# Can occupational therapy manpower be replaced with social robots in a singing group during COVID-19?

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**Abstract**.
**BACKGROUND:** Prior to the COVID-19 global health emergency, reducing direct contacts between therapists and patients is an important issue, and could be achieved by using robots to perform certain caring activities.
**OBJECTIVE:** This study compares therapeutic factors of singing group activities directed by social robots and by occupational therapists at elderly care centers during this COVID-19 outbreak.
**METHODS:** This project has a quasi-experimental research design, based on a pilot study of 14 subjects aged above 65 years. They received eight sessions of singing group therapy given by a social robot or an occupational therapist. Completed copies of a therapeutic-factor questionnaire were then collected.
**RESULTS:** At the 4th week, the scores for 8 therapeutic factors were higher in sessions with the occupational therapist than the robot-directed sessions, reaching a statistically significant level; at the 8th week, the scores for 3 therapeutic factors, including imparting of information, were higher in sessions with the occupational therapist than in sessions with the robot. The top scoring therapeutic factor in the robot sessions was group cohesiveness.
**CONCLUSIONS:** Social robots may be good companion tools for elderly care during this COVID-19 outbreak, but group therapy sessions supervised by real-person therapists still have higher therapeutic factor scores than those conducted by robots. The number of subjects needs to be increased to enhance the validity of future study results.

Keywords: Occupational therapist, social distancing, group therapy, therapeutic factors, pandemic, COVID-19

## 1. Introduction

During this COVID-19 outbreak, epidemic prevention and social distancing is an important issue for long-term care institutions, and measures to reduce contact infection are therefore worthy of consideration and study [1]. COVID-19 will inevitably have an impact on the intervention methods of future occupational therapy [2]. Using robots to carry out certain caring activities is likely to lower direct contact between therapists and patients amid the epidemic, while also maintaining mental health. Medical staff have prevented the spread of COVID-19 more successfully in Taiwan than in other countries [1]. This research article thus presents a study of the application of social robots

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to assist occupational therapists with singing group therapy under COVID-19.

Robots are still mainly adopted for physiological applications, such as surgical operations and post-stroke habilitation [3–5], and not much for psychological care or reducing contact infections. A study of 23 cases at a veterans' center found that using social robots for companion care could improve the subjects' expression of emotions and reduce their negative emotions, and identified robotic care as a significant non-drug therapy intervention for mental health [6]. Another study used companion robots to care for five senior-center patients, and found that the curative effects varied among the patients. Nevertheless, social robotics still merit further development [7].

Group therapy is very common method of psychological care for senior people. The effectiveness of social robots in conducting group and recreational activities is worthy of study when considering the therapeutic effectiveness of group therapy.

Another previous study found that a social robot as a companion can increase a patient's sense of comfort, and that even brief, daily robotic companionship can bring positive improvements to physical and mental health for patients with mental illness. [8]. However, due to the relatively small number of related research articles so far, the use of social robots for senior care and mental care certainly merits further study [7, 8].

Yalom identified factors that can affect it, called "therapeutic factors". Kanas created a list of 12 such factors [9, 10], and scored them based on patients' feedback from and feeling about their group-therapy sessions. These 12 factors, which are often adopted to assess the effectiveness of group therapy [10], are altruism, group cohesiveness, universality, interpersonal learning, development of socializing techniques, imparting of information, catharsis, imitative behavior, the corrective recapitulation of the primary family group, self-understanding, instillation of hope and existential factors [9, 10].

Using robots can reduce COVID-19 contact infections and enable flexibility in the use of medical manpower. The application of robotics to health care is now being taken increasingly seriously. However, studies about the benefits of robotic care focus more on physiological than psychological care. Whether robots can take over the psychological effects brought about by real-person occupational therapists remains a very worthy research issue in this era of manpower shortage for long-term care.

