Application of psychological and social strategies to increase engagement in human-robot interaction.

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ABSTRACT

The aging population and the advance of new technologies create a gap between the old and the new generations. Social robotics is an emergent field that aims to bring the elderly closer to technology. However, its use and development still need further research to evaluate its benefits in real scenarios. Social robotics also face the challenge of developing practical, usable, and reliable systems capable of interacting with people naturally and comprehensively. Considering the potential of social robots in assisting people, this research presents a novel approach that aims to apply engagement methods, and social psychology to human-robot interaction to improve the users’ acceptance and use of this technology.

KEYWORDS

Social robotics; Human-robot Bonding; Social psychological strategies; Engagement

The aging population and the advance of new technologies create a gap between the old and the new generations. This isolation denotes that the digital development of new devices for the elderly requires robust adaptive designs to achieve their daily use. Older adults’ limited use of technology makes social robots a promising tool in the older adult’s environment to reduce the digital gap and bring them closer to new technologies by providing adaptive assistance. However, this approach has not gained enough engagement due to the limited capabilities social robots can nowadays exhibit. Nowadays, social robotics focuses on many research areas like cognitive stimulation of older people [1] and autonomous decision-making [4] gaining relevance in human-robot interaction. However, obtaining a high level of user engagement has not been explored enough and appears as a promising line to improve robot behavior.

This research line investigates the use of social and engagement strategies to promote the use of social robots. The strategies and skills used take strong inspiration from other technologies like smartphones or social networks, which have demonstrated a powerful impact on society by incorporating novel methods to grab users’ attention. We apply a methodology that aims to enhance the engagement between users and social robots while also providing as much benefit as possible. The project intends to develop and implement state-of-the-art applications into social robots that incorporate social techniques derived from psychology and game theory to improve users’ physical and mental capabilities and engage their attention effectively. This interdisciplinary field combines computer science, social robotics, and human psychology knowledge to develop technologically advanced and socially beneficial solutions.

The proposed methods are developed for Mini [7], a social robot created in the Social Robotics Laboratory at the University Carlos III of Madrid. Mini is a robot conceived to entertain and interact with older adults with an early stage of cognitive impairment. Mini’s goal is to assist them in their daily life to reduce their loneliness. The robot can perform activities like playing games, showing videos, or telling the latest news. Mini carries out these functions thanks to its ability to interact through multimodal interaction, which allows communication and conveys information through different interfaces effectively. The robot has a touch screen, voice generation, or lively gestures to complement its many activities with expressive behavior. Considering the opportunities and capabilities in Mini, this work creates a bond with the user to maximize the interaction time and engagement. To accomplish this goal, we have developed new activities with psychological strategies [5] oriented to improve user experience and the appropriate use of our robot.

Using these strategies has reported positive results in previous works [5, 6], positively impacting the developer’s perspective seeking to strengthen the connection between the user and a technological device and the final users. Nevertheless, from a psychological point of view, these strategies also carry unfavorable connotations due to their association with addictive behavior. Additive behavior, in this context, can be defined as a recurrent behavior initially yielding pleasure but subsequently resulting in a loss of control and disruption to daily functioning [2]. Therefore, and considering the negative impact that the misuse of technology brings to some people, this work explores avoiding the adverse effects of promoting technology use, like social robots using psychological strategies. We divide the strategies we use to generate a high level of engagement between users and robots into two groups:

- General group: The strategies in this group can be generally applied during the normal interaction of the Mini robot. They make the robot behave similarly to a pet to engage the user in the robot’s care. This similarity can positively affect the psychological and physical aspects of the user since it fosters the use of the system [3].
The activities that have been developed are:

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  give the user a more active role in using the robot. Therefore, they are typically based on improving the physical and mental well-being of the user.

  Within the first group of strategies, the one that stands out is *logotherapy*. This strategy focuses on improving the user’s perception that the activity is worthwhile. A second strategy in this group is *variable rewards*. It consists of rewarding the user with incentives at different interaction points. For instance, these incentives can occur at the end of a game when a high score is achieved or when the robot is used for extended time. To implement the strategies described in the general part, we use a biologically inspired model that emulates the different needs that the robot has, similar to those of a pet. The processes included in Mini are feeding, health, affection, and hygiene. These processes create deficits such as hunger, illness, detachment, or dirt. The user’s role is to reduce these deficits giving different objects (electronic tags) that have different effects. For example, giving food to Mini reduces its hunger.

  The *specific strategies* in the second group aim to create a high engagement with different games related to typical activities carried out in day centers or residences. These activities are developed to give the user a more active role in using the robot. Therefore, they are handmade activities using the robot as a support platform. In other words, the robot guides the user in performing the activity. The activities that have been developed are:

  - **Paint and color**: The robot selects a drawing template divided into colored boxes and guides the user to paint it.
  - **Solve a puzzle**: The robot proposes different puzzles and tells the user the type of puzzle and the solution to be found.
  - **Memory games**: The robot proposes various visual challenges or labyrinths for the user to solve.
  - **Buttons games**: The robot has a peripheral with five buttons to play two games. In the whack-a-mole game, the user has to press the button when it lights up. In the Simon game, the user has to remember a light sequence and repeat it.

  The activities affect the robot’s needs (hunger, health, affection, and hygiene) and simultaneously have different strategies to increase user engagement. The robot indicates the level of difficulty of each game (sense of usefulness), the users’ scores (collecting or achievement system), or the variable rewards that users receive. It also minimizes usage friction and seeks the accumulation of temptation by making activities more manual and competitive. Another strategy used is the *beginner’s luck*. That is, games are adapted to the level of the user to maintain frustration.

  Preliminary results that have explored the user of this methodology in human-robot interactions have reported that, on average, users want to spend more time with the robot implementing these methods. This outcome suggests higher engagement between the users and the robot. To provide a detailed analysis of these preliminary results, we are actively conducting tests and refining the implementation of diverse strategies. The overarching objective is to augment user engagement effectively.

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  **REFERENCES**


Figure 1: Mini with the objects, tablet, and button peripheral.