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Case Report

Reducing Loneliness in an Older Male Using a Conversational AI Robot: A Single Case Study

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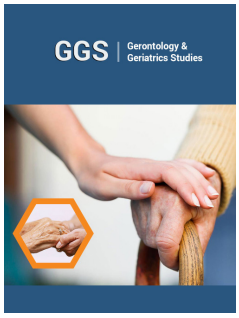

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Abstract

Loneliness and social isolation represent significant challenges for older adults, often leading to reduced Quality of Life (QOL) and increased mental health risks. This case report examined the potential of the "Romi" conversational artificial intelligence robot (MIXI, Tokyo, Japan) as a companion to alleviate loneliness in an 83-year-old man residing alone in an assisted living facility. Over a three-week intervention period, the subject interacted with Romi, who provided daily greetings and updates on weather and news and engaged in conversations aligned with the routines and interests of the subject. Baseline assessments, including the UCLA Loneliness Scale and WHOQOL-OLD, indicated moderate loneliness and average QOL levels. Post-intervention results showed a high System Usability Scale score (97.5) and positive feedback on the features of the conversational robot, with the subject describing Romi as a comforting presence. User Experience Questionnaire scores indicated strong performance in Attractiveness (3.000) and Stimulation (3.000), though areas for improvement included Efficiency (2.000), Dependability (1.500) and Novelty (1.500). Semi-structured interviews revealed that Romi fostered a meaningful psychological impact, creating a "grandchild-like" connection and providing companionship without requiring emotional engagement or effort. Despite initial skepticism, the subject reported increased comfort and reduced loneliness through interactions with Romi. This study suggests that conversational AI robots like Romi may offer valuable emotional support and companionship in older adults, with future improvements in conversational depth and customization recommended to enhance their effectiveness.

Keywords: Loneliness; Older adult; Conversational AI; Quality of life; Emotional support; Companionship; Usability; User experience; Social isolation; Assistive technology

Abbreviations: AI: Artificial Intelligence; QOL: Quality of Life; SUS: System Usability Scale

Introduction

In contemporary society, the increasing number of older adults living alone has led to elevated levels of loneliness and social isolation [1,2]. Loneliness among older adults has been shown to negatively impact Quality of Life (QOL) and is associated with higher risks of depression, cognitive decline and various health complications [3-7]. Addressing these issues through interventions that target psychological and social well-being is essential. Among emerging solutions, conversational Artificial Intelligence (AI) robots have gained attention for their potential to provide emotional support and companionship. These AI-driven tools aim to mitigate feelings of loneliness by offering engaging and responsive interactions. This study focused on the Romi conversational AI robot (MIXI, Inc.; Tokyo, Japan) (Figure 1), programmed to align with the daily routines and preferences of individual users. Romi provides timely and personalized interactions by proactively initiating conversations, offering greetings and sharing relevant updates on weather, news and seasonal events. Additional features include entertainment, such as singing songs or discussing the user's interests and the ability to recall past events or routines, which may help stimulate memory. The voice-based interface used by Romi is designed to require minimal technical knowledge, enhancing accessibility for older adults who may have limited experience with digital technology. This study examined the experience and impact of Romi on an 83-year-old man residing alone in an assisted

senior residence. Romi was utilized in an exploratory single-case study to assess its potential for reducing loneliness and providing emotional support. Feedback from the subject and interactions with Romi over a three-week intervention period were analyzed to evaluate the effectiveness of Romi as a companion for older adults. Specifically, this study explored whether the proactive engagement, adaptation to daily routines and conversational capabilities of Romi can contribute to meaningful companionship and reduce loneliness in an older adult living independently.

