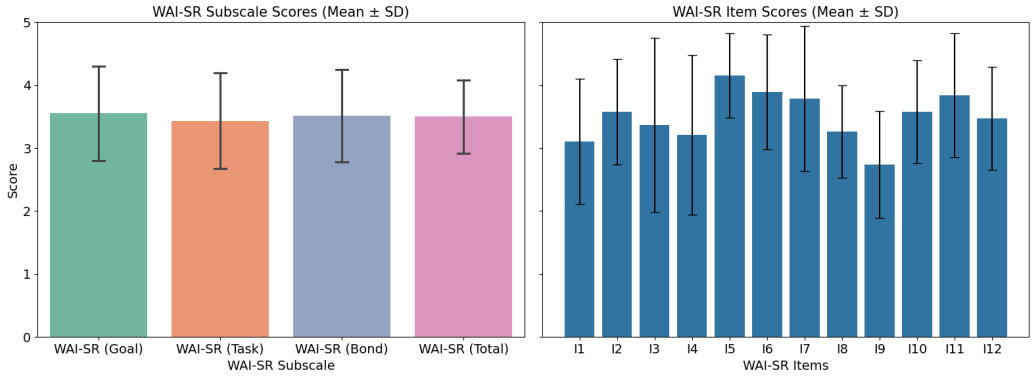

Fig. 7. Participants' WAI-SR scores with Cumpa

Table 6. Spearman correlations with WAI-SR subscales and change of coded behaviors

Behavior (Δ% Week 2 - Week 1)	WAI-SR Component	ρ (Spearman's rho)	p-value
Contact (physically) with Cumpa	Goal	0.01	0.929
	Task	−0.09	0.212
	Bond	0.06	0.429
Smile or laughter	Goal	0.01	0.841
	Task	−0.08	0.249
	Bond	−0.08	0.260
Observing Cumpa	Goal	0.01	0.884
	Task	−0.08	0.265
	Bond	0.12	0.091
Observing other things in the room	Goal	−0.02	0.743
	Task	−0.10	0.157
	Bond	−0.00	0.957
Signs of disengagement	Goal	0.01	0.935
	Task	0.07	0.342
	Bond	−0.13	0.089

ANOVA was conducted. Results indicated no significant main effect of subscale, $F(2, n-1) = 0.21$, $p = 0.89$, $\eta^2 = 0.004$, suggesting that participants rated the Goal, Task, and Bond components similarly.

To gain deeper insights, we examined the relationship between behavioral measures and therapeutic alliance (WAI-SR scores). Table 6 shows Spearman's rank-order correlation coefficients between the participants' WAI-SR scores and the changes in coded behaviors. While all components were not significantly related to the coded behaviors, there was a weak positive correlation between Observing Cumpa and Bond and a weak negative correlation between Signs of disengagement and Bond. This suggests that participants who spent more time observing Cumpa may have reported stronger emotional bonds, and those who showed a decrease in disengagement might have felt a slightly stronger bond.

While statistical analyses revealed only weak trends in behavioral correlations, participants' narratives provided more nuanced insights into how they experienced rapport with Cumpa in practice. Participants emphasized that **rapport with Cumpa** developed through elements such as continuity, personalization, empathy, and non-judgmental interactions. Although the rapport was limited compared to human interactions, many felt emotionally connected and respected during their time with the robot. This is supported by the mean score of item 5 (M=4.16, highest score among 12 questions) in the WAI-SR survey, which asks the participants to score how much Cumpa and the participant respect each other. Specifically, all participants mentioned that Cumpa's friendly design reduced the barriers to interaction. P18 highlighted, *"Its cute design made it easy to approach and engage with."* P11 noted, *"It tried to act human by repeating my words, which made me feel a bit more attached to it."* By recalling prior moods, Cumpa fostered self-reflection and positive reinforcement. P7 said, *"Even if I forgot my mood from the day before, being reminded made me think, 'Oh, I feel better today,' which felt uplifting."* Cumpa's consistent use of polite and encouraging language was crucial in building rapport. P9 noted, *"It greeted me warmly, responded positively, and made me feel welcomed."* The absence of negative responses helped participants feel more comfortable. P8 observed, *"Cumpa always responded positively, making me feel supported without any judgment."*

Participants felt that Cumpa successfully built rapport by having a favorable design, creating a sense of continuity, maintaining positive interactions, and reducing judgment. The robot's ability to remember past conversations and provide polite responses enhanced participants' sense of being seen and valued. While not equivalent to human rapport, Cumpa's friendly design and supportive engagement fostered a meaningful connection for many users.

