The impact of a PARO intervention on depression and well-being in older adults in long-term care in Taiwan

Shu-Chuan Chen

RN, BSN, MN

School of Nursing and Midwifery
Griffith Health Group
Griffith University

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Abstract

Background

Depression is a common mental health condition that can have significant impacts on the physical and psychological well-being among older adults. The prevalence of depression increases substantially in older adults living in long-term care (LTC) facilities and may diminish their ability to pursue and experience pleasure. Pharmacotherapy for depression has adverse side effects and does not always benefit older people. Therefore, psychosocial interventions for older adults with depression are needed to improve mental well-being. A social robot called PARO, developed to engender a beneficial psychological effect or enrichment, is a potential psychosocial intervention for improving mental well-being in older adults with dementia. However, very little is currently known about PARO as an intervention for older adults with depression. Therefore, this study could fill current knowledge gaps and help with our understanding of the effect of using PARO with older people with depression.

Objectives

There were two phases in this PhD study. Phase one was an online survey and phase two was a mixed methods experimental study. The aims of the online survey study were to: (1) modify, translate and validate the Chinese version of Attitudes Towards the Use of Social Robot (ATTUSR-C) questionnaire for use with Taiwanese health personnel; and (2) investigate the attitudes of Taiwanese health personnel working in LTC facilities towards the use of social robots for older adults. The aims of the mixed methods experimental study were to explore: (1) the effect of an eight-week 24-hour PARO intervention on depression and well-being in older adults in LTC facilities in
Taiwan; and (2) participants’ experiences and perceptions following participation in the intervention.

**Methods**

Phase one involved a cross-sectional design. Settings were LTC facilities across Taiwan. Purposive sampling was used and health personnel working in LTC facilities provided information for the cross-sectional survey. Content validity, internal consistency reliability, and factor analysis of the ATTUSR-C questionnaire were evaluated. All recruited participants received an email containing study information and a URL link to the survey. Data collection took place from November 2017 to May 2018.

Phase two involved a mixed methods experimental design with a quasi-experimental approach. Embedded qualitative interviews were used to gain insights into statistical associations and individual perspectives in this present study. Settings were four nursing homes in southern Taiwan and the sample was 20 older adults with depression living in LTC facilities.

Phase two consisted of two stages. Stage 1 was an eight-week observation stage in LTC facilities where the purpose was to observe usual mood, behaviour and activities of older adults with depression. Stage 2 was an eight-week 24-hour PARO intervention during which a PARO was introduced to participants and subsequently left with them.

The Chinese version of the Geriatric Depression Scale – Short Form, the Chinese version of UCLA Loneliness Scale Version 3, and the Chinese version of the World Health Organization Quality of Life Questionnaire for older adults were administered at four time points: a week before the start of the eight-week observation, immediately after the eight-week observation, mid-point of the PARO intervention, and straight after
the eight-week PARO intervention. A semi-structured interview was conducted with the older adults following the completion of their participation in the intervention.

**Results**

Content validity of the modified Chinese version of the ATTSUR questionnaire was first assessed by a panel of five academic nursing professors (I-CVI = 0.83 / S-CVI/Ave = 0.93) followed by face validity examination by 10 clinical instructors (Fleiss’s kappa = 0.82). Finally, psychometric testing (i.e. exploratory factor analysis and internal consistency a = 0.84) was conducted using a convenient sample of 95 nurses. The final modified Chinese version of the ATTSUR questionnaire is a one-factor model consisting of 15 items with good validity and reliability.

A total of 416 health professionals responded to the online survey. The mean age of respondents was 39.16 years (SD = 11.37). Of these, the mean length of work experience was 6.12 years (SD = 5.74). About 85.8% of the respondents were female, and 14.2% were male. The majority of respondents (75.9%) had obtained college or above education. Registered nurses (43.5%) and nursing aides (31.7%) were the majority of respondents. Over half of the respondents (56.5%) were working in nursing homes, and 25.7% were working in residential aged care. A point-biserial correlation was conducted to explore the relationship between attitudes and awareness of using social robots. Attitudes of respondents towards the use of social robots for older adults in LTC were found to be positively and significantly correlated with their awareness of the use of social robots in nursing homes (rpb = .18, p < .000). Most health personnel had positive attitudes towards the use of social robots in LTC facilities, as they considered social robots to be beneficial and practical in psychosocial care for older adults. The ATTUSR-C questionnaire had good validity and reliability.
Twenty participants completed phase two. Scores on depression, loneliness, and quality of life demonstrated significant positive changes over time ($p < .000$). The qualitative findings showed that participants expressed positive experiences and perceptions about the PARO intervention, such as improved mood, alleviated loneliness, and increased interpersonal interactions with other people. Three themes emerged from the interviews: humanising PARO by relating it to personal experiences and engagement, increased social interaction with other people through participants' use of PARO and companionship, which all resulted in improved mental well-being. The outcomes demonstrate that a 24-hour PARO intervention has the potential to improve mental well-being among older adults with depression who live in LTC facilities.

**Conclusion**

The ATTUSR-C questionnaire is a reliable and valid instrument for assessing the acceptability of social robots for health professionals working in LTC facilities. Positive attitudes towards the use of social robots can increase the acceptance and utilisation of social robots. Health personnel and nursing researchers can use the findings of this study to encourage and inspire further interventions that use robots to improve the quality of life in care settings. The findings of this mixed methods experimental study indicated that PARO has the potential to alleviate depression and loneliness and improve the quality of life for older adults living in LTC facilities. Using PARO for companionship can be a key factor in decreasing depression and loneliness, as it provided comfort and calming effects for older adults with depression. This study was the first study known to undertake a 24-hour PARO intervention in older adults with depression and confirmed the feasibility of the implementation of PARO in aged-care settings. As a consequence, the research findings provided theoretical foundations...
for further studies about the use of PARO in older adults with depression. The study filled gaps in knowledge and identified the need for further development in the area of PARO interventions with older people with depression.
Statement of Originality

