The Role of Socially Assistive Robots in the Care of Older People: To Assist in Cognitive Training, to Remind or to Accompany?

Sylwia Łukasik 1,2,*, Sławomir Tobis 3,†, Julia Suwalska 4,‡, Dorota Łojko 2, Maria Napierała 2, Marek Proch 2, Agnieszka Neumann-Podczaska 5 and Aleksandra Suwalska 2

1 Institute of Human Biology and Evolution, Faculty of Biology, Adam Mickiewicz University in Poznań, 61-614 Poznan, Poland
2 Department of Mental Health, Poznan University of Medical Sciences, 60-572 Poznan, Poland; lojko@ump.edu.pl (D.L.); mnapierala@ump.edu.pl (M.N.); drp73@poczta.fm (M.P.); asuwalska@ump.edu.pl (A.S.)
3 Department of Occupational Therapy, Poznan University of Medical Sciences, 60-781 Poznan, Poland; stobis@ump.edu.pl
4 Department of Treatment of Obesity, Metabolic Disorders and Clinical Dietetics, Poznan University of Medical Sciences, 60-569 Poznan, Poland; jsuwalska@ump.edu.pl
5 Geriatrics Unit, Department of Palliative Medicine, Poznan University of Medical Sciences, 61-245 Poznan, Poland; ar-n@wp.pl
* Correspondence: lukasik@amu.edu.pl
† These authors contributed equally to this work.

Abstract: The rapid development of new technologies has caused interest in the use of socially assistive robots in the care of older people. These devices can be used not only to monitor states of health and assist in everyday activities but also to counteract the deterioration of cognitive functioning. The aim of the study was to investigate the attitudes and preferences of Polish respondents towards interventions aimed at the preservation/improvement of cognitive functions delivered by a socially assistive robot. A total of 166 individuals entered the study. Respondents completed the User’s Needs, Requirements and Attitudes Questionnaire; items connected to cognitive and physical activity and social interventions were analyzed. Perceptions and attitudes were compared by gender and age groups (older adults ≥ 60 years old and younger adults 20–59). Women showed a more positive attitude towards robots than men and had a significantly higher perception of the role of the robots in reminding about medications \(p = 0.033\) as well as meal times and drinks \(p = 0.018\). There were no significant differences between age groups. Respondents highly valued both the traditional role of the robot—a reminding function—as well as the cognitive interventions and guided physical exercises provided by it. Our findings point to the acceptance of the use of socially assistive robots in the prevention of cognitive deterioration in older people.

Keywords: elderly; cognitive impairment; psychosocial interventions; sustainable technology; socially assistive robots

1. Introduction

The world’s population is ageing: older persons are increasing in number and make up a growing share of the population in virtually every country [1]. The proportion of people aged 65 or more will increase from 9% in 2019 to 16% by 2050 [2]. As the population grows older, the prevalence of age-related diseases such as dementia will surge [3]. Dementia is an umbrella term for diseases characterized by a decline in multiple domains of cognitive function that affects a person’s ability to perform daily activities. Its most common type, Alzheimer’s disease (AD), contributes to 60–70% of all dementia cases [4,5]. Another distinct kind of cognitive decline is mild cognitive impairment (MCI), defined as...
a heterogeneous clinical syndrome reflecting a worsening in cognitive performance and neuropsychological assessment results. MCI does not significantly influence the activities of daily living. However, it is considered to be a risk state for further cognitive and functional decline, with 5–15% of people developing dementia per year. Approximately 50% of people suffering from MCI remain stable for up to 5 years; in some cases, cognitive symptoms improve over time [6,7].

Age is the most important risk factor for cognitive decline, but ageing is not inevitably associated with dementia [8]. A link between cognitive decline and dementia and lifestyle-related risk factors (sedentary lifestyle, smoking, unhealthy diet, harmful use of alcohol) is also indicated. In addition, some diseases, such as hypertension, diabetes, hypercholesterolemia, obesity and depression, are known to be associated with an increased risk of developing dementia. Modifiable risk factors also include social isolation and cognitive inactivity [8,9].

In recent years, many studies have been conducted on the use of psychosocial interventions in people living with dementia and those at risk of dementia based on evidence of modifiable lifestyle risk factors [10,11]. Such interventions can be effective in the management of the clinical symptoms of dementia and can play an important role in the prevention of this disorder in people with MCI and cognitively intact older people at risk of dementia [11]. Psychosocial interventions include a diverse and broad range of treatments [12]. Among them, cognitive rehabilitation (CR), which supports people with dementia and their caregivers using a goal-oriented approach, is particularly important. The aims include, among others, activities of daily living, self-care, social activities and communication, to optimize the ability to function in everyday life [13]. Psychosocial interventions include cognitive training, physical exercise, dietary treatments, art-oriented therapy, reminiscence therapy [12], cognitive stimulation and social activity [8]. Cognitive training involves repeated, planned, structured practice of tasks targeting specific cognitive domains, such as executive functions or memory [14]. Cognitive stimulation is engagement in various types of activities and discussions aimed at the general enhancement of cognitive and social functions [15,16]. Psychosocial interventions, such as cognitive training as well as physical and social activity, are recommended by the WHO guidelines on risk reduction for cognitive decline and/or dementia [8].

