

# A Theoretical Framework For The Development of “Needy” Socially Assistive Robots

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**Abstract.** We suggest a theoretical framework for the design and development of a "needy" socially assistive robot (SAR) for the elderly. Our hypothesis is that a needy SAR will be more readily accepted by those that require them and would result in overall more positive care outcomes when compared to a non needy alternative. This is supported by existing works which indicate traits that can be considered needy are viewed favourably when correctly integrated. We provide guidance on the key design considerations that should be made in order to implement these traits successfully into a SAR. Using this newly created framework we will subsequently proceed to evaluate the effectiveness of integrating a SAR with these traits in a real-world scenario.

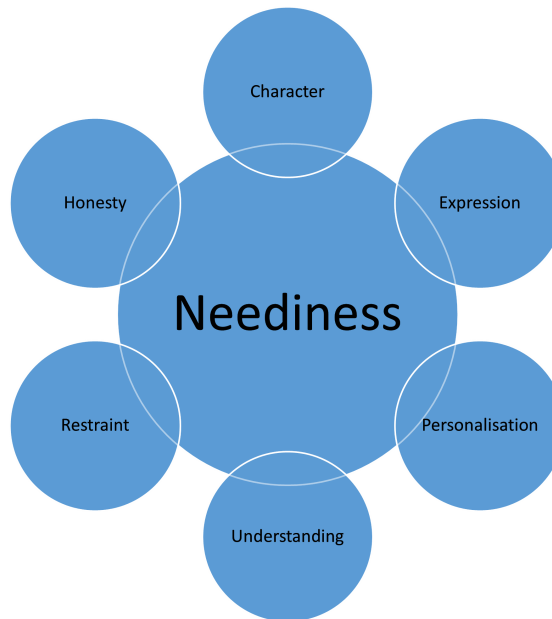
**Keywords:** Socially Assistive Robot · Neediness · Needy · Framework · Elderly · Independent Living

## 1 Introduction and Motivation

The ageing populations of countries[25, 29, 2, 1] have put strain on their respective healthcare systems. Independently living, high-risk individuals, such as the elderly or those living with frailty, can suffer from a lack of interaction [21]. Pets are regularly used to aid with healthy ageing as they provide benefits linked to improving the symptoms of mental health issues, reducing loneliness and isolation [17, 12]. Furthermore, high-risk individuals can find it difficult to take care of animals due to safety concerns [10]. A potential solution to these problems is the use of Socially Assistive Robots (SARs) [11, 6]. SARs do not have the downsides of pets and recent studies have indicated that they are capable of filling a companionship role, allowing them to act as a pet substitute [31, 5]. While research indicates that SARs are an effective means of caring for the elderly [7, 3], their adoption has not yet become widespread. Although work is minimal at present, studies indicate that the creation of SARs with “needy” characteristics results in a greater rate of affection and overall acceptance [18, 9, 15, 4]. Merriam-webster dictionary defines needy as “marked by want of affection, attention, or emotional support” [20]. These traits generally have a negative connotation, however, when employed effectively such as by children or pets, these traits can be

endearing. We evolve the definition of "neediness" in this environment to facilitate inclusiveness to SARs as "a dependence on someone else which is shown through a request of attention and support". While design guidelines exist for the creation of SARs, there is a lack of specific frameworks to aid in the design of much-needed and beneficial SARs with needy characteristics. Through this theoretical framework, we aim to highlight the design considerations that need to be taken to successfully design a needy SAR. Although this framework aims to facilitate the development of a needy SAR for a broad set of users, it has been tailored towards the elderly who are anticipated to be the primary demographic. At present, our research team is collaborating with experts at Gloucester City Homes (GCH) to confirm the validity of these expectations. Several trials are ongoing to evaluate the effectiveness of this framework in an assisted living setting. During these trials we intend to experiment with the implementation of SARs that were designed using this framework by conducting monitored tests with elderly individuals. Surveys and interviews will be conducted in order to appraise whether this framework was able to successfully assist in the design of an effective needy SAR that is readily accepted.

## 2 Framework



**Fig. 1.** Diagram with the key traits that make up the Needy SAR Framework

**Neediness** For a robot to be considered “needy” it must emulate a dependence on the user, such as by requesting that the user simulate the process of assisting or taking care of it. These requests do not need to be limited to speech synthesis, as neediness can be expressed in many different forms, such as through gestures or text. All needy interactions should be positive as perceived enjoyment has an effect on the intention for elderly users to interact with a SAR [14].