This work has not previously been submitted for a degree or diploma in any university.
To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

Shu-Chuan Chen

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<th>Description</th>
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<tbody>
<tr>
<td>AAT</td>
<td>Animal assisted therapy</td>
</tr>
<tr>
<td>ADL</td>
<td>Activities of daily living</td>
</tr>
<tr>
<td>ATTUSR-C</td>
<td>The Chinese version of Attitudes Towards The Use of Social Robot questionnaire</td>
</tr>
<tr>
<td>DSM-5</td>
<td><em>The Diagnostic and Statistical Manual of Mental Disorders</em> fifth edition</td>
</tr>
<tr>
<td>GDS</td>
<td>Geriatric depression scale</td>
</tr>
<tr>
<td>LTC</td>
<td>Long-term care</td>
</tr>
<tr>
<td>MMSE</td>
<td>Mini-mental state examination</td>
</tr>
<tr>
<td>PARO</td>
<td>Personal assistive robot</td>
</tr>
<tr>
<td>QOL</td>
<td>Quality of life</td>
</tr>
<tr>
<td>TAU</td>
<td>Treatment as usual</td>
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<tr>
<td>WHOQOL-OLD</td>
<td>The World Health Organization Quality of Life Questionnaire-Older Adults</td>
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Dissemination of Study Outcomes


Chapter 1 Introduction

This chapter begins with a discussion of the background to this study, and outlines the prevalence and symptoms of depression, the impact of depression and well-being in older adults, treatment of depression, social robot interventions in mental health, and attitudes of health personnel toward using a social robot with older adults. Following this, the research aims, research significance, and research questions are presented. Finally, the thesis structure for this study is outlined.

1.1 Overview

The world has a rapidly ageing population and almost 70% of the population aged 65 years and over is expected to need long-term care (LTC) at some point in their lives (Feder & Komisar, 2012; U.S. Department of Health & Human Services, 2017). LTC is generally required by older people with disabilities emanating from chronic conditions that are mostly related to this age group (Singh, 2014). The very nature of LTC often results in older adults losing their independence and this can increase their frailty and reduce their mobility. As a consequence, older adults are at risk of physical, mental, and psychosocial impairment (Chau, Kissane, & Davison, 2019b; Chiang et al., 2010; Forsman, Schierenbeck, & Wahlbeck, 2011b). For example, research shows that people who live in LTC facilities have higher rates of depression than those living in the community (Chau, Kissane, & Davison, 2019a; Fiske, Wetherell, & Gatz, 2009; Jongenelis, Pot, & Eisses, 2003). Research has also shown that depression adversely affects the well-being of older adults; it may increase feelings of loneliness (van Winkel et al., 2017) and result in poorer quality of life (Sivertsen, Bjorklof, Engedal, Selbaek, & Helvik, 2015). The mental health of older adults residing in LTC facilities is a concern that needs to be addressed worldwide. Despite this, there is limited research on effective interventions for
treating depression among older adults living in LTC facilities. Therefore, these issues require more attention in order to develop effective strategies to manage depression in this population.

In recent years, there has been increasing interest in the use of social robots to help alleviate psychological distress and encourage social interaction among older adults with dementia (Jøranson, Pedersen, Rokstad, & Ihlebaek, 2015; Moyle et al., 2016; Roger, Guse, Mordoche, & Osterreicher, 2012). A social robot is an artificial intelligence system that is designed to interact and communicate with humans and other robots by following social behaviours and rules attached to its role (Feil-Seifer & Mataric, 2005). The system was developed to engender a beneficial psychological effect or enrichment, and is a potential new intervention for improving mental well-being in older adults (Bemelmans, Gelderblom, Jonker, & de Witte, 2012; Chen, Jones, & Moyle, 2018; Pu, Moyle, Jones, & Todorovic, 2019). In recent years, there has been a proliferation of studies that explore the use of social robots and their effect on the physical and psychological well-being of older adults in western countries and Japan (Bemelmans, Gelderblom, Jonker, & de Witte, 2015; Moyle et al., 2017b; Riek, 2017; Takayanagi et al., 2014). Although the prevalence of depression in older people is high, there have been few empirical investigations into social robot interventions with depressed older adults that demonstrate the potential positive effects of this technology on depression (Kargar & Mahoor, 2017; Randall et al., 2019). Therefore, as the global population is ageing, it is imperative that we design a rigorous study that focuses on older adults with depression in LTC facilities.
1.2 Background

1.2.1 The prevalence of depression

The prevalence of depression increases with age and persists into older age. The World Health Organization (WHO) estimated that the overall prevalence of depressive disorders among older populations is between 10% to 20%, depending on the cultural situation (Barua, Ghosh, Kar, & Basilio, 2011). According to a worldwide estimate, approximately five million older adults experience late-onset depression, but it remains under-recognised and inadequately treated (Viscogliosi et al., 2013). Moreover, approximately 14% of older adults have clinically significant depressive symptoms, even in the absence of major depression (Kok & Reynolds, 2017).

The prevalence of depression increases substantially among older adults living in a hospital or LTC facility (Seitz, Purandare, & Conn, 2010). Rates of depression are three to four times higher in people who live in LTC than those living in the community (Jongenelis et al., 2003). Estimates of depression amongst LTC residents range widely from 11% to 78% in the U.S. (Gaboda, Lucas, Siegel, Kalay, & Crystal, 2011). In Australia, an estimated 10% to 15% of older adults who live in the community experience depression (Haralambous et al., 2009), whereas 52% of all permanent aged-care residents are reported to have mild, moderate or major symptoms of depression (Australian Institute of Health and Welfare, 2013). In Taiwan, studies have found the prevalence of depression to be approximately 20% in older adults living in the community, whereas just over half (52%) of all LTC residents suffer from geriatric depression (Chang et al., 2013a; Lin, Wang, Chen, Wu, & Portwood, 2005). These findings corroborate a higher prevalence of depression in LTC residents and indicate that older people living in institutional facilities have more complex care needs.
1.2.2 Symptoms of depression in older adults

