

## Chapter 54

# An Autonomous Robot-to-Group Exercise Coach at a Senior Living Community: A Study in Human-Robot Interaction

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### ABSTRACT

*A NAO humanoid robot is programmed to act as an autonomous exercise instructor at a senior living community. In an on-site session, the robot does (i) a warm-up routine in which the robot directs participants to ask it to perform various tasks such as dancing and reciting poems and (ii) an exercise routine in which the robot guides participants through various physical exercises such as leg, hand, and neck exercises. The participants include six elderly residents, three nurses/caregivers, and two administrators. The elderly group is categorized with respect to cognitive awareness and physical capability. The session is videoed and then analyzed to measure several dimensions of human-robot interaction with these diverse participants, including affective reaction, effective reaction, and group responsiveness. Following the exercise session, a focus group session is conducted with the seniors and a separate focus group session conducted with the nurses and administrators to glean further data.*

### INTRODUCTION

It is well-known that the elderly population will increase dramatically during the 21<sup>st</sup> century while the population of care-givers will decrease, thus resulting in a social problem to which researchers, entrepreneurs, and governments currently are seeking possible solutions. In the US, for example, by 2050 the

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population aged 65 and over is projected to be 83.7 million, almost double the population of 43.1 million in 2012. Baby boomers are largely responsible for this increase in the elderly population, as they began turning 65 in 2011. By 2050, the surviving baby boomers will be over the age of 85 (Ortman et al., 2014).

There are several reasons that explain the upcoming increase in the elderly population: (i) better lifestyle habits, including a decline in tobacco usage, healthier diets, and an increase in physical and mental exercise, (ii) advances in preventive medicine and better methods of diagnosis, prognosis, and treatment of disease, (iii) advances in assistive technology such as hearing aids, mobility devices, and wearable or implanted technologies that monitor crucial bodily functions, (iv) higher levels of education, which generally correlates with longevity, and (v) enhanced governmental policies such as social security and protection for persons with disabilities, among other reasons. Seniors increasingly choose to age-in-place in their homes or to join a senior living community. Fewer seniors choose to live with and depend on family members.

Assistive robotics is an area that shows promise to aid the elderly in their day-to-day tasks. For example, a companion robot may provide the means to remind the elderly of tasks such as medicine-taking, appointments, visits, and the like. A companion robot also may carry out meaningful conversation with an elderly person, thus alleviating problems of loneliness and depression. Seniors enjoy talking about their past. A robot's knowledge base could be populated with information about important general events during the lifetime of the elder and also with information about specific experiences of the elder (Lewis, 2014a). An animaloid robot may provide companionship also and, like pet therapy, be useful towards reducing anxiety and increasing general well-being. Special-purpose service robots may help with house or apartment chores such as vacuuming, cleaning, cooking, and the like. A tele-presence robot on the elder's premises may provide the means for others to visit the elder remotely, or a tele-presence robot off the elder's premises may provide the elder with the means to visit friends and relatives remotely. All of these possibilities could contribute to an elder person's quality of life. However, in the face of speculation about the kinds of assistance that robots could offer elderly people, there are questions of acceptance, ethics, security, economy, management, and sustainability of such robots (Lewis, 2014b).

Here the authors focus on one sort of service that a robot could provide for elderly people – a motivator for physical exercise. Regular exercise and physical activity are important to the physical and mental health of everyone, including older adults. Regular physical activity can produce long-term health benefits and help reduce the risk of certain diseases and disabilities that develop as people grow older (Exercise and Physical Activity, 2016). Several other researchers are experimenting also with humanoid robots as motivators of physical exercise for seniors (Fasola & Matarić, 2013; Gadde et al., 2011; Görer et al., 2013; Hebesberger et al., 2016; Litoiu & Scassellati, 2015; RoboCoach, 2016).

The pilot study described here involves a session with the humanoid robot NAO serving as an exercise coach on the premises of the Golden Oaks Senior Living Community in Oklahoma, USA on October 23<sup>rd</sup> 2015 (see Golden Oaks Village, 2016). The purpose of our work is to evaluate the interaction between the robot and the elderly residents with a special focus on their affective and effective reactions to the robot. A secondary but important purpose of the study is to evaluate the acceptability of the robot by care-givers and administrators with respect to economy, management, and sustainability. The robot autonomously leads the participants through two forms of interaction: one in which it interacts via various fun tasks such as dancing, telling jokes, and singing, and one in which it interacts more seriously by encouraging the participants to engage in physical exercises, including exercises for the eyes, neck, hands, feet, legs, and torso. The robot and the participants interact in two ways. The first way is via or-

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