The availability of caregivers is not sufficient to keep up with the increasing demand for specialized care. Therefore, it is necessary to explore the applicability of intelligent systems that could enable older people to live independently and make more efficient use of human care services [17]. Sustainable technologies can improve older adults’ health and wellbeing, promote their social inclusion, and facilitate independent living and contribution to the community [18]. Robots are one of the options that could accommodate the widening gap between the need for and supply of healthcare services [19].

So far, several robots have been developed to assist the elderly in various aspects of daily life, including monitoring the environment of the elderly by detecting gas or fire [20], assisting in food preparation [21] and the consumption of meals [22,23], supporting bathing [24] and doing housework [25]. These devices are designed to ensure the safety of the elderly [26,27], inter alia through fall detection [28,29] or by monitoring health [30,31]. They can also compensate for memory impairment through the use of cognitive prostheses—technological solutions compensating for memory impairment and improving the performance of everyday tasks requiring memory [32], for example providing reminders for meetings or of the need to take medicines [33].

Socially assistive robots are designed to develop an interaction with people in an interpersonal manner [34]. Prominent among these are companion robots, which create a close interaction with humans and accompany them to reduce loneliness and mental stress [35]. Another group includes socially assistive robots (SARs), which also develop close, effective interaction with users; however, their purpose is to assist with and achieve measurable progress in rehabilitation or learning [18]. It is stressed that SARs are robots that assist users (e.g., older people, children with autism spectrum disorder) through social
rather than physical interactions [36]. They are also defined as robots capable of providing assistance to the user by means of social interaction. SARs can also be a valuable tool in providing interventions that target cognitive and functional abilities [37–39]. When tailored to the needs and expectations of older people with cognitive impairment, SARs may allow seniors to maintain independence and stay at home for longer [40].

However, even with extensive research and development (e.g., GiraffPlus EU FP7 [31], Mobiserv EU FP7 [41] and Hobbit EU FP7 projects [42]), robots have yet to become prevalent in the homes of older people, and much of the research is driven by technological developments rather than careful consideration of user needs [43]. In the implementation of robots in the care for older people, successful human–robot interaction (HRI) is a key issue [44]. A study by Peca et al. [45] on human–robot interaction showed that a semi-autonomous robot is a better solution than a fully autonomous one for vulnerable populations such as people with cognitive deficits. According to Orejana et al., in order to improve a user’s cognitive function, the robot should take into consideration the user’s situation and develop good collaboration to engage the user in long-term training [38,46].

According to the Technology Acceptance Model (TAM), an individual’s perceptions of technology can impact their decisions regarding its use [47]. It should be stressed that, in order to be successful in introducing such robots to care for the elderly, they must meet the expectations of older people and their caregivers so that they want to use these devices [48]. There is little research concerning robots aimed at counteracting the deterioration of cognitive functioning. In recent years the number of such studies has increased significantly [49]. Research conducted to date in this area has largely focused on the use of robots for cognitive training.

Cognitive training consists of cognition-based interventions designed to provide structured practice in performing tasks connected with aspects of cognitive functioning, such as memory, attention, language or executive functions [50]. It also improves social communication skills [46]. According to Kim et al. [51], conducting cognitive training using robots has greater effects than training carried out in the traditional way, using paper and pencil. This is because exposure to new technology is more difficult and challenging for seniors than using familiar devices, and the novelty effect may not only contribute to increased brain activity but may also enhance seniors’ motivation to participate [51]. Li [52], on the other hand, demonstrated that physically embodied robots are more persuasive, are perceived more positively, and provide better effectiveness compared to virtual agents (chatbots). The role of robots in providing cognitive training is to improve impaired cognitive functions, e.g., memory function [53] and attention [54,55]. Robots can facilitate social interaction, communication and positive mood, thus further improving the efficiency and effectiveness of cognitive training [56]. In a study by Pino et al. [57], better therapeutic behavior was observed in elderly people with MCI, some of whom had reduced depressive symptoms, who participated in memory training using a humanoid social robot (NAO).