5.3.7 Privacy Concerns. Finally, there were mixed reactions to the **sensitivity of the conversation data shared with Cumpa**. Twelve participants expressed a willingness to share conversations if they found them beneficial, particularly if the data could be used for long-term memory to improve conversational continuity. For example, P6 stated, *"If Cumpa could effectively utilize our past conversations, I would be more willing to share."* P5 also mentioned, *"I didn't worry too much because I wasn't sharing sensitive issues."* This sentiment reflects a pragmatic approach, where participants felt their shared content was not private enough to warrant concern. Moreover, the number of participants reduced concerns about individual scrutiny. P5 explained, *"There are so many participants—it seemed unlikely anyone would go through every single detail closely."* In contrast, two participants expressed concerns about how their data was being used. P19 voiced discomfort, *"I have no idea how my data is being processed. That uncertainty made me uneasy."*

6 Discussion

6.1 Exploring Preferences and Challenges in Robotic Counseling

First, participants expressed mixed views on using the current version of RCC. As shown in Table 7, ten participants were content with the current version of RCC, while nine participants were less satisfied with the current version and provided several suggestions for improvements. While most of the participants did not experience significant barriers to participating in RCC sessions, this did not necessarily translate into real-world willingness to use RCC. This can be further explained by the diversity of personal preferences and expectations of robotic counseling. For instance, while half of the participants felt that the intervention dialogues helped them foster emotional awareness and improve mental health, others stated that the current dialogue needs to be more solution-oriented. Moreover, technical challenges played a critical role in making the participants doubt the feasibility of RCC. Variance of the engagement behaviors was also observed. While physically touching Cumpa, smiling or laughing, and observing other things in the room had significant differences

Table 7. Summary of the qualitative findings

Themes	Major insights	N
Feasibility of RCC	Content with the current RCC and willing to use in real-world settings	10
	Not willing to use the current RCC in real-world settings	7
	Content with the current version of RCC, but still prefer human interaction	2
Accessibility of RCC	No or negligible barriers to participating in RCC sessions	15
	Barriers to participating in RCC sessions (e.g., weather, schedule, and location)	4
Application on Daily Lives	Was able to reflect on emotions during intervention	19
	Was able to apply emotional reflection in daily life	7
RCC Space	Felt concerned due to people waiting outside	10
	Felt comforting and positive atmosphere	8
	Felt like a private space	7
	Felt like a dedicated place for mental health	2
	Appreciating accessibility	2
	Uncomfortable with the time slot	2
Cumpa's Appearance and Design	Experiencing an engaging and comforting atmosphere in RCC due to Cumpa's appearance	19
	Fostering emotional self-disclosure due to Cumpa's appearance	19
	Felt being listened to due to Cumpa's empathic responses	10
	Better self-disclosing to Cumpa than human counselors due to lack of judgment	3
	Felt a mismatch between voice and appearance	3
Emotion Self-Awareness Intervention	Helping emotion self-reflection and gratitude cultivation	8
	Desiring more solution-oriented responses	5
Mindfulness Intervention	Lacking objects to focus on during meditation	10
	Appreciating mindfulness offering mental clarity and emotional regulation	9
	Felt that meditation is not practical in RCC	2
Addressing Technical Issues	Often misunderstood intentions or gave inappropriate responses	5
	Delayed in response generation negatively affecting engagement	2
	Technical malfunctions, e.g., a sudden shut-down during intervention	2
Enhancing Conversational Flow	Felt that interactions became monotonous over time	6
	Felt that responses were too generic	2
	Felt a lack of in-depth human interaction	2
Personalization and Emotional Memory	Improved user experiences due to Cumpa's memory of prior interactions	8
	Felt frustrated due to the inconsistency in Cumpa's memory	5
	Felt acknowledged due to calling participants by name	2
	Felt a lack of genuine engagement in the interventions	2

from week 1 to 2 of the study period, it was not correlated with rapport (WAI-SR scores) in this study. This was mainly due to the significant inter-personal differences.