Depression is a common mental health problem in older adults. Depression is related to a range of illnesses involving body, mood, and thoughts and it interferes with daily life and normal functioning (National Collaborating Centre for Mental Health, 2010b). Depression is an umbrella term for a number of different forms of depressive disorders, such as major depressive disorder, disruptive mood dysregulation, and persistent depressive disorder (American Psychiatric Association, 2013). However, research on depression in older populations has increasingly focused on the symptomatology of depression rather than diagnostic categories, because older adults with depression often present clinically significant subsyndromal states (Carrière et al., 2017). The symptoms of depressive disorders include: depressed mood, diminished interest or pleasure in almost all activities, fatigue or loss of energy, and feelings of worthlessness or excessive or inappropriate guilt (American Psychiatric Association, 2013). These symptoms may be accompanied by somatic and cognitive changes that significantly affect people's capacity to maintain their daily functioning.

1.2.3 Impact of depression in older adults living in LTC

Depression can have a severe impact on the physical and psychological well-being of older adults. There is evidence that depression is strongly associated with many negative health outcomes for older adults (Novick et al., 2015) and presents as somatic symptoms, such as insomnia, loss of appetite, fatigue, headaches, pain and lethargy (Luppa et al., 2012). Previous studies have indicated that the physical adverse effects of depression can impact the brain, heart, and other parts of the body. These adverse effects may include reduced brain volume (Roiser, Elliott, & Sahakian, 2012; van Tol et al., 2010), increased risk of heart disease (Niranjan, Corujo, Ziegelstein, & Nwulia, 2012), diabetes (Roy &
Depression can also significantly impact on psychosocial functioning in older adults. These effects are related to the core symptoms of depression, such as depressed mood, feelings of hopelessness, lack of interest or pleasure in activities, difficulty in concentrating, and increased risk of suicide (Chen et al., 2015; Yang, Zhao, Wang, Liu, Zhang, Li & Cui, et al., 2015). Furthermore, a prior study revealed that the risk factors of late-life depression included multiple medical conditions, disability and functional decline, and cognitive impairment (Davison, McCabe, Knight, & Mellor, 2012), and these factors are also associated with a high risk of recurrence and increased rates of suicidal mortality (Chau et al., 2019b; Yi, 2016). As a consequence, these negative effects may diminish older adults’ ability to pursue and experience pleasure, as well as to reduce their motivation to engage in social interactions with families or friends (Yang et al., 2015).

In addition, even though it is highly treatable, depression remains the most common mental health condition amongst residents of LTC facilities (Chau et al., 2019a). Evidence has shown that depression appears to increase the risk of admission to LTC facilities and older adults with depression often have greater care needs at the point of entry into a LTC facility (Chau et al., 2019b; Davison et al., 2018; Morley, 2010; Snowdon, 2010). Depression in older adults living in LTC requires more complex care than the care given to those without depression, due to medical comorbidities and functional and cognitive impairments. A systematic review was conducted to assess the risk factors for depression in LTC by Chau et al. (2019b), who reported that a positive institutional environment tends to decrease stress whereas a negative environment decreases engagement, social interaction, and needs fulfilment, thereby increasing loneliness. Furthermore, the risk factors for depression are greater among older adults living in LTC facilities than those
dwelling in the community (Chau et al., 2019b).

Previous studies have identified that there is a positive correlation between depression and loneliness. Older adults who report feelings of loneliness tend to experience higher levels of depression and more negative emotions (Hawkley & Cacioppo, 2010; Liu, Gou, & Zuo, 2016). Studies showed that loneliness was associated with poor psychological adjustment, and dissatisfaction with family and society (Jansson et al., 2017; Prieto-Flores, Forjaz, Fernandez-Mayoralas, Rojo-Perez, & Martinez-Martin, 2011). In this regard, psychological and social vulnerability might be exacerbated in older adults living in LTC and may eventually impact their quality of life. These negative influences may have severe consequences, such as increased disability, functional decline, social isolation, and death by suicide (Simning & Simons, 2017; Yang et al., 2015).

1.2.4 Impact of loneliness on older adults living in LTC

Loneliness is an important issue caused by a variety of correlated negative quality of life consequences. Loneliness refers to a subjective, negative feeling related to deficient social relations or a lack of valued interpersonal relationships, or the inability to establish satisfying relationships (Brownie & Horstmanshof, 2011). When an individual's social network is insufficient, there will be an increase in loneliness. Evidence has shown that loneliness may be more prevalent in LTC residents compared to community-dwelling older adults (Andrew & Meeks, 2018). This might be related to the loss of friends, transition to care facilities, declining health conditions, and increased dependence (Finlay & Kobayashi, 2018; Jansson et al., 2017; Prieto-Flores et al., 2011). Previous research indicated that more than 50% of older adults living in LTC facilities experience loneliness to some degree (Drageset, Kirkevold, & Espehaug, 2011; Nyqvist, Cattan, Andersson, Forsman, & Gustafson, 2013). Many empirical studies have demonstrated that older
adults who perceive feelings of loneliness tend to experience higher levels of depression and more negative emotions (Cacioppo, Hughes, Waite, Hawkley, & Thisted, 2006; Hawkley & Cacioppo, 2010; Liu et al., 2016). Studies have revealed that loneliness has many negative impacts, such as poor physical health, poor quality of life, declining cognitive performance, and extended depressive symptoms for older adults in LTC facilities (Drageset, Espehaug, & Kirkevold, 2012; Hawkley & Cacioppo, 2010; Luanaigh & Lawlor, 2008; Nyqvist et al., 2013). The significant prevalence of loneliness in LTC facilities requires more attention in current research initiatives. Therefore, it is suggested that effective and innovative psychosocial interventions that aim to reduce the sense of loneliness among older adults with depression in LTC facilities are warranted.