To date, several different robots with functions connected with cognitive training have been developed, including Hector (Europe, [58]), Cafero (New Zealand, [59]), IRobiQ (Korea, [60]), Ifbot (Japan, [61]), Silbot (Korea, [51]), Mero (Korea, [51]) and Wam arm [62]. Kim et al. [51] found that multi-domain robotic cognitive training in the elderly has an inhibitory effect on age-related structural changes in the grey matter of the brain. According to Andriella et al. [62,63], cognitive interventions, especially the use of games in the treatment of mild dementia, are very promising, not only in terms of maintaining cognitive performance at the same level but also contributing to its improvement. Older people taking part in such training have been reported to have a lesser decline in the ability to perform daily activities, allowing them to remain largely independent in their own homes [64,65]. Physically embodied robots represent a promising technology that could be used in the future as accessible, effective tools for conducting cognitive training [46].
The development of a socially assistive robot that can provide cognitive training for older people is a challenge. According to Breazeal et al. [34], such a task requires an understanding of human intelligence and behavior across multiple dimensions (i.e., cognitive, affective, physical, social, etc.) as well as a multidisciplinary approach including robotics and artificial intelligence specialists, psychologists, neuroscientists, design engineers and anthropologists. This article describes research into one of the first steps—a study of preferences regarding robot functions. This study was conducted by a multidisciplinary team that included psychiatrists, community therapy specialists, psychologists, an anthropologist and an occupational therapist.

The aim of the study was to investigate the attitudes and preferences of Polish respondents towards psychosocial interventions aimed at the preservation/improvement of cognitive functions, delivered by a socially assistive robot. We examined the perception of individual functions of a SAR as well as age and gender differences in the acceptance of this technology. The results of our study are expected to contribute to a better understanding of users’ needs and requirements for the design and development of socially assistive robots that provide psychosocial interventions for older adults with dementia and mild cognitive impairment and that support their caregivers.

2. Materials and Methods

The data collection was carried out as part of the ENRICHME (ENabling Robot and Assisted Living Environment for Independent Care and Health Monitoring for the Elderly) project, financed within the European Union Horizon 2020 Programme (ID 643691). The aim of the ENRICHME project was to evaluate the use of the robot in the home environment to support patients with mild cognitive impairment [66]. The research was conducted with the consent of the Bioethics Committee of the Poznan University of Medical Sciences (consent number 389/17). The Bioethics Committee did not consider our study a medical experiment; thus, written consent was not required. The subjects received detailed information about the research and that their participation would be voluntary. Questionnaires were distributed and returned anonymously; returning a completed questionnaire was considered implied consent to participate.

2.1. Recruitment

The subjects were recruited in the general population. The group of participants was a convenience sample; the recruitment process took place through advertisements on local radio and in local press, and leaflets and the snowball method were also used. The criteria for inclusion were an age above 18 and a command of the Polish language sufficient to complete the questionnaire. The participants did not receive remuneration for their participation in the survey.

2.2. The Studied Group

The study involved 166 people aged between 20 and 84 years, consisting of 131 women and 35 men. The average age of the studied group was 41.5 ± 18.2 years (men 48.2 ± 19.6, women 39.7 ± 17.4 years). The surveyed persons were divided into two age groups: younger adults, 20–59, consisting of 129 persons, and older adults, 60+, consisting of 37 persons.

2.3. Users’ Needs, Requirements and Abilities Questionnaire

The research was conducted using the UNRAQ (User’s Needs, Requirements and Abilities Questionnaire) survey, developed within the ENRICHME project. UNRAQ contains a series of statements on the function and role of the robot in elderly care and is described in detail elsewhere [67,68]. Participants specify their level of agreement or disagreement on a symmetric agree–disagree Likert scale [69]. In order to obtain a point-based score, the following values are assigned to the answers: I strongly disagree—1 point; I partially disagree—2 points; I neither agree nor disagree—3 points; I partially agree—4 points; I
strongly agree—5 points. The questionnaire was completed in paper form. Participants in the survey did not have any experience with socially assistive robots. Before completing the UNRAQ, they were shown a picture of the Kompai robot (Robosoft, France) for a realistic image of the socially assistive robot concept. The researcher was present at all times during the survey to address questions when needed.

Only the items concerning the psychosocial interventions delivered by SARs are included in this study. The results obtained are presented as mean values and standard deviation (SD).

2.4. Statistical Analysis

All calculations were made using the Statistica 13 package (Statsoft, Poland). Statistical significance of differences between individual groups was assessed using the Mann-Whitey U test. Differences of $p < 0.05$ were assumed to be statistically significant.

3. Results

In the study group, a positive attitude towards robots assisting elderly people was observed. Most of the statements were strongly agreed to by more than half of the participants. The respondents most often strongly agreed with the statements concerning the role of the robot in terms of reminding (about medication, appointments, meals) and helping to find lost objects (over 70% of the respondents strongly agreed). An important finding was that over 75% of the respondents were positive toward memory training, and over 65% toward cognitive stimulation, encouragement and guidance on physical exercises. Less than half of the respondents strongly agreed with statements concerning actions aimed at mood (about 40%), social contacts (about 45%) or the role of the robot as a companion (34%). The results are presented in Tables 1 and 2.