Previous studies about applications of social robots in long-term care have focused on the field of physiology, while few study the effectiveness of group therapy based on therapeutic factors. Additionally, due to the limited number of test cases, persuasive evidence for robotic care's effectiveness is lacking. The purpose of this research project is to compare the therapeutic factor scores of group therapy activities at an elderly care center directed by social robots and by occupational therapists, for use as reference for the distribution of medical manpower during the next pandemic.

## 2. Method

### 2.1. Research design

This project adopted quasi-experimental research design. Real-field sample cases were accumulated, to ensure that the study reflected clinical reality. The subjects, most of whom were residents of an elderly care center, received eight sessions of group singing therapy activities, supervised by either social robots or occupational therapists. The differences in therapeutic factors between these two groups were analyzed using a therapeutic-factor questionnaire immediately after the fourth and eighth activities. This study took place between May and July 2020.

### 2.2. Participants

The 14 subjects of this study were aged 65 or over, from a New Taipei City senior care center, healthy or sub-healthy, had no diagnosis of dementia, and had MMSE scores above 28. They all understood instructions, with no communication problem or hearing loss. As volunteers were solicited, these residents had come forward to act as subjects of this study.

### 2.3. Research tools

This project adopted the following tools.

(1) The a assessment tool for therapeutic factors: the therapeutic factor questionnaire in this study is taken from the therapeutic factor flashcards of the Chinese Association of Group Psychotherapy. The assessment method was the same as that adopted by previous investigators. The highest score was 10 points, and the lowest score was 2 points [11, 12].

(2) This study adopted the Zenbo® social robot (ASUS Company, Taipei, Taiwan), which can play songs and music, lead a singalong and play videos.

## 2.4. Procedure

A social robot and an occupational therapist each ran a singing therapy group once a week for 40 minutes, for eight weeks. The combined number of sessions for both groups was thus 16. Each singing-group therapy session included 5–10 minutes of warm-up activities, 40 minutes of main group activities, and then 10 minutes of group report and discussion. The subjects had been selected to meet our choice criteria, and given their consent. The study process had the following steps:

Step 1: Volunteers were divided into two groups, in which every group member signed a consent form. Over the 8-week intervention process, both the experimental and control groups engaged in different types of activities; but received the same environmental control condition and related care.

Step 2: At the 4th week, all subjects in both groups were asked to answer the therapeutic-factor questionnaire.

Step 3: At the 8th week, all subjects in both groups were asked to answer the therapeutic-factor questionnaire.

## 2.5. Data analysis

Data analysis was performed using the SPSS 20.0 statistical software, with SPSS 25.0 adopted for further data statistics and analysis. The differences in therapeutic factors between experimental group and control group were tested using the nonparametric-statistics Mann-Whitney U Test and the Wilcoxon signed-rank test. The latter test was adopted to calculate the changes in displayed strength, level of significance of differences, and the influence of individual therapeutic factors on the singing group.

## 3. Results

This analytical results were as follows:
*Comparison of therapeutic factors of singing therapy sessions conducted by social robot between week 4 and week 8*

The scores were higher in week 8 than in week 4 in 11 of the 12 therapeutic factors. However, only the "interpersonal learning" factor reached a statistically significant value (0.017).

*Comparison of therapeutic factors of singing therapy sessions conducted by occupational therapists between week 4 and week 8:*

Scores for group cohesiveness, universality, interpersonal learning, recapitulation of the primary family group, self-understanding and installation of hope were lower in week 8 than in week 4, with the "interpersonal learning" factor reaching statistical significance (value 0.017).

*Comparison of therapeutic factors between singing therapy sessions supervised by robot and occupational therapist in week 4*

The occupational therapist's sessions scored better in all therapeutic factors than the robot's sessions in week 4. Eight factors — universality, interpersonal learning, development of socializing techniques, imparting of information, catharsis, imitative behavior, the recapitulation of the primary family group and installation of hope — reached the statistically significant level.

*Comparison of therapeutic factors between singing therapy sessions supervised by robot and occupational therapist in week 8*

The occupational therapist's sessions scored better than robot's sessions in imparting of information, catharsis and imitative behavior, with differences in scores reaching the statistically significant level.

