The Role of the Physical Embodiment of a Music Therapist Robot for Individuals with Cognitive Impairments: Longitudinal Study

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Abstract— **The world population is growing older. Global aging is occurring at a rate never seen before, it is expected that in 2040 there will be three times more people over the age 85 than there are today. Even if nursing homes and other care facilities can provide assistance, space and staff shortages are already becoming an issue. One of the aims of this work is to show the benefits of robot's physical embodiment in human-robot social interactions. The social therapist robot tries to provide customized cognitive stimulation by playing a music game with the participant. The results of the pilot study over a 6 month period depict a more efficient, natural, and preferred interaction with the robot rather than with the simulated robot.**

Keywords: socially assistive robotics, customizable interaction, human-robot interaction, cognitive stimulation

I. INTRODUCTION

In the recent past years, the rehabilitation and assistive technology focused on developing more flexible and customizable robotic systems. The main goal of these kind of robots is to support disabled and elderly people with special needs in their home environment, and therefore to improve their quality of life. Moreover, most advanced countries are becoming aging societies, and the percentage rate of people with special needs is already significant grow. This methodology focuses on hypothesis-testing by using the socially assistive robotics (SAR) technology aimed at providing affordable personalized cognitive assistance, motivation, and companionship to users suffering from cognitive changes related to aging, dementia and/or Alzheimer's disease. This work aims to validate that a robotic system can establish a productive interaction with the user, and can serve to motivate and remind the user about specific tasks/cognitive exercises.

II. METHODOLOGY AND RESULTS

The experiment consists of repeated sessions, during which the user and the computer/robot interact in the context of a music cognitive game called "Name That Tune". A learning and adaptation system that aims to maximize the user's task performance on the cognitive task was developed. The objective measure used in the study is the button pushing

Figure 1: The two conditions that are tested: (a) The image represents the human-robot interaction and (b) The image illustrates the human-computer interaction (the participant will see on the computer the simulated robot)

reaction time for both song and silence detection. The main goal is to minimize the reaction time and maximize the number of correct answers, signifying improvement of cognitive attention. The robot/computer attempts to achieve this goal by modeling the level difficulty of the game: easy, medium, and difficult. The robot (or the simulated robot on the computer) uses its body and arms to congratulate/disapprove the correct/ incorrect answer to the game.

The pilot experimental group consisted of 3 participants from Silverado Senior Living care facility. All the participants were seniors over 70 year old suffering of cognitive impairment and/or Alzheimer's disease. This is a 12 months study. The results obtained with our 3 participants suggest that the elderly preferred the robot to the computer. The computer with the simulated robot was perceived more as a TV, and did not receive as much attention as the physical robot; in fact two out of the three participants paid no attention to it (see Figure 1). The pilot study results already show promise for our approach.