1.2.5 Quality of life of older adults living in LTC

Quality of life (QOL) is defined as “the individual’s perception of their position in life in the context of the culture and value system in which they live and in relation to their goals, expectations, standards, and concerns” (WHOQOL Group, 1994). Quality of life in LTC is complex and involves the environmental, psychological, social, and functional aspects of older peoples’ lives (Shippee, Henning-Smith, Kane, & Lewis, 2015). Previous studies have shown that people with depression have more functional impairments and poorer QOL than older adults with other chronic illnesses (Akyol, Durmus, Dogan, Bek, & Canturk, 2010; Sivertsen et al., 2015). The environment of LTC facilities may affect the QOL of older people (Harrison et al., 2017), due to their dissatisfaction with a monotonous life, loss of autonomy, and lack of social interaction with others (Simeao et al., 2018). Simeao et al. (2018) compared the QOL in older adults who lived in residential homes to those who attended daycare centres. The results showed that institutionalised older women presented the worst QOL. Furthermore, older people living in LTC
encountered more emotional distress and loneliness, which may exacerbate their negative perception of QOL (Gerino, Rollè, Sechi, & Brustia, 2017; Jansson et al., 2017). Studies of psychosocial interventions in LTC, such as reminiscence interventions (Siverova & Buzgova, 2018), animal assisted therapy (Banks, Banks, & Willoughby, 2008; Olsen et al., 2016), and social robot interventions (Jøranson, Pedersen, Rokstad, & Ihlebaek, 2016b; Moyle et al., 2013) have reported positive effects on mood and QOL. However, little is known about how social robots affect depression, loneliness and QOL for older adults with depression in LTC. Therefore, further research is needed to gain more knowledge on the subject.

1.2.6 Treatment of depression

1.2.6.1 Pharmacotherapy

Antidepressants and depression-specific psychosocial therapies are the mainstay treatments for depression. Boyce et al. (2012) reported that the use of antidepressants is a much more common strategy for treating depression in residents living in nursing homes than potentially effective psychosocial interventions. Nevertheless, pharmacotherapy has adverse side effects, such as dry mouth, blurred vision, constipation, urinary retention and cardiotoxicity, which can lead to dental caries, falls, and urinary tract infections (Mitsch, 2013). Another concern is treatment variability in older adults who receive antidepressants. As older adults living in LTC are typically older, they may have more medical comorbidities and take additional prescribed medications that could result in a higher risk of drug-drug interactions (Boyce et al., 2012). Moreover, older adults with chronic diseases may have altered pharmacokinetics and pharmacodynamics, which can reduce the efficacy of antidepressants (Funnell, 2010; Kok & Reynolds, 2017). These
factors can also increase the occurrence of other unexpected issues, such as delirium and heart failure in older adults.

To date, nursing professionals have advocated the integration of non-pharmacological or psychosocial interventions in the care of older adults with depression, as opposed to a single focus on biomedical approaches (Apostolo, Bobrowicz-Campos, Rodrigues, Castro, & Cardoso, 2016). In addition, qualitative research has reported that both patients and healthcare professionals are in favour of psychosocial interventions over pharmacotherapy for older adults with depression (National Collaborating Centre for Mental Health, 2010a; Roberge et al., 2016). Furthermore, the high cost of medications, and the fact that some people do not benefit from pharmacotherapy means that investigation into the benefits of psychosocial interventions, such as social robot interventions as a means of reducing depression in older adults is advantageous.

1.2.6.2 Psychosocial approaches for older adults with depression

A significant advantage of psychosocial interventions over pharmacotherapy is that psychosocial interventions have few physiological side effects, particularly among older adults. The effectiveness of psychosocial interventions has been supported by previous studies, which have presented promising results for geriatric depression (Forsman, Nordmyr, & Wahlbeck, 2011a). Meta-analysis demonstrated significant positive effects for groups that had psychosocial interventions for geriatric depression, compared to care-as-usual or control groups (Cuijpers, Karyotaki, Pot, Park, & Reynolds, 2014; Mohr et al., 2014). Given the higher prevalence of geriatric depression, the adverse effects of antidepressants, and higher rates of morbidity and mortality associated with depression
symptoms and severity in residents in LTC, there is a pressing need for appropriately targeted psychosocial and/or psychotherapeutic interventions.

Several factors challenge the effectiveness of psychotherapies for older adults with depression aside from the merits of psychosocial interventions. First, older adults with both depression and physical illness may exhibit a lower response to psychological and behavioural treatment, because their depressive symptoms may reflect physiological changes (Hall & Reynolds-Iii, 2014). In addition, the participant dropout rate in psychosocial interventions is another limitation of these interventions. Attrition rates reported in the literature generally range from 10% to 50% across a variety of settings (Hans & Hiller, 2013). The reasons for not completing treatment include: weak therapeutic alliance, low expectations of treatment effectiveness, and low treatment motivation (Kegel & Flückiger, 2015). Therefore, these particular factors may affect the effectiveness of psychotherapies for treating depression.

In addition, the patterns of clinical practice downplay the importance of treating depression in LTC. Research has found that people with depression have fewer opportunities to receive prescribed non-pharmacological therapies in LTC facilities (Grabowski, Aschbrenner, Rome, & Bartels, 2010), and also have relatively low expectations when they participate in a therapeutic program (Gallo et al., 2016). Another issue is that some group-based interventions are common in LTC facilities and are considered to be practical and efficient since many residents can be treated simultaneously. However, people with depression who may feel threatened in social groups can experience more stress in group interventions (Lawrence, Fossey, Ballard, Moniz-Cook, & Murray, 2012). Finally, the main challenges faced by LTC are not having a skilled workforce to deliver appropriate psychosocial interventions combined with the
challenges involved in embedding research evidence into clinical practice. From this perspective, the availability of trained therapists and a consideration of patient preferences may further narrow the choice of interventions for older adults living in LTC facilities. Furthermore, due to the shortage of trained care staff and the financial burden of paid psychosocial therapies for older adults, it is a challenge to provide these kinds of therapies in LTC. Therefore, there is a need to provide alternative forms of individual assistance for older adults with depression in order to overcome the barriers to participating in group activities in LTC.