Table 1. Opinions on cognitive interventions of socially assistive robots (SARs) (N = 166) $^a$.

<table>
<thead>
<tr>
<th>Cognitive Intervention</th>
<th>Statement</th>
<th>Strongly Agree (%)</th>
<th>Strongly Disagree (%)</th>
<th>Other (%)</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training</td>
<td>The robot should help the elderly to preserve their memory function, e.g., by playing memory games with them</td>
<td>127 (76.5)</td>
<td>0 (0.0)</td>
<td>39 (23.5)</td>
<td>4.7 ± 0.6</td>
</tr>
<tr>
<td>Stimulation</td>
<td>The robot should have entertainment functions (e.g., gaming partner, reading aloud or playing music function)</td>
<td>110 (66.3)</td>
<td>3 (1.8)</td>
<td>53 (31.9)</td>
<td>4.5 ± 0.9</td>
</tr>
<tr>
<td>Prosthesis</td>
<td>The robot should remind the elderly about medication</td>
<td>149 (89.8)</td>
<td>0 (0.0)</td>
<td>17 (10.2)</td>
<td>4.9 ± 0.5</td>
</tr>
<tr>
<td></td>
<td>The robot should remind the elderly about appointments</td>
<td>124 (74.7)</td>
<td>0 (0.0)</td>
<td>42 (25.3)</td>
<td>4.7 ± 0.6</td>
</tr>
<tr>
<td></td>
<td>The robot should remind about meals and drinks</td>
<td>121 (72.9)</td>
<td>4 (2.4)</td>
<td>41 (24.7)</td>
<td>4.6 ± 0.9</td>
</tr>
<tr>
<td></td>
<td>The robot should help the owner to find lost objects (e.g., glasses, keys)</td>
<td>129 (78.7) $^a$</td>
<td>1 (0.6) $^a$</td>
<td>34 (20.7) $^a$</td>
<td>4.7 ± 0.6</td>
</tr>
</tbody>
</table>

$^a$ Data computed for 164 respondents due to missing data in two questionnaires.
Table 2. Opinions on guided physical exercise, mood and social interventions of SARs (N = 166) a.

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Statement</th>
<th>Strongly Agree (%)</th>
<th>Strongly Disagree (%)</th>
<th>Other (%)</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical exercise</td>
<td>The robot should encourage and guide the elderly to perform physical exercises</td>
<td>113 (68.1)</td>
<td>1 (0.6)</td>
<td>52 (31.3)</td>
<td>4.6 ± 0.7</td>
</tr>
<tr>
<td></td>
<td>The robot should detect the owner’s mood (facial expression)</td>
<td>68 (41.2) a</td>
<td>8 (4.8) a</td>
<td>89 (53.9) a</td>
<td>4.0 ± 1.1</td>
</tr>
<tr>
<td></td>
<td>The robot could decrease the sense of loneliness and improve the mood of the elderly person</td>
<td>60 (36.4) a</td>
<td>9 (5.5) a</td>
<td>96 (58.2) a</td>
<td>4.0 ± 1.1</td>
</tr>
<tr>
<td>Mood</td>
<td>The robot could encourage the elderly to enhance their contacts with friends</td>
<td>72 (43.4)</td>
<td>8 (4.8)</td>
<td>86 (51.8)</td>
<td>4.1 ± 1.1</td>
</tr>
<tr>
<td>Social activity</td>
<td>The robot should initiate contacts with others (calling friends, initiating skype conversations)</td>
<td>76 (45.8)</td>
<td>5 (3.0)</td>
<td>85 (51.2)</td>
<td>4.2 ± 1.0</td>
</tr>
<tr>
<td>Companionship</td>
<td>The robot should accompany the owner in everyday activities (watching TV, preparing meals)</td>
<td>56 (33.9) a</td>
<td>11 (6.7) a</td>
<td>98 (59.4) a</td>
<td>3.9 ± 1.1</td>
</tr>
</tbody>
</table>

a Data computed for 165 respondents due to missing data in one questionnaire.

3.1. Opinions of Women and Men on Cognitive Training

Women and men showed roughly the same high acceptance of statements on cognitive training and cognitive stimulation. Both groups had a relatively low appreciation of the usefulness of mood evaluation and intervention functions and the function of the robot as a companion in everyday activities. Women were more likely to accept individual robot functions. A higher percentage of women than men strongly agreed with reminder and physical activity statements; however, these differences did not achieve statistical significance. In terms of mean values, women had significantly higher scores in terms of reminding about medication and reminding about meals and drinks. The results are presented in Tables 3 and 4.