## 4. Discussion

Prior to the COVID-19 global health emergency, reducing direct contacts is an important issue for occupational therapy during COVID-19 outbreak [2, 13]. Many residents of long-term care institutions are living under psychological stress. Due to conditions like epidemic outbreaks, for the sake of reducing direct contact infections, occupational therapists may not always be able to lead group-therapy activities in person. Therefore, the capability of robots to take over part of occupational psychotherapy is worth further study. This investigation thus took singing-therapy groups as objects, and found that the scores of robot-directed singing therapy sessions in week 8 were higher than or equal to those in week 4 in 11 of the 12 therapeutic factors. This finding indicates that test-takers' acceptance of singing therapy directed by a robot increased during the process. However, only

Table 1
Therapeutic factors of singing therapy sessions conducted by social robot between week 4 and week 8 ($n = 7$)

| | Average | | Sig. |
|---|---|---|---|
| | Week 4 | Week 8 | |
| Altruism | 7.429 | 8.571 | 0.102 |
| Group cohesiveness | 7.857 | 8.714 | 0.180 |
| Universality | 5.143 | 6.000 | 0.462 |
| Interpersonal learning | 4.286 | 6.571 | 0.017* |
| Development of socializing techniques | 5.000 | 7.429 | 0.088 |
| Imparting of information | 3.714 | 3.714 | 1.000 |
| Catharsis | 4.571 | 4.571 | 1.000 |
| Imitative behavior | 3.286 | 3.286 | 1.000 |
| Corrective recapitulation of the primary family group | 4.143 | 4.714 | 0.496 |
| Self-understanding | 5.286 | 4.429 | 0.197 |
| Instillation of hope | 5.714 | 6.000 | 0.527 |
| Existential factors | 7.429 | 8.000 | 0.461 |

*$p < 0.05$, **$p < 0.01$; ***$p < 0.001$, using t-test between week 4 and week 8.

Table 2
Therapeutic factors of singing therapy sessions conducted by occupational therapists between week 4 and week 8 ($n = 7$)

| | Average | | Sig. |
|---|---|---|---|
| | Week 4 | Week 8 | |
| Altruism | 7.714 | 8.143 | 0.854 |
| Group cohesiveness | 8.571 | 7.571 | 0.197 |
| Universality | 7.429 | 6.143 | 0.248 |
| Interpersonal learning | 7.286 | 5.857 | 0.233 |
| Development of socializing techniques | 7.286 | 7.286 | 1.000 |
| Imparting of information | 6.286 | 6.286 | 1.000 |
| Catharsis | 7.714 | 7.714 | 1.000 |
| Imitative behavior | 6.714 | 6.714 | 1.000 |
| Corrective recapitulation of the primary family group | 7.857 | 4.143 | 0.017* |
| Self-understanding | 5.571 | 5.000 | 0.670 |
| Instillation of hope | 8.143 | 6.286 | 0.058 |
| Existential factors | 7.571 | 8.429 | 0.216 |

*$p < 0.05$, **$p < 0.01$; ***$p < 0.001$, using t-test between week 4 and week 8.

Table 3
Comparison of therapeutic factors between singing therapy sessions supervised by social robot and occupational therapist in week 4

| | Average | | Sig. |
|---|---|---|---|
| | Social robot | Occupational therapist | |
| Altruism | 7.429 | 7.714 | 0.277 |
| Group cohesiveness | 7.857 | 8.571 | 0.473 |
| Universality | 5.143 | 7.429 | 0.027* |
| Interpersonal learning | 4.286 | 7.286 | 0.006* |
| Development of socializing techniques | 5.000 | 7.286 | 0.029* |
| Imparting of information | 3.714 | 6.286 | 0.050* |
| Catharsis | 4.571 | 7.714 | 0.030* |
| Imitative behavior | 3.286 | 6.714 | 0.003* |
| Corrective recapitulation of the primary family group | 4.143 | 7.857 | 0.005* |
| Self-understanding | 5.286 | 5.571 | 0.449 |
| Instillation of hope | 5.714 | 8.143 | 0.047* |
| Existential factors | 7.429 | 7.571 | 0.344 |

*$p < 0.05$, **$p < 0.01$; ***$p < 0.001$, using t-test between week 4 and week 8.