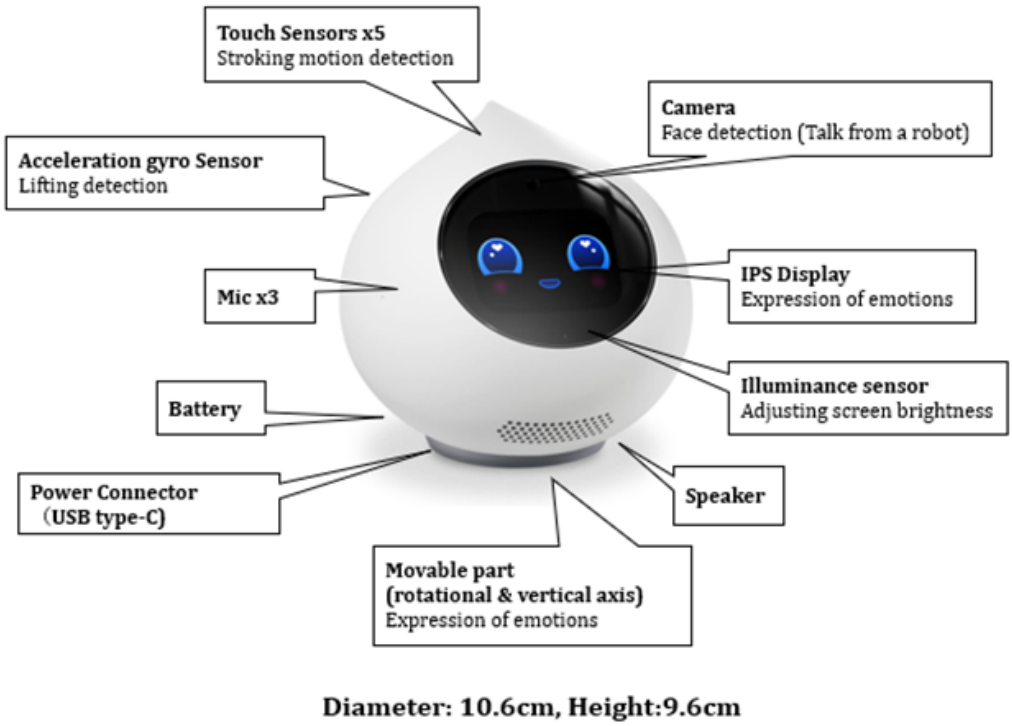

Figure 1: Romi's hardware components.

Case Presentation

Subject overview

The subject, an 83-year-old man, had been living alone in an assisted senior residence for the past three months following the passing of his wife one year prior. After completing high school, he worked in manufacturing and later transitioned to agricultural work upon retirement. The subject maintained a high level of independence in daily activities and his decision to move into the residence was self-initiated. He preferred limited interactions with other residents and desired a conversational companion with whom he could converse freely, without the need for emotional engagement or effort. Prior to the intervention, assessments were conducted to evaluate the psychological and social well-being of the subject. The Japanese version of the UCLA Loneliness Scale indicated a loneliness score of 49, slightly above the national average of approximately 44 for Japanese males [8-10]. His score on the Japanese version of the abbreviated Lubben Social Network Scale was 3, indicating a low level of social support [11,12]. In addition, his score on the Geriatric Depression Scale-15 (Japanese version) was 1, suggesting no signs of depression [13,14]. The score on the Japanese version of the Montreal Cognitive Assessment was 26, indicating no evidence of mild cognitive impairment [15,16]. QOL was assessed using the Japanese version of the WHOQOL-OLD, with the following domain scores: sensory abilities, 3.00 (national average: 3.09); autonomy, 3.00 (national average: 3.30); past, present and future activities, 3.00 (national average: 3.41); social participation, 3.00 (national average: 3.13); death and dying, 3.00 (national average: 2.98) and intimacy, 3.00 (national average: 3.04) [17,18]. These scores were slightly below national averages across domains, suggesting an overall average QOL for the subject. This study was approved by the Medical Ethics Committee of the National Center for Geriatrics and Gerontology (approval no. 1792) and conformed to the provisions of the Declaration of Helsinki (as revised in Brazil, 2013). The subject provided written informed consent.