Table 3. Subjects’ opinions on cognitive interventions of SARs, broken down by gender; Male (M)—N = 35, Female (F)—N = 131 a.

<table>
<thead>
<tr>
<th>Cognitive Intervention</th>
<th>Role of the Robot</th>
<th>Sex</th>
<th>Strongly Agree (%)</th>
<th>Strongly Disagree (%)</th>
<th>Other (%)</th>
<th>Mean ± SD</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training</td>
<td>Help in preserving cognitive functions (memory games)</td>
<td>M</td>
<td>26 (74.3)</td>
<td>0 (0.0)</td>
<td>9 (25.7)</td>
<td>4.7 ± 0.5</td>
<td>0.766</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>101 (77.1)</td>
<td>0 (0.0)</td>
<td>30 (22.9)</td>
<td>4.7 ± 0.6</td>
<td></td>
</tr>
<tr>
<td>Stimulation</td>
<td>Entertainment functions (gaming, reading aloud, playing music)</td>
<td>M</td>
<td>23 (65.7)</td>
<td>0 (0.0)</td>
<td>12 (34.3)</td>
<td>4.6 ± 0.7</td>
<td>0.977</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>87 (66.4)</td>
<td>3 (2.3)</td>
<td>41 (31.3)</td>
<td>4.5 ± 0.9</td>
<td></td>
</tr>
<tr>
<td>Reminding about medication</td>
<td></td>
<td>M</td>
<td>24 (68.6)</td>
<td>0 (0.0)</td>
<td>7 (20.0)</td>
<td>4.7 ± 0.6</td>
<td>0.033</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>100 (76.3)</td>
<td>0 (0.0)</td>
<td>11 (31.4)</td>
<td>4.9 ± 0.4</td>
<td></td>
</tr>
<tr>
<td>Reminding about appointments</td>
<td></td>
<td>M</td>
<td>20 (57.1)</td>
<td>2 (5.7)</td>
<td>13 (37.1)</td>
<td>4.3 ± 1.1</td>
<td>0.367</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>101 (77.1)</td>
<td>2 (1.5)</td>
<td>28 (21.4)</td>
<td>4.7 ± 0.6</td>
<td></td>
</tr>
<tr>
<td>Reminding about meals and drinks</td>
<td></td>
<td>M</td>
<td>25 (71.4)</td>
<td>0 (0.0)</td>
<td>10 (28.6)</td>
<td>4.6 ± 0.8</td>
<td>0.018</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>104 (80.6) a</td>
<td>1 (0.8) a</td>
<td>24 (18.6) a</td>
<td>4.8 ± 0.6</td>
<td>0.187</td>
</tr>
</tbody>
</table>

a Data computed for 129 respondents owing to missing data in two questionnaires.
### Table 4. Subjects’ opinions on other functionalities of a socially assistive robot broken down to gender; Male (M)—N = 35, Female (F)—N = 131.

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Role of the Robot</th>
<th>Sex</th>
<th>Strongly Agree (%)</th>
<th>Strongly Disagree (%)</th>
<th>Other (%)</th>
<th>Mean ± SD</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical exercise</strong></td>
<td>Encouraging and guiding physical exercises</td>
<td>M</td>
<td>20 (57.1)</td>
<td>0 (0.0)</td>
<td>15 (42.9)</td>
<td>4.5 ± 0.6</td>
<td>0.160</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>93 (71.0)</td>
<td>1 (0.8)</td>
<td>37 (28.2)</td>
<td>4.6 ± 0.7</td>
<td></td>
</tr>
<tr>
<td><strong>Mood</strong></td>
<td>Detection of mood (facial recognition)</td>
<td>M</td>
<td>12 (34.3)</td>
<td>1 (2.9)</td>
<td>22 (62.9)</td>
<td>4.1 ± 0.9</td>
<td>0.864</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>56 (43.1)</td>
<td>7 (5.4)</td>
<td>67 (51.5)</td>
<td>4.0 ± 1.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reducing loneliness and mood improvement</td>
<td>M</td>
<td>11 (31.4)</td>
<td>0 (0.0)</td>
<td>24 (68.6)</td>
<td>4.1 ± 0.8</td>
<td>0.839</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>49 (37.7)</td>
<td>9 (6.9)</td>
<td>72 (55.4)</td>
<td>3.9 ± 1.2</td>
<td></td>
</tr>
<tr>
<td><strong>Social activity</strong></td>
<td>Encouragement of social contacts</td>
<td>M</td>
<td>12 (34.3)</td>
<td>1 (2.9)</td>
<td>22 (62.9)</td>
<td>4.2 ± 0.8</td>
<td>0.887</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>60 (45.8)</td>
<td>7 (5.3)</td>
<td>64 (48.9)</td>
<td>4.1 ± 1.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Initiation of contacts (calls, video conversations)</td>
<td>M</td>
<td>18 (51.4)</td>
<td>0 (0.0)</td>
<td>17 (48.6)</td>
<td>4.4 ± 0.8</td>
<td>0.263</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>58 (44.3)</td>
<td>5 (3.8)</td>
<td>66 (51.9)</td>
<td>4.1 ± 1.1</td>
<td></td>
</tr>
<tr>
<td><strong>Companionship</strong></td>
<td>Accompanying in everyday activities</td>
<td>M</td>
<td>12 (34.3)</td>
<td>2 (5.7)</td>
<td>21 (60.0)</td>
<td>3.9 ± 1.1</td>
<td>0.795</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>44 (33.8)</td>
<td>9 (6.9)</td>
<td>77 (59.2)</td>
<td>3.9 ± 1.2</td>
<td></td>
</tr>
</tbody>
</table>