1.2.7 Social robot interventions in mental health

Advances in technology have created a vast potential for the provision of a new form of health and social care. In recent years, there has been increasing interest in the use of social robots to act as a catalyst to alleviate psychological distress and encourage social interaction for older adults with dementia (Chen et al., 2018; Pu et al., 2019). A previous study has found that a social robot, such as PARO a robotic baby harp seal (Personal Assistive RobOt; described in Chapter 2), has similar beneficial effects as live animals, and these robots can elicit the same degree of attachment as a live dog (Banks et al., 2008). Social robots have led to a proliferation of studies that explore the physical and psychological outcomes for older adults with dementia (Jøranson et al., 2015; Moyle et al., 2019b; Petersen, Houston, Qin, Tague, & Studley, 2017). However, there have been few empirical investigations into social robot interventions with depressed older adults. Therefore, as a result of the global ageing population, it is imperative that a rigorous study is designed which focuses on older adults with depression in LTC facilities. This is described in more detail in Chapter 2, the literature review.
1.2.8 Attitudes of health personnel toward using a social robot for older adults

Notwithstanding the demonstrated effectiveness of a social robot, it is essential to understand the attitudes of health professionals toward them, because their attitudes will determine the success or failure of the implementation of social robots in health care. A prior study supported this notion that the attitudes of staff towards social robots were an associated factor that affected the acceptability of social robots for older adults living in LTC facilities (Broadbent, Stafford, & MacDonald, 2009). Esmaeilzadeh, Sambasivan, Kumar & Nezakhati (2011) indicated that when a social robot is introduced into a care setting, this technological device may affect professional autonomy, relationships with patients, routines, and workflow. In addition, evidence has shown that both professionals and patients with positive attitudes towards using social robots have a higher potential to use them (Costescu & David, 2014). In contrast, there are barriers related to the use of social robots, and these include feelings of embarrassment related to failing to interact with a social robot in front of others (Hung et al., 2019) and lack of knowledge (Broadbent et al., 2012). Thus, the ineffective use of social robots in care settings may be associated with a failure to assess and address staff reactions to social robots (Stafford et al., 2010). Despite these findings, there are few studies that focus on the influence of external perspectives, such as healthcare providers, on the acceptance of social robots (Gagnon, Orruño, Asua, Abdeljelil, & Emparanza, 2012; Kowitlawakul, 2011). Therefore, this current study is essential, as it addresses health professionals' and social care workers’ attitudes towards using social robots in LTC settings. This is described in detail in Chapter 3, which discusses phase one of the study, the online survey.
1.3 Research aims

There were two phases in this current study. Phase one was an online survey and phase two was a mixed methods experimental study.

The aims of the online survey study were to:

(1) modify, translate and validate the Chinese version of Attitudes Towards the Use of Social Robot (ATTUSR-C) questionnaire for use with Taiwanese health personnel.

(2) investigate the attitudes of Taiwanese health personnel working in LTC towards the use of social robots for older adults.

The aims of the mixed methods experimental study were to explore:

(1) the effect of an eight-week 24-hour PARO intervention on depression and well-being in older adults in LTC facilities in Taiwan.

(2) participants’ experiences and perceptions after participation in the intervention.

1.4 Research significance

This study is significant for a number of reasons; in particular, it offered an opportunity to examine an innovative psychosocial intervention (i.e. social robot) for older adults living with depression in LTC facilities. Due to the side effects or limited response to antidepressants among older adults with depression, psychosocial interventions have often been an alternative treatment. Empirical research suggests that the integration of psychosocial interventions and pharmacotherapy in mental healthcare are the best approaches for older adults with depression (Apostolo et al., 2016). A meta-analysis revealed that psychosocial interventions, such as exercise-based interventions, had a
demonstrated beneficial effect on reducing depression symptoms in older adults living in LTC facilities (Simning & Simons, 2017). An intervention with social robots, such as a PARO, is one type of psychosocial intervention that can alleviate psychological distress among older adults.

To date, the research evidence has demonstrated that the use of social robots can lead to an improvement in mental well-being for older adults with dementia (Jøranson et al., 2016b; Moyle et al., 2013; Petersen et al., 2017; Robinson, Macdonald, Kerse, & Broadbent, 2013). However, very little is known about PARO as an intervention for depressed older adults living in LTC. Moreover, according to a systematic review conducted by Chen et al. (2018), the results demonstrated that a diversity of methods adopted in social robot interactions (e.g. setting and schedule) resulted in inconsistent outcomes for older adults. Therefore, this research could shed new light on the effect of PARO on older adults with depression, since it uses a PARO intervention for 24-hours, seven days a week, for eight weeks. The findings may fill the knowledge gap regarding the dose-response of the social robot intervention for older adults with depression.

Furthermore, much of the research related to PARO has been conducted in Japan and Western countries, but less research has been conducted in a Chinese cultural context. This is the first study known to utilise a rigorous research design using PARO as an intervention for Taiwanese older adults with depression and also the first study to utilise a 24-hour intervention for such a population. Additional research is needed to evaluate whether the intervention with PARO has benefits over an extended period in other settings, populations and with different cultures. The outcome of this study is the provision of relevant evidence and advanced knowledge of the effectiveness of PARO in a Chinese cultural context.
1.5 Research questions

Phase one

(1) What are the validity and reliability of ATTUSR-C for health personnel?
(2) What are health personnel's attitudes towards the introduction of a social robot to older adults in LTC facilities in Taiwan?