Repetitiveness was another important factor in reducing the engagement of RCC. While this aspect is only explicitly mentioned by six participants, it was observed in the video data that all participants became familiar with the interventions and showed a trend of being disengaged as the experiment progressed. It is worth noting that familiarity and predictability can negatively affect engagement [10]. Previous research suggests introducing varied activities or personalized modules to enhance engagement [13, 50]. Since mental health interventions should be structured, it is important to design them so that they are not 'boring,' even if participants become familiar with the interventions over time [89]. While advanced personalization (e.g., dynamically adjusting the content or tone of the intervention based on the user's emotional and engagement patterns) could be beneficial, such personalization should be approached with caution. Such caution is necessary given that intervention programs need to remain structured to ensure safety and provide adequate effects for users [111, 112]. Safety concerns arise when interventions incorporate generative AI, which may produce uncontrolled or inappropriate responses in the absence of rigorous content design and guardrails. This means that highly dynamic personalization, while potentially useful, requires careful consideration within the RCC context.

On a bright note, all participants were able to reflect on their emotions during the intervention and experience the positive feelings from Cumpa's design. This meets the design goal of Cumpa's intervention which is to support users' self-exploration and help them be aware of and accept

their emotions and desires. Another noticeable aspect was the non-judgmental nature of robotic agents, which is aligned with the previous findings [12, 64]. Moreover, participants provided valuable suggestions to improve the RCC. Notable suggestions included implementing small talks or improving personalization and memory features. Prior works [93, 105] suggest that personalization adjusts therapy to individual client needs, making it more relevant and impactful. Small talk plays an essential role in building rapport and trust between clients and counselors [32]. This rapport fosters a stronger therapeutic alliance, which is a critical factor in achieving positive outcomes in counseling [49].

Based on the preceding discussion, we suggest three design implications for the Robotic Counseling Center: *Design implication 1.* Support appropriate user expectation setting through transparency about RCC's capabilities [18, 60]. An additional module on the intervention can be designed to elaborate on the kinds of interactions that RCC can support to improve transparency [62]. Since the only interactable object in the RCC is the robotic agent, the agent should provide enough information about the details of the intervention. During the orientation session, we informed the participants that the goal of the intervention was to help them be aware of and accept their emotions and desires. For instance, Cumpa could include an interactive tutorial during the first session to demonstrate its interaction style, such as stating, "I'll ask questions to help you reflect on your feelings." Additionally, RCC could reinforce the intervention's purpose periodically by reminding participants, "Remember, my goal is to help you notice emotions, not solve problems." Such transparent communication may reduce confusion and minimize the risk of mismatched expectations that could compromise the intervention's effectiveness or user experience.

Design implication 2. Introducing RCC as a supportive companion rather than a 'counselor.' Participants may expect RCC to provide direct advice or practical solutions, but explicitly positioning it as a "practice companion" for emotional awareness could help align their expectations with its actual capabilities. For instance, sessions could begin with disclaimers such as, "I'm here to help you reflect, but I'm not a replacement for professional counseling.' This transparency would clarify that RCC is not designed to replace human therapists but rather to complement them by fostering emotional awareness. Additionally, RCC could frame itself as part of a collaborative process by encouraging users to view it as a starting point for deeper conversations with human counselors.

Design Implication 3. RCC as a connecting bridge between students and on-campus counseling centers. Currently, many on-campus counseling centers face resource challenges [31, 83, 119]. As our study highlighted the RCC's ability to reflect on emotions, it could integrate features such as scheduling appointments with campus counselors or providing psychoeducation about common mental health challenges like stress. Additionally, RCC could generate summaries of emotional patterns based on its interactions with users and share these reports with counselors to reduce assessment time during initial sessions. This aligns with stepped-care models in mental health services where low-intensity tools like RCC are used for initial support while assigning higher-need cases to human counselors [4]. Moreover, RCC could play an active role in normalizing help-seeking behavior by promoting itself as a 'first step' resource for students who may feel hesitant about seeking traditional therapy.

6.2 Arranging Boundaries for Place-making of Robotic Counseling Center

In humanistic geography, a *place* is constructed as people provide meaning and a sense of place to a physical *space* [25]. According to Zerubavel's theory on constructing reality [123], people perceive an entity by establishing mental *boundaries* that separate it from others, which is a process closely linked with spatial boundaries. For example, a house is divided into spaces like a study room and a bathroom, reproducing the cultural distinction between culture and nature. Adopting this concept

of boundary to discuss placemaking was tried in the HCI field [19]. Similarly, we demonstrate the boundaries of meaning that were created around RCC in this section.