* Data computed for 130 respondents owing to missing data in one questionnaire.

3.2. Comparison of Acceptance of Robot Functions between Younger and Older Respondents

A larger percentage of people in the older age group (over 60 years of age) positively assessed the usefulness of robot functions connected with cognitive training and cognitive stimulation. However, the difference did not reach statistical significance. Mean values for most of the analyzed statements were slightly higher in the older group. The situation was different with regard to the statement concerning meal and drink reminders; there was a tendency towards a difference between older and younger respondents, with mean values lower in older respondents. The results are presented in Figures 1 and 2.

![Figure 1](image-url)  
Figure 1. Opinions of older and younger participants on cognitive interventions using a socially assistive robot (data expressed as % of ‘strongly agree’ answers).
regarding drug reminders and meal and drink reminders. We, therefore, did not confirm the usefulness of reminder functions of robots; there was statistically significant difference in both gender groups. Women gave a higher rating to the reminding functions of robots, but also cognitive training and cognitive stimulation and training) in both gender groups. Women gave a higher rating to the reminding functions of robots, but also cognitive training and cognitive stimulation function improved cognitive functions.

4.2. Opinions on Psychosocial Interventions of SARs—Gender Differences

Our research indicates a similarly high acceptance of cognitive interventions (cognitive stimulation and training) in both gender groups. Women gave a higher rating to the usefulness of reminder functions of robots; there was statistically significant difference regarding drug reminders and meal and drink reminders. We, therefore, did not confirm the results of the Heerink et al. [80] study, in which women “would not want any technology that would help them too much in doing and remembering things” and “would prefer to help seniors to remain independent for longer but can also support the work of doctors and caregivers of the elderly [71]; thus, research in this area is extremely important. Our research was focused on the perception of assistive robots as a potential tool for psychosocial interventions aimed at the preservation/improvement of cognitive functions in seniors. The results revealed a positive attitude towards cognitive intervention delivered by robots, which is consistent with previous reports on the acceptance of assistive robots for older people in the home environment [72].

The most important finding in our work is that older respondents rated highly not only the reminding functions of robots, but also cognitive training and cognitive stimulation, which shows that the elderly are aware of the need to take action to prevent the deterioration of cognitive functions and see the potential of assistive technology in this area. It is crucial to understand older people’s approach to assistive technologies. In addition, the level of acceptance of the individual functionalities of assistive robots is crucial when designing them. This will ensure appropriate interaction between robots and older people and thus make them more effective [73]; even the best-planned cognitive intervention will not produce the desired result if the older person does not wish to participate. Our findings complement the results of previous studies on the perception of robots. Previous studies mainly focused on the general acceptance of the robot or the acceptance of its individual functions [67,72,74–76]. Research to date has focused primarily on the acceptance of robots already produced [77] rather than the expectations of seniors or their caregivers regarding such devices, as in case of this study. It should be noted that the expectations of users of socially assistive robots are not always consistent with the beliefs of those responsible for their design or production [78]. Therefore, knowing the exact needs and expectations of potential users of these devices is crucial and necessary for older people not only to want to use them but also to feel comfortable in their presence [79].

4. Discussion

4.1. Opinions on Psychosocial Interventions Provided by Socially Assistive Robots

Each year, technology is increasingly permeating various aspects of our lives. It is also increasingly applicable to the care of the elderly [70]. Assistive robots not only can help seniors to remain independent for longer but can also support the work of doctors and caregivers of the elderly [71]; thus, research in this area is extremely important. Our research was focused on the perception of assistive robots as a potential tool for psychosocial interventions aimed at the preservation/improvement of cognitive functions in seniors. The results revealed a positive attitude towards cognitive intervention delivered by robots, which is consistent with previous reports on the acceptance of assistive robots for older people in the home environment [72].