Phase two

(1) What is the effect of an eight-week 24-hour PARO intervention on depression in older adults in LTC facilities in Taiwan?
(2) What is the effect of an eight-week 24-hour PARO intervention on loneliness in older adults with depression in LTC facilities in Taiwan?
(3) What is the effect of an eight-week 24-hour PARO intervention on QOL for older adults with depression in LTC facilities in Taiwan?
(4) What are the participants’ experiences and perceptions after participating in the PARO intervention?

1.6 Thesis structure

The thesis consists of seven chapters. This current chapter, Chapter 1, provides an overview of the research background, significance of the study, research aims and questions, and an introduction of the thesis structure.

Chapter 2 provides a literature review related to the use of social robots in LTC. First, a comprehensive literature review of social robot interventions in healthcare settings is presented. Second, a published paper entitled “Systematic review of social robots for depression in older adults” (Chen, Jones, & Moyle, 2018) is included, along with an
update of the subsequent evidence. Finally, the conceptual framework of this study illustrates how, and why, a PARO intervention for older adults with depression can be used to alleviate depression and loneliness and improve quality of life.

Chapter 3 provides details of the methods and results of the phase one online survey, which investigated the attitudes of health personnel towards the introduction of social robots in LTC in Taiwan. This chapter includes an accepted paper (Chen, Jones, & Moyle, 2019) that outlines the study background, research design, participants, data collection, ethical considerations, data analysis, and validity and reliability of the instrument. Following this, the results and discussion of the online survey are presented.

Chapter 4 describes the methodological approach used to conduct the phase two PARO intervention for the purposes of determining its effects on depression, loneliness, and quality of life for older Taiwanese people living in LTC. The justification for using a mixed methods experimental design is put forward. This chapter describes the methods used, including the study design, settings, participants, recruitment strategy, sample size, intervention, data collection, outcome measurements, interview, data analysis, and ethical considerations of the research.

Chapter 5 presents the results of phase two. First, the response rate, demographic characteristics, and health information are specified. Second, quantitative results are provided to show changes in depression, loneliness, and quality of life. For example, a repeated MANOVA analysis, Friedman test analysis, and post-hoc examination using paired sample t-tests and the Wilcoxon signed-rank test are presented in the quantitative results. Third, qualitative results using thematic analysis are provided. This chapter presents the participants’ experiences and perceptions of their involvement in the PARO intervention.
Chapter 6 provides a detailed discussion of the outcomes from the phase two 24-hour PARO intervention, and compares these findings to current research in the literature. The effect of the PARO intervention on depression and well-being are explicated, along with a discussion of the use of PARO in helping older adults with depression to improve their mental well-being in LTC in Taiwan, with reference to the literature. The experience and perceptions of older adults with depression after participating in the PARO intervention are discussed to help gain a better understanding of utilisation of the PARO. Following this, the ethical dilemmas, strengths and limitations of this study are outlined.

The final chapter, Chapter 7, presents the conclusions and recommendations for clinical practice, nursing research, and nursing education.

1.7 Summary of the chapter

Depression, which is a common mental health problem in older adults, is related to a range of illnesses involving body, mood, and thoughts; it interferes with daily life and normal functioning. The prevalence of depression increases with age and persists into older age. Moreover, according to the literature, the prevalence of geriatric depression increases substantially among older people living in LTC facilities in both Australia and Taiwan. Geriatric depression can have enormous effects on the physical and psychological well-being of older adults in LTC. These findings help explain why older people living in LTC facilities have more complex care needs. It has been shown that antidepressants cause many side effects, and some older people do not benefit from pharmacotherapy. Thus, nursing professionals have advocated the integration of psychosocial interventions in the care of older adults with depression, instead of a single focus on biomedical approaches.
To date, advances in technology have created a vast potential for the provision of a new form of health and social care. The main focus of interest for this study includes the innovative use of social robots, such as PARO, to facilitate social interaction and participant engagement in care settings. Social robot interventions are based on human-animal interactions. Previous studies have found that social robots have similar beneficial effects as live animals and that robots can elicit the same degree of attachment as a dog (Banks et al., 2008; Wada, Shibata, Saito, & Tanie, 2004). Some studies have used social robots as companions for older adults with cognitive impairment and other physical disabilities (Jøranson et al., 2015; Moyle et al., 2019b; Petersen et al., 2017). However, very little is known about PARO interventions in other populations, such as older adults with depression living in LTC facilities. Furthermore, much of the research with PARO has been conducted in Japan and Western countries, but with little research in Chinese cultural contexts. This is the first study to utilise a rigorous research design and to utilise a 24-hour PARO in an intervention for older adults with depression. The outcome of this study will provide relevant evidence and a more comprehensive understanding of the effectiveness of PARO in a Chinese cultural context.

Notwithstanding the demonstrated effectiveness of a social robot, it is essential to understand the attitudes of health personnel towards social robots, because their attitudes may determine the success or failure of the implementation of social robots in health care. A previous study supported the notion that the attitudes of staff towards social robots were an associated factor that affected the acceptability of the use of social robots for older adults living in LTC facilities (Broadbent et al., 2009). Despite these findings, there are few studies that focus on the influence of external perspectives, such as healthcare providers, on the acceptance of social robots. Therefore, this study is crucial as it
incorporates a specific investigation into the attitudes of health personnel towards using social robots in LTC facilities. The following chapter provides a review of the literature and a systematic review of social robot interventions for the treatment of depression in older adults.
Chapter 2 Literature Review

2.1 Introduction

This chapter outlines both the theoretical and research literature on social robot interventions in LTC facilities and the research framework of this study. It presents a literature review related to animal assisted therapy in healthcare, a systematic review of social robots used to treat depression in older adults, updated evidence of the PARO intervention in depression, and the conceptual framework of the biopsychosocial model used in this study.

2.2 Implementation of social robots in long-term care

2.2.1 Effects and challenges of animal assisted therapy (AAT) in healthcare

Many LTC facilities have introduced live animal visits and activities into their care model as a means of improving mental well-being among older adults. It is now well documented in a number of studies that animal visits are associated with a decrease in depressive symptoms (Travers, Perkins, Rand, Bartlett, & Morton, 2013), as well as a reduction in feelings of loneliness (Banks et al., 2008), as these activities enhance social interaction in people who are cognitively intact (Bernabei et al., 2013).