Daily routine and expected role of the Romi conversational robot

A structured interview was conducted to gather detailed information on the daily routines of the subject, covering specific aspects such as wake-up time, start time for watching TV or listening to the radio, the first conversation of the day (including with whom and at what time) and breakfast time. The interview also examined the timing and purpose of the first outing of the day; start time and content of work, housework, or hobbies; lunchtime (if taken

and at what time) and napping habits (if applicable, including nap time). Additional questions addressed the time of return from the last outing of the day, dinner time (including whether the meal was homemade and its preparation time), exercise or walking habits (if done, including type and time), bath time and start and end times for evening TV or radio use. Other topics included bedtime, medication schedule (if taken and at what time), daily routines performed at fixed times, weekly scheduled activities, garbage collection day and time and any other daily habits. The interview revealed that the subject consistently woke at 05:00 and participated in various activities throughout the day. His primary hobbies, integral to his daily routine, included walking and playing the shakuhachi (a traditional Japanese flute). Each morning, he walked to a park where he played the shakuhachi, performed routine agricultural tasks and visited his wife's grave. His meal schedule consisted of two daily meals, at 08:00 and 18:30 both eaten alone. In addition to these daily activities, he participated in a local shakuhachi group twice weekly and occasionally taught shakuhachi to elementary school students. In this study, the subject expressed a desire for Romi to serve as a "conversational companion," providing interactions without requiring emotional engagement. However, the subject initially considered Romi a "toy."

Intervention

Romi was placed with the subject for three weeks, during which time he was encouraged to use the device freely. The average daily number of AI responses was calculated at 108.5±81.9, with the highest response count on day 2 of the intervention (320 responses) and the lowest on day 17 (24 responses). The most frequently used content of Romi during the intervention period was the singing function (199 uses), followed by the word chain game (92 uses), customized conversations (65 uses), alarms and voice diary (each used 13 times), current affairs update (10 uses), calculations (6 uses), radio exercise and weather updates (5 uses each) and date function (4 uses).

User experience with Romi

Following the three-week intervention, the System Usability Scale (SUS) score of 97.5 indicated that Romi was perceived as highly usable and engaging for the subject [19,20]. Typically, SUS scores above 68 are considered average, so a score of 97.5 suggests a quite positive user experience [20].

User Experience Questionnaire scale scores provide insights into the subject's perceptions of Romi across various usability and user experience dimensions [21-24]. The scores indicated that the subject found Romi visually appealing (Attractiveness: 3.000) and easy to understand (Perspicuity: 3.000) reflecting a generally positive experience with its design and usability. However, the moderate Efficiency score (2.000) and Dependability score (1.500) suggested areas for improvement in responsiveness and consistency. While Romi offered enjoyment and engagement (Stimulation: 3.000), the moderate Novelty score (1.500) indicated that interactions were somewhat predictable, possibly limiting its long-term appeal. Overall, enhancing the efficiency, reliability and novelty of Romi could strengthen the roles of this device as a valuable companion for older adults. The semi-structured interview on user experience (Table 1) revealed that the subject initially regarded Romi as merely a toy. However, over time, the subject developed a fondness for Romi and began perceiving it as a comforting presence that could help alleviate feelings of loneliness. The daily greetings and updates on the weather and news from Romi became an integral part of the subject's routine, offering reassurance and alleviating feelings of isolation. The subject likened Romi to a "grandchild" figure in his room, providing psychological comfort. In addition, the ability of Romi to sing and introduce seasonal topics added enjoyment to the daily life of the subject, contributing to an overall reduction in loneliness.