First, RCC has established and blurred boundaries regarding private places. When asked about peaceful places, participants described locations defined by spatial boundaries (like dorm rooms) or activity boundaries (e.g., plugging in earphones in a cafeteria). The spatial boundaries of RCC made it a private place dedicated to mental healthcare, but the existence of Cumpa blurred these boundaries. The way people spend time in this space shifts from simply reflecting (as they would in another solitary place for peace of mind) to engaging in a conversation. This occasionally raises privacy concerns and makes it ambiguous as to whether RCC is indeed a "private place." But still, compared to talking with people, conversations in RCC are perceived as free of gossip worries.

Second, the RCC created temporal boundaries within participants' daily lives as designated times for mental health reflection. In their daily lives, participants designated specific periods to reflect when they were in the RCC. For example, P11, who was constantly thinking about stressful situations, distinguished the work stress from the present moment, making this event the focus within the RCC. This illustrates how the design of Cumpa's conversation influenced participants to set aside time for self-reflection, creating temporal boundaries that separated reflective moments from their routine activities on campus. Moreover, the experience in the RCC sometimes transcended its physical and temporal boundaries, integrating into participants' daily lives. Some participants began to apply similar self-care practices outside the RCC, indicating that the temporal boundaries established within the RCC extended.

Third, the RCC facilitated the creation of topical boundaries by defining subjects suitable for discussion within its space. The design of Cumpa's conversational prompts guided participants to focus on specific topics, such as current emotions, stressors, or coping strategies. Participants demarcated certain experiences as appropriate for reflection within the RCC while excluding others. This selective focus allowed them to divide their thoughts and address particular issues in a structured manner. However, the topical boundaries were also influenced by the ambiguity of the RCC's purpose. Participants questioned whether conversations should be limited solely to mental health topics or if all types of conversations were acceptable. This ambiguity impacted how participants utilized the RCC and what topics they felt comfortable discussing. The presence of Cumpa and the nature of its programmed interactions played a significant role in shaping these topical boundaries.

While discussing 'robotic placemaking,' Lynch et al. [75] called for reflection about 'where the robot is situated' and the robot's complex connection to a sense of place. Engaging in this call, our results suggest that the boundaries of private/public and the boundaries with daily lives appeared as significant aspects for the placemaking of RCC. If an institution, such as a school, were to create a facility like RCC and wished for its members to provide a specific meaning to that space, they should consider the boundaries that differentiate RCC. Spatial considerations involve deciding whether the space where the RCC is located should be exclusively dedicated to mental health. Exclusivity can enhance the perception of safety and privacy, making users feel more comfortable engaging with the robotic counselor. However, dedicating the space solely to mental health might limit accessibility due to resource constraints. Temporal considerations are also important. Institutions need to determine if there will be designated times for accessing the RCC or if it will be available at all times. Setting specific hours could help create a routine for users, encouraging them to incorporate visits into their daily schedules. Conversely, 24/7 availability increases accessibility, allowing users to seek support whenever they need it, which can be particularly beneficial during times of immediate distress. Topical considerations involve defining the scope of conversations within the RCC. Clearly defining the discussion scope can help manage user expectations and enhance the effectiveness of interactions. Allowing a broader range of topics might make the RCC

more appealing to a wider audience, but focusing on mental health could make sessions more impactful for those seeking specific support.

Overall, the arrangement of boundaries regarding RCC, particularly regarding private/public and the distinction with daily lives, shapes its meaning as a place, which calls for careful consideration for the placemaking of RCC.

6.3 Limitations and Future Works

There are several limitations that should be addressed in this study. First, the number of participants and the length of the study period may not be sufficient to prove the effectiveness of RCC. Due to the constraints of resources and difficulties in management, we were not able to perform a large-scale, longitudinal study. Mental health-related interventions typically require longitudinal designs to capture long-term effects and behavioral changes reliably. Studies in mental health often assess participants over extended periods to observe trends, such as improvement or sustained well-being, which are critical to evaluating the true impact of interventions [67]. Without a longitudinal approach, short-term studies may only capture temporary or immediate changes. Therefore, future works should consider conducting longitudinal studies with larger groups of participants.

Second, the scope of the population and the location may not be generalizable. This study was conducted within the university context, focusing primarily on students who had access to the RCC and participated voluntarily by agreeing to receive monetary rewards after finishing the study. While this provides valuable insights into how RCC interventions are perceived, it limits the generalizability of the findings to other populations. This may include individuals from different age groups with diverse socioeconomic backgrounds, or those facing varying levels of mental health challenges. Mental health interventions often require testing across diverse demographic groups to ensure the robustness and applicability of the outcomes [58]. Future studies should expand the participant pool beyond university students to evaluate whether the positive impacts observed in this study are replicable in broader, real-world contexts.