However, AAT has limitations and challenges in LTC facilities mainly due to the problems animals may cause, which can mean many LTC facilities prohibit them being on site (Shibata & Wada, 2011). Some of the situations that may arise include: the risk of animals being underfoot and causing falls, the infliction of injuries such as bites or scratches, an increased risk of parasites and/or infectious disease, and the additional burden on staff as a result of care requirements (Huff-Mercer, 2015). Furthermore,
individuals can have positive or negative attitudes toward animals. For example, some people may fear certain animals or breeds due to previous bad experiences. Finally, there are animal welfare concerns whereby involuntary disruptive behaviours can occur among older adults with mental conditions, particularly dementia, which can place an animal at risk of harm (Libin & Cohen-Mansfield, 2004). For all these reasons, robot pets have recently been introduced into health and social care settings.

### 2.2.2 Social robot interventions for older adults in healthcare

To date, advances in technology have created the potential for a new form of health and social care. The main focus of interest for this study includes the innovative use of social robots to facilitate social interaction, or participant engagement, in care settings (Bemelmans et al., 2010). Previous studies have found that social robots have similar beneficial effects as live animals and that these robots can elicit the same degree of attachment as a live dog (Banks et al., 2008). As a consequence, social robots are increasingly considered to be a beneficial alternative to AAT for older adults living in LTC facilities.

There are many different types of social robots currently in use for the purposes of improving positive psychological effects for older adults in health and care settings. Some of the robots are designed to be like different species of familiar animals. The majority of research using social robots includes a baby harp seal called PARO, a robotic dog called AIBO, a robotic cat called NeCoRo, and a humanoid torso, Bandit (Bemelmans et al., 2012). In 2004, a robotic cat was first introduced to people with cognitive impairment and physical disability as a companion tool with the aim of increasing recipients’ positive experiences and improving mental well-being during the interaction (Libin & Cohen-Mansfield, 2004). Wada and his colleagues (2005) conducted an intervention study using
a baby harp seal, PARO, and found that interactions with PARO improved residents’ mood and depression, encouraged communication, and decreased levels of stress. These early results support the claim that social robots have a positive effect on mental well-being among older adults.

A number of studies have since been conducted for over a decade in LTC, and used social robots as companions for older adults with cognitive impairment and other physical disabilities. However, in 2013 there was a shift in the methodological approaches and outcomes of social robot research. Prior to 2013, social robot research was predominantly technical-based, and was undertaken by engineers, software developers and robotic scientists. In addition, most studies were conducted to investigate the effect of social robots using non-randomised controlled trials. In 2013, the first two randomised control trials using PARO for people with dementia and older adults were published (Moyle et al., 2013; Robinson et al., 2013). Moyle et al. (2013) conducted a randomised crossover trial to compare the effect of a group PARO intervention and a group reading activity on the emotions of people living with dementia in LTC. They found the PARO intervention group had higher pleasure scores following the intervention, compared to the reading activity. Furthermore, Robinson et al. (2013) employed a randomised controlled trial to investigate the psychosocial effects of PARO in a residential home compared to a control group, and found that residents who interacted with PARO experienced a significant decrease in feelings of loneliness over the period of the trial.

More recent studies have shown the use of social robots can encourage positive behavioural states (Lane et al., 2016), improve social behaviour (Robinson et al., 2013), and quality of life (Jøranson et al., 2016b; Moyle et al., 2013), result in positive psychological effects (Jøranson et al., 2015; Moyle et al., 2013), and physiological effects
(Petersen et al., 2017; Robinson, MacDonald, & Broadbent, 2015) in older adults. Kargar and Mahoor (2017) used an eBear, an animal-like social robot, to improve mood and increase happiness and well-being for older adults with moderate depression. This study recruited seven older adults, who were community volunteers, with no to moderate depression. Each participant interacted with eBear for up to one hour, three times a week for four weeks. The Geriatric Depression Scale and the Face scale mood evaluation were used to investigate the effects of the eBear intervention. The results showed that the level of depression decreased in five out of the seven older adults, indicating that a social robot such as the eBear can have promising effects on mood of older adults with depression. The results of the study showed that interacting with the eBear can increase the happiness and mood of these users. As a result, it is hypothesised that social robots, such as PARO, may have the same positive effect on older adults with depression.

2.2.3 PARO

PARO was developed by Dr Takanori Shibata in Japan. It has the appearance of a baby harp seal (Figure 2.1); the current version (V9) weighs 2.5 kilogrammes and is approximately the size of a newborn baby with the addition of four flippers and a tail. PARO is equipped with an array of tactile sensors that monitor sound, light, temperature, and touch via artificial intelligence software. Light sensors capture external movements and PARO moves its tail and flippers and opens its eyes in response to touch and voice. Embedded microphones receive verbal communication, enabling PARO to recognise voice, respond to voice commands, interact with users, and produce sounds like a real harp seal. PARO can show human-like emotional reactions when it feels surprised, happy, or angry, and it will cry when it is neglected or does not receive sufficient attention. PARO has a diurnal rhythm, making it active during the day and inactive at night,
seemingly asleep. It has anti-static fur that prevents bacteria from attaching to it and spreading.

PARO was designed to engender psychological or enrichment effects as a mental commitment robot (Shibata, 2004). Visually, PARO looks like a seal, but it is classified as a non-familiar animal, because a harp seal is not a domestic, household animal (Shibata, 2004). While some robot animals resemble familiar pets, such as cats and dogs with which people are familiar, PARO does not present stereotypical expected behaviours when people interact with it, as few people have interacted with, or have experience or knowledge about seals. This was one of the driving forces behind the selection of the seal appearance for the robot. PARO is a unique social mediator, as interlocutors are required to reframe and adapt their interaction to better suit the new and unfamiliar context, thus increasing the potential for interactivity, connection, and unique bonding. In this study, PARO was used as a psychosocial intervention with the aim of improving mental well-being, in particular depression, loneliness, and QOL in older adults with depression.