Table 4
Comparison of therapeutic factors between singing therapy sessions supervised by robot and occupational therapist in week 8

| | Average | | Sig. |
|---|---|---|---|
| | Social robot | Occupational therapist | |
| Altruism | 8.571 | 8.143 | 0.294 |
| Group cohesiveness | 8.714 | 7.571 | 0.137 |
| Universality | 6.000 | 6.143 | 0.398 |
| Interpersonal learning | 6.571 | 5.857 | 0.231 |
| Development of socializing techniques | 7.429 | 7.286 | 0.422 |
| Imparting of information | 3.714 | 6.286 | 0.050* |
| Catharsis | 4.571 | 7.714 | 0.030* |
| Imitative behavior | 3.286 | 6.714 | 0.003* |
| Corrective recapitulation of the primary family group | 4.714 | 4.143 | 0.237 |
| Self-understanding | 4.429 | 5.000 | 0.219 |
| Instillation of hope | 6.000 | 6.286 | 0.448 |
| Existential factors | 8.000 | 8.429 | 0.367 |

*$p < 0.05$, **$p < 0.01$; ***$p < 0.001$, using t-test between week 4 and week 8.

the "interpersonal learning" score had a statistically significant difference.

At the 4th week, the scores of all 12 therapeutic factors in the occupational therapist's sessions were higher than or equal to those in the robot's sessions. The differences in scores of eight factors — universality, interpersonal learning, development of socializing techniques, imparting of information, catharsis, imitative behavior, the recapitulation of the primary family group and installation of hope — all reached the statistically significant value.

Some therapeutic factors of singing therapy sessions supervised by robot scored higher than the occupational therapist's sessions in week 8, but none of the differences were statistically significant. Conversely, three therapeutic factors had higher scores in the occupational therapist's sessions than in the robot's sessions — imparting of information, catharsis and imitative behavior, and the difference was statistically significant. Accordingly, the therapeutic effect scores indicate that the robot-assisted group

sessions still cannot replace the occupational therapist's sessions.

Robot-assisted singing group therapy sessions had the highest scores in group cohesiveness, altruism and existential factors, at both weeks 4 and 8. One possible interpretation is that robot-led singing therapy sessions can most easily develop these three factors. Future work to develop these three factors with limited manpower could adopt robots in place of therapists to perform therapy.

The COVID-19 pandemic has created great challenges to the lives of people with disabilities and occupational therapists, the creative work patterns of maintaining social distance is an important issue [14]. This pilot study used social robot to perform singing activities to maintain the social distance between the therapist and the patient, and compare the therapeutic factor between therapist and social robot at elderly care centers.

This study has some limitations. First, the number of sample cases is too small, at only 14 sample cases divided into two groups. Second, this investigation used only singing group therapy, and the results may not apply to other types of group therapy. Third, the only social robot adopted in this investigation was Zenbo®. Other types of social robots may very well bring about different conclusions in future studies.

## 5. Conclusion and suggestion

Concerns about reducing direct contact infections and therapist shortage in rural areas during epidemic outbreaks have led to consideration of robot-enhanced group therapy as an alternative to therapist-led sessions. This study has taken group singing as an example, and draws the following conclusions.

1. Social robots may replace manpower for parts of group activity. Three therapeutic factors — group cohesiveness, altruism and existential factors — have shown higher effectiveness scores when singing group therapy is conducted by the robot.
2. In most cases, singing group therapy sessions supervised by real-person therapists still score higher than those conducted by robots in terms of therapeutic factors.
3. Future research should use more sample cases. Studies could then be run to compare the scores

of therapeutic factors for person-led and robot-led sessions of other types of group therapy, and of sessions led by different robots. Analytical results of these wider studies would be useful for clinical reference.

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## Conflict of interest

The authors declare no potential conflicts of interest in writing this article.

## Ethics approval

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