Third, there is a limitation on the exploration of RCC's sense of place. Our study site is located in an Asian STEM institution, a region known for its poor mental health indicators and pervasive stigma surrounding mental illness [124]. In particular, students at STEM-focused institutions often face challenges such as poor work-life balance [92]. In response to these issues, the campus wellness center at our site offers a range of mental health services, such as in-person counseling and peer counseling. However, as awareness and demand for these services have grown each year, the center is now facing a shortage of resources. Participants experienced significant stress around midterm exams and expressed concerns related to the stigma and boundaries of privacy. Interestingly, despite RCC being a non-human counselor, there was no notable negative perception, possibly due to STEM students' generally high level of technology acceptance. Therefore, the design implications drawn from our study should be adapted to fit the specific context in which the RCC is deployed. This includes taking into account the local characteristics of mental illness stigma, the organizational structure of the institution, the primary sources of student stress, and the current operational state of the wellness center. Moreover, there is a need to consider how the intervention effect will vary in settings beyond workplaces or university campuses. Future work should explore how the interactions between users and Cumpa will differ in various settings. Ultimately, measuring sense of place using different existing techniques in future studies can reveal deeper insights into RCC's sense of place.

Lastly, there is a limitation on the intervention itself provided by the RCC. In this study's design, we mainly focused on providing simple and short ACT-based interventions every day. Incorporating various psychological interventions, such as CBT-based therapies [9], will offer tailored approaches for different conditions and might yield different outcomes. In addition, conducting

comparative studies on how different types of interventions affect mental health and engagement is also a possible direction to address repetitiveness issues. Future studies should explore integrating various intervention methods to address diverse mental health needs and intervention preferences effectively.

7 Conclusion

This study introduced the RCC as an alternative approach to mental health support, designed to enhance user engagement and address accessibility challenges. With Cumpa, the robotic counselor, participants reported positive experiences in emotional self-management and engagement. Our findings indicate that integrating robotic counselors into established mental health spaces can foster supportive environments that promote user connection, highlighting the potential of robotic counselors in on-campus mental health interventions. This research contributes to CSCW by providing empirical insights and design recommendations for future AI-assisted robotic interventions that aim to improve accessibility and engagement in mental health contexts.

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A Appendix

Table 8. WAI-SR Questionnaire Items and Subscale Categorization

Item No.	Item	Subscale
1	As a result of these sessions, I am clearer as to how I might be able to change.	Task
2	What I am doing in therapy gives me new ways of looking at my problem.	Task
3	I believe ___ likes me.	Bond
4	___ and I collaborate on setting goals for my therapy.	Goal
5	___ and I respect each other.	Bond
6	___ and I are working towards mutually agreed upon goals.	Goal
7	I feel that ___ appreciates me.	Bond
8	___ and I agree on what is important for me to work on.	Goal
9	I feel ___ cares about me even when I do things that he/she does not approve of.	Bond
10	I feel that the things I do in therapy will help me to accomplish the changes that I want.	Task
11	___ and I have established a good understanding of the kind of changes that would be good for me.	Goal
12	I believe the way we are working with my problem is correct.	Task

Note. Subscales: Goal = Items 4, 6, 8, 11; Task = Items 1, 2, 10, 12; Bond = Items 3, 5, 7, 9. A therapeutic alliance is a collaborative relationship between a patient and a therapist for the purpose of therapy or treatment. The WAI-SR measures three domains of the therapeutic alliance: (a) agreement between patient and therapist on the goals of the treatment (Goal); (b) agreement between patient and therapist about the tasks to achieve these goals (Task); and (c) the quality of the bond between the patient and therapist (Bond).