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try to remember and do as much as possible without any help until there would really be no way out but to use technology”.

Other studies have also indicated lower acceptance of robots by women. In the study by Cortellessa et al. [81], women were more likely to indicate that a robot can cause problems at home and to keep a greater distance in personal interaction with the robot. Men more often accepted the fact that a robot makes decisions autonomously. It should be noted that the functions that were more accepted by women than by men in our study were simple reminder functions that could be considered beneficial to health and may accepted by women for pragmatic reasons.

4.3. Opinions on Psychosocial Interventions of SARs—The Influence of Age of the Subjects

Our research demonstrated that older people show acceptance of the psychosocial interventions provided by robots. This confirmed the results of the study by Backonja et al. [82], in which most reactions to the psychosocial impact of socially assistive robots did not differ between age groups. Many studies to date on the general acceptance of technology, rather than a specific narrow application as in the case of this study, point to concerns and problems of older people regarding technology, including robots. It is stressed that the current young generation is more technology savvy and may, therefore, be more inclined to using social robots than the current older generation [83]. Younger people who have grown up with the development of technology are often seen as experts and are more positive about new technologies than older people. On the other hand, young people may be more aware of the limitations of technology (e.g., just having functionality does not determine its effectiveness if the training is not properly designed and selected). It is emphasized that when older adults were asked about their perceptions, they were open to new robotic technologies [73,84,85]. Older people may be more accepting of integrating certain robotic technologies into daily life than younger ones [86]; it is thus necessary to adjust strategies and approaches for their needs [82].

4.4. Perception of the Individual Functions of the Robot

Our research showed that older people, potential users of the socially assistive robot (people over 60 years of age) demonstrate a similar acceptance of psychosocial interventions by the robot as that of younger people (aged 20–59). The exception was the meal or drink reminder function of the device. This observation is consistent with previous reports in this respect [67,75]. This may be connected with the desire to maintain the autonomy of the user, a state in which the robot should behave as the user wants and not the other way around [87]. At the same time, for older people, acknowledging that their condition requires a reminder of such basic needs may be associated with a sense of failure [67,75].

The seniors surveyed rated equally high the empowering (related to active cognitive training) and supporting (e.g., reminding about the location of a given object) functions of robots [88]. This is an interesting observation, because the effect of cognitive training will not be immediately noticeable to the user. According to Talaei-Khoei, older people are more likely to accept devices that support them immediately (e.g., hearing aids) than those that are intended to empower them [89]. The positive approach to cognitive training provided by robots observed in our study may be due to the fact that older people are aware of their own limitations and know what they will not be able to live independently in their own homes without and the fact that they see greater chances for independence in training. As a result, they consider long-term activities to be as important as short-term help in the case that they forget where they put something. Similarly, about 70% of the respondents (both younger and older) definitely accepted the role of a robot in encouraging and guiding physical exercise, which can also be seen as an empowering activity. It has been suggested that a key motivation in technology adoption by older adults is the presence of a significant perceived benefit [90]; therefore the beneficial aspects of a socially assistive robot may include the fact that it helps people to help themselves rather than doing it for the user [87].
It is important to note that the functions of a robot such as social activity and interventions concerning mood were rated lower than those aimed at cognitive or physical activity. Average values were about 4 (or 'partially agree'), which still means acceptance. It should be noted that the percentage of people strongly opposed to equipping the robot with these functions ('strongly disagree') was small: up to 5.5% in the younger group and up to 11% in the older group. Low acceptance of the role of a robot as a companion in daily activities is worth noting: as much as 18.9% of older people did not accept this function of robots. Only 40% of older people and 32% of younger people definitely agreed with this task of the robot. It should be noted that many older people in western cultures live independently in their own homes and want to stay there. Socially assistive robots are therefore intended to serve as tools to enable older people to live independently for longer [19]. Subjects in our study group treated robots as a tool for cognitive training and guided physical activity. In addition, only half of the older respondents expected encouragement of social contact, a little more (62%) expected initiation of social contact. Less than half of the older people expected the robot to recognize the mood of the user or help reduce the feeling of loneliness. Such an attitude of older people may result from their fear of the negative influence of robots on their lives, as introducing a robot into an older person’s home may be associated with reducing opportunities for human social contact and the neglect of older people by society and their families. The misconception that a robot meets the emotional and social needs of older people can be a justification for this. Concerns about loneliness and social isolation indicate that robots should not be used to replace human companionship [91]. The robot’s companionship in everyday activities may be also associated with a sense of loss of privacy and autonomy [92]. It is noteworthy that older people in our study considered SARs as multidomain technology. Limiting the cognitive assistance function to making the user remember their plans and taking medication [17] is insufficient. Bedaf et al. [93] highlighted that the introduction of robots is not justified when tasks can be solved equally effectively by a simpler and cheaper technology; for example, robots may not be needed to improve communication between older adults and their relatives. On the other hand, in the wake of the global pandemic, socially assistive robots could be used to maintain social networks, connect with relatives and peers and help with treatment compliance, without the risk of spreading a COVID-19 infection [48,94,95]. Furthermore, it should be noted that seniors’ attitudes towards SARs may change during their use (interaction with the SAR). A study by Portugal et al. [96] showed that seniors are more likely to interact with assistive robots if they have had a previous opportunity to familiarize themselves with SARs; hence, it is conceivable that seniors’ attitudes towards a function that provides them with companionship in everyday life could change over time. For this reason, it is important to design robots in a modular way, i.e., so that it is possible to change or extend their functionality over time if necessary [96].