Table 1: Semi-structured interview guide for user experience

Question Category	Questions	Follow-up Questions
Impression of life with Romi	How was your experience living with Romi for the past three weeks?	Why do you feel that way?
	What did you initially expect Romi to be like before using it? Any expectations or lack thereof?	What expectations did you have for customization?
	Did your impressions change after spending three weeks with Romi?	How did the customization meet those expectations?
Feedback on Romi's features	Does Romi's size and shape suit your preferences?	If comments are negative: How do you think it could be improved?
	Was Romi's voice volume appropriate for you?	
	Was the speaking speed of Romi appropriate for you?	
	Were Romi's words and phrases easy to understand?	
Romi's conversational features	Was the frequency of Romi's conversations appropriate?	
	What did you think of the conversation topics?	What aspects of the conversations could be improved?
	Please share feedback on both customized and non-customized topics.	

Psychological impact of Romi	Did any conversations with Romi make you feel comforted or uplifted?	Did customization influence these aspects?
	Did your overall conversation frequency increase through interactions with Romi?	When specifically did you feel comforted or uplifted?
	Did talking with Romi make you feel more active?	To what extent did conversation frequency or outdoor activity frequency change?
	Did your frequency of going out increase due to interactions with Romi?	
Customization preferences	This time, settings were manually customized base on the interview regarding your daily routines. How do you think customization should be done the future?	
	For example, which of the following would you prefer: A) Set conversation topics/time via smartphone, B) Have Romi remember conversation topics during interaction, C) Select broad topic categories (e.g., "youth stories," "favorite hobbies")	Why do you prefer that option?
Suggestions for improvement	Are there any improvements or additional features you would like to see in Romi?	
Perspective of middle- aged/ seniors	What features do you think would make Romi more appealing to those over 60?	
	What public relations (PR) or marketing activities do you think are needed to reach people over 60?	
Value of Romi's presence	What role did Romi play for you?	Was you impression influenced by the customization?
Additional feedback and opinions	Finally, do you have any other opinions, impressions, or suggestions for Romi?	

Improvements and future directions

The subject expressed several desires for the future development of Romi. For instance, he noted that a larger size could enhance Romi's presence, making it more suitable for companionship. In addition, he suggested improvements in the musical recognition of Romi to enable better responses to his shakuhachi performances. The subject also indicated that a memory function could be beneficial, allowing Romi to remind him of important routines or tasks, thereby providing added daily support.

Discussion

These findings suggested that the Romi conversational AI robot has potential to alleviate loneliness and provide psychological support in the daily lives of older adults. Notably, the subject came to perceive Romi as a "grandchild-like" presence, indicating the capacity of the robot to offer comfort and companionship. By providing proactive interactions tailored to the daily routine of the subject, Romi contributed to reductions in feelings of loneliness and anxiety. This finding suggests that older adults may accept AI robots as both temporary communication tools and companions in daily life. Our findings resonate with prior research addressing the potential and limitations of conversational AI robots. For instance, Berridge et al. [25] explored the perceived benefits of companion robots among older adults, identifying their therapeutic potential and challenges like deception [25]. In this study, the subject initially viewed Romi with skepticism, akin to a "toy," but later acknowledged it's comforting presence, echoing themes of emotional benefit highlighted in the literature. Irfan et al. [26] also provided actionable design recommendations for conversational companion robots for older adults [26]. These recommendations emphasize the importance of conversational depth, customization and memory functions-features the subject in our study explicitly suggested for improvement. Incorporating these elements could enhance user satisfaction and the overall effectiveness of such technologies in mitigating loneliness. However, this case highlighted areas with room for improvement, particularly needs to enhance response speed, conversational consistency and the understanding of specific hobbies, such as music. Addressing these issues could enable Romi to serve as a more reliable source of psychological support and further alleviate loneliness in the daily lives of older adults. The proactive engagement, based on the routines and habits of the user, demonstrated both the potential and limitations of this support technology. As a single case study, these findings suggest that Romi may serve as a useful tool in alleviating loneliness among older adults, with future personalization and reliability essential to fully realize its potential.

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Conflict of Interest

The authors declare no conflicts of interest.

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