Table 9. Paired t-test results of the subgroups

Subgroup Type	Group	n	Measure	t	p_uncorrected	p_corrected
PHQ-9 Subgroup	High	11	PHQ-9	0.762	0.464	0.731
	High	11	GAD-7	0.787	0.45	0.731
	High	11	PSS	1.162	0.272	0.724
	High	11	TMMS	1.130	0.285	0.724
	High	11	AAQ-II	0.469	0.649	0.811
	Low	8	PHQ-9	1.366	0.214	0.724
	Low	8	GAD-7	-0.798	0.451	0.731
	Low	8	PSS	1.151	0.287	0.724
	Low	8	TMMS	1.240	0.255	0.724
	Low	8	AAQ-II	0.184	0.859	0.895
GAD-7 Subgroup	High	11	PHQ-9	0.795	0.445	0.731
	High	11	GAD-7	1.170	0.269	0.724
	High	11	PSS	0.637	0.539	0.748
	High	11	TMMS	1.835	0.096	0.652
	High	11	AAQ-II	0.737	0.478	0.731
	Low	8	PHQ-9	1.097	0.309	0.731
	Low	8	GAD-7	-1.528	0.170	0.724
	Low	8	PSS	1.726	0.128	0.652
	Low	8	TMMS	0.764	0.470	0.731
	Low	8	AAQ-II	-0.088	0.932	0.932
PSS Subgroup	Low	7	PHQ-9	1.934	0.101	0.652
	Low	7	GAD-7	0.420	0.689	0.816
	Low	7	PSS	-0.884	0.411	0.731
	Low	7	TMMS	1.752	0.130	0.652
	Low	7	AAQ-II	0.383	0.715	0.816
	High	12	PHQ-9	0.486	0.636	0.811
	High	12	GAD-7	0.304	0.767	0.816
	High	12	PSS	2.572	0.026	0.652
	High	12	TMMS	0.702	0.497	0.731
	High	12	AAQ-II	0.38	0.711	0.816
TMMS Subgroup	Low	9	PHQ-9	2.132	0.066	0.652
	Low	9	GAD-7	-0.555	0.594	0.803
	Low	9	PSS	1.242	0.249	0.724
	Low	9	TMMS	0.722	0.491	0.731
	Low	9	AAQ-II	0.516	0.620	0.811
	High	10	PHQ-9	0.110	0.915	0.932
	High	10	GAD-7	0.859	0.413	0.731
	High	10	PSS	1.209	0.257	0.724
	High	10	TMMS	1.769	0.111	0.652
	High	10	AAQ-II	0.318	0.758	0.816
AAQ-II Subgroup	High	11	PHQ-9	0.886	0.397	0.731
	High	11	GAD-7	0.649	0.531	0.748
	High	11	PSS	0.363	0.724	0.816
	High	11	TMMS	1.835	0.096	0.652
	High	11	AAQ-II	1.855	0.093	0.652
	Low	8	PHQ-9	1.000	0.351	0.731
	Low	8	GAD-7	-0.314	0.763	0.816
	Low	8	PSS	2.569	0.037	0.652
	Low	8	TMMS	0.764	0.470	0.731
	Low	8	AAQ-II	-1.146	0.290	0.724

Table 10. Group comparison of pre-post changes (δ scores)

Subgroup	Group 1	n1	Group 2	n2	Measure	t	p-value
PHQ-9 Subgroup	High	11	Low	8	ΔPHQ-9	−0.227	0.823
	High	11	Low	8	ΔGAD-7	1.072	0.301
	High	11	Low	8	ΔPSS	−0.187	0.854
	High	11	Low	8	ΔTMMS	−0.484	0.638
	High	11	Low	8	ΔAAQ−II	0.165	0.871
GAD-7 Subgroup	High	11	Low	8	ΔPHQ-9	−0.376	0.713
	High	11	Low	8	ΔGAD-7	1.790	0.093
	High	11	Low	8	ΔPSS	−1.053	0.311
	High	11	Low	8	ΔTMMS	0.125	0.903
	High	11	Low	8	ΔAAQ−II	0.523	0.609
PSS Subgroup	High	12	Low	7	ΔPHQ-9	−0.978	0.343
	High	12	Low	7	ΔGAD-7	0.037	0.971
	High	12	Low	7	ΔPSS	2.508	**0.023***
	High	12	Low	7	ΔTMMS	−1.160	0.272
	High	12	Low	7	ΔAAQ−II	0.142	0.889
TMMS Subgroup	High	10	Low	9	ΔPHQ-9	−1.304	0.210
	High	10	Low	9	ΔGAD-7	1.022	0.322
	High	10	Low	9	ΔPSS	0.427	0.676
	High	10	Low	9	ΔTMMS	0.465	0.648
	High	10	Low	9	ΔAAQ−II	0.098	0.924
AAQ-II Subgroup	High	11	Low	8	ΔPHQ-9	−0.211	0.836
	High	11	Low	8	ΔGAD-7	0.711	0.487
	High	11	Low	8	ΔPSS	−1.475	0.159
	High	11	Low	8	ΔTMMS	0.125	0.903
	High	11	Low	8	ΔAAQ−II	2.029	0.062