**Restraint** As reported in the introduction, neediness can be viewed as a negative trait unless presented in a specific endearing way, or when dependence becomes excessive and unmanageable. Therefore, a robot must not request more support than is viable for the user to provide. An elderly or frail user for example must not feel pressure to perform actions when it would be uncomfortable to do so. In such a situation the robot should either stop prompting or find a different method of interacting with the user. While the user should be encouraged to interact with the SAR, there should be no significant downsides when failing to care for the robot, as this could cause undue stress.

One of the most prevalent barriers to pet ownership is the physical demands of providing care overwhelming older individuals. In some cases this extends to individuals neglecting their own personal health and well being in an attempt to provide this care. [23] It is important that the future development of needy SAR’s does not lead to similar problems.

**Honesty** While anthropomorphism is important in developing empathy for a SAR, it must not attempt to deceive the user into believing that is a living being. Explaining that the SAR is a tool rather than a pet is preferred, particularly for the elderly or disabled, as this can be confusing and demeaning [22]. They must also not be presented as a replacement for human contact. Instead they should be integrated as a method to afford greater independence to the user.

**Character** Robots should have a defined personality as they are viewed more positively than those that stick to formal means of communication [4, 13, 16]. Interaction through friendly and casual means, such as using informal language, can greatly influence the enjoyment that users receive from using SARs [15]. Consistent communication between users and robots forms social bonds between the two, resulting in greater satisfaction [27]. Mistakes with long term consequences can drastically reduce trust [28], however expressing regret and vulnerability by asking for support has shown to increase overall acceptance by endearing the robot to the user [18, 9]. Indicating that these traits, which by our definition would be considered needy, are popular among elderly users.

**Expression** Expressions, both visual and mental, are an important aspect of viewing SARs as a potential companion, rather than a simple tool, and are therefore important for creating a robot that users want to care for. Showing basic human-like characteristics can help with allowing users to feel that they can understand and relate to a SAR [26]. However, these expressions do not always need to be a direct mirror of human expression. Subtle cues that portray emotions can allow users to empathise, even in instances where the SAR is not a humanoid [32]. In order to be perceived as natural these expressions need to be manifested immediately during communication [24].

**Personalisation** SARs should be tailored to suit the preferences of individuals, ensuring that their requirements are kept at the forefront of design to encourage prolonged adoption. Robust personalisation also allows SARS to be adapted to support users with disabilities, increasing overall usability by making sure that vulnerable users are not excluded [30]. Personalising less functionally significant aspects, such as the voice, can help to appeal to different demographics and increase overall enjoyment [8].

**Understanding** Voice control integration has proven to reduce the learning curve for elderly users [24], however barriers to using this method of interaction still need to be considered. While speech recognition technology has seen significant advances, concerns remain surrounding how well they can understand user requests. Elderly people in particular are hindered by this as speech may be slurred or otherwise difficult for the device to understand. This is compounded by a lack of support for multiple languages, as individuals would rather communicate through their first language, which may not be possible [19]. Users being unable to understand existing SARs is a common source of frustration [9]. Enunciation from speech-based robots needs to be clear, as the elderly are more likely to have hearing disabilities. Additional methods of communication, such as through a display, can lessen the severity of these issues [24].

### 3 Summary and Future Work

In this paper, we have suggested a framework with 7 design considerations that current evidence indicates will allow for the successful creation of a SAR with needy traits. It discusses and contains real world examples of where these traits have been successfully implemented resulting in a higher rate of acceptance, as well as instances where a lack of accommodation for these traits has resulted in a lower rate of user satisfaction. We have attempted to address the major problems that have already been identified by the use of existing SARs. These include functional problems, such as the difficulty with understanding that some users have, as well as accommodation for preferences that, while not critical, will provide a more pleasant interaction. In addition we discussed several major concerns that we believe will emerge when developing a needy SAR for elderly demographics, including considerations that need to be made for the common disabilities they face. We intend to expand on this work by utilising this framework to design SARs that will be trialed in housing associations across the UK. While this framework is primarily targeted at the elderly, many of the factors contained within it are suitable for implementation into SARs for a general user base. Work will need to be done to ascertain whether the traits in this framework are equally important to different cultures, age ranges and genders, as current work indicates the expectations and needs of these demographics differ greatly.

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