A thorough analysis of the needs and attitudes of the elderly prior to the design and deployment of social robots is therefore necessary. This stems from the very definition of an SAR: a social assistive robot is a robot, the goal of which is to create close and effective interaction with a human user for the purpose of giving assistance and achieving measurable progress in convalescence, rehabilitation, learning, etc. [97]. If we want SARs to be successful, they need to be accepted by older people [19].

According to the Technology Acceptance Model, it is essential to know when and how people accept technology because acceptance is the determinant of whether people will use a certain technology or not [98]. If people have a positive perception of the usefulness of a technology and perceive this technology as easy to use, the corresponding product will be accepted by the user group [98]. However, it is necessary to bear in mind that this model is mostly applied to technologies that are far into the development stage or are already in use [99], and SARs are still in their development stages and are not yet widely in use. The aim of development of social assistive robots is to provide cost-effective sustainable technology for vulnerable older people. These robots could provide cognitive training and other psychosocial interventions that complete the work of caregivers and
therapists [100]. Our results support the idea of user-driven, rather than technology-driven, robot design and development [101], with involvement of end-users (older people) and other stakeholders (formal and informal caregivers, therapists) [46,101]. The results of our research into the acceptance of psychosocial interventions provided by socially assistive robots may be useful in the design process of robots for the care of seniors, who are often considered a population that requires a custom-tailored integration of robots. They may also be important for healthcare professionals in order to adequately prepare older people for the introduction of sustainable technology, helping them overcome fears related to technology.

4.5. Limitations of the Research and Future Directions

Our research is not without its limitations. One is the relatively small number of people involved in the study, which reduces the chance of detecting effects. For this reason, the results obtained should be interpreted with some caution. It should also be noted that only people living in Poland, whose needs and views on cognitive-enhancing robots may not reflect the views and needs of older people living in other European countries, participated in the study. Different countries have different care habits for their older citizens and different family cultures in general [81]. However, it should be underlined that surveys among inhabitants of one country are justified because they provide the homogeneity of a sample. Another weakness of this study is the lack of interaction between respondents and socially assistive robots.

Finally, we point out some strategies that may prove useful in designing further studies on socially assistive robots in support of older people and their caregivers:

- carrying out the research on a larger group of people who would come from different cultural backgrounds and live in different environments;
- increasing the number of longitudinal studies to examine how older people’s expectations and requirements regarding social robots change with age;
- investigating whether users’ attitudes and expectations towards SARs providing psychosocial interventions change as a result of their interaction with them (e.g., through live demonstration of the device to test subjects), and determining whether they continue to prefer the same functions of the robot;
- forming research teams from different scientific disciplines (medical, technical and social sciences) to conduct more in-depth and comprehensive research on the needs and requirements of older people regarding SARs.

5. Conclusions

Our results revealed a positive attitude of the people surveyed towards the function of a socially assistive robot that enables psychosocial interventions in older people. In the studied group, women assessed the reminder function more positively than men. Seniors, as potential users of socially assistive robots, recognize their potential for providing integrated health and social care in a home environment and see the need to equip such devices with a function for providing the active training of cognitive functions (e.g., through cognitive games). At the same time, they appreciated the usefulness of the reminder function for everyday tasks.

Socially assistive robots can enable older people to live independently and remain at home for longer, which is especially useful for people with mild cognitive impairment and Alzheimer’s disease. However, knowing the exact needs and expectations of seniors with regard to assistive devices is not only important for them to want to use them, but also to feel comfortable in their presence. By focusing on cognitive interventions, we tried to achieve and show a deeper insight into the preferences of older people, as they require a tailored introduction to robots.

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Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Bioethics Committee of the Poznan University of Medical Sciences (protocol code 389/17 and date of approval 6 April 2017).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available upon request from the corresponding author.

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