*Figure 2.1* PARO (Takayanagi, Kirita, & Shibata, 2014)
2.2.4 The effects of a PARO intervention on mental well-being for older adults

PARO, which is one of the commonly used social robots, has been used in hospitals and LTC facilities in many countries including Australia, Denmark, Italy, Japan, Sweden, and the USA. PARO interventions are based on human-animal interactions designed to provide physiological, psychological, and social benefits through physical interaction (Shibata & Wada, 2011). Sensory stimulation derived from stroking, hugging, and kissing PARO triggers physiological effects and can result in a reduction in stress-hormone levels (Shibata, 2004), lower blood pressure, and heart rates (Robinson et al., 2015). Psychological effects are experienced through the comfort and joy experienced during close interaction (Chang, Šabanović, & Huber, 2013b). Social benefits are derived from engagement in activities (Cohen-Mansfield, Marx, Dakheel-Ali, Regier, & Thein, 2010).

PARO appears to have positive impacts for older adults on agitation (Jøranson et al., 2015; Moyle et al., 2017b), anxiety (Moyle et al., 2013), loneliness (Robinson et al., 2013), depression (Jøranson et al., 2015; Liang et al., 2017; Petersen et al., 2017), and quality of life (Jøranson et al., 2016b; Moyle et al., 2013; Robinson et al., 2013). Although PARO has promising psychological effects for older adults living in LTC, inconsistent outcomes in depression were found in a meta-analysis (Pu et al., 2019) and systematic review (Chen et al., 2018). Therefore, in order to address this inconsistency, further work is required to establish the precise effect on older adults with depression.
2.3 Systematic review of social robot for depression in older adults

This review evaluates existing primary studies and investigates the reporting of the effect of social robot interventions on depression. It comprises a systematic review published in the *Journal of Nursing Scholarship*.


The *Journal of Nursing Scholarship* has a 2018 Impact Factor of 2.54 and ranked 3 out of the 120 journals in the subject category of “Nursing” (“2018 Journal of Citation Reports® Science Edition”, 2019). Since this manuscript was published in late 2018, it has been cited eight times by November 26, 2019 (Google Scholar).
Statement of contribution to co-authored published paper

This chapter includes a co-authored paper. The bibliographic details of the co-authored paper, including all authors, are:


My contribution to this paper involved: Conceptualising and designing the study, undertaking systematic searches, data extraction, carrying out the initial analysis, drafting and finalising the manuscript.

Minor modifications and edits were applied to the original publication to fit the thesis formatting.

(Signed) Date: 12/12/2019

Shu-Chuan Chen

(Countersigned) Date:12/12/2019

Corresponding author of paper: Shu-Chuan Chen

(Countersigned) Date:12/12/2019

Principal supervisor: Professor Wendy Moyle
Title: Social Robots for Depression in Older Adults: A Systematic Review


2.3.1 Abstract

**Purpose:**

In recent years, there has been an increase in the number of studies using social robots to improve psychological well-being. This systematic review investigates the effect of social robot interventions for depression in older adults.

**Methods:**

The Preferred Reporting Items for Systematic Reviews and Meta-Analysis method was used to identify and select existing studies. Nine electronic databases were searched for relevant studies. Methodological quality was assessed using the Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument. Screening, data extraction, and synthesis were performed by three reviewers. Inclusion criteria covered original quantitative studies investigating social robots for depression in older adults.

**Findings:**

Seven studies were identified – six randomised controlled trials and one comparison study – with all classified as good quality. Social robot interventions consisted of companion, communication, and health-monitoring robots. Three studies presented promising outcomes for reducing depressive symptoms in older adults following social robot
interventions, and three studies showed decreased, but non-significant, trends in depression scores.

Conclusions:

The results highlight the potential of social robot interventions for reducing depression in older adults. However, the evidence is not strong enough to formulate recommendations on clinical effectiveness.

Clinical relevance:

Social robots are being used with increasing frequency to potentially provide personal support to older adults living in long-term care facilities. Social robots can be used to help alleviate depressive symptoms when used in group activities.

Key words: depression, older adults, social robot
2.3.2 Background

Depression is prevalent in younger adults when compared to older adults (Fiske et al., 2009). Nevertheless, depression in older adults is a growing issue, as the prevalence of depression increases with age and persists into older age (McCall & Kintziger, 2013). Pharmacotherapy and psychosocial therapies are the mainstay treatments for depression. However, pharmacotherapy has adverse side effects resulting in poor adherence to antidepressant medication schedules (Kok & Reynolds, 2017). Older adults with depression frequently have medical comorbidities that result in their taking multiple medications that may alter pharmacokinetics and pharmacodynamics and can lead to reduced clinical efficacy of antidepressants and risk of multi-drug interactions (Boyce et al., 2012).

There is increasing interest in psychosocial management of geriatric depression, as not all older people benefit from pharmacological treatment (Kovich & Dejong, 2015). A significant advantage of psychosocial interventions over pharmacotherapy is that this form of intervention results in few physiological side effects and offers promising results for geriatric depression (Forsman et al., 2011a). In recent years, live animal visits and innovative technologies have been promoted as psychosocial interventions that can improve the well-being of older adults (Bemelmans et al., 2012). Live animal visits have been associated with a decrease in depressive symptoms (Travers et al., 2013) and a reduction in loneliness (Banks et al., 2008). A meta-analysis examined the effect of animal assisted therapy (AAT) on the psychological and functional status of older adults and reported that AAT had a larger effect on depression (Effect Size = – 0.34) than other psychiatric conditions, or behavioural disturbances (Vírués-Ortega, Pastor-Barriuso, Castellote, Población, & de Pedro-Cuesta, 2012). However, in spite of its benefits AAT
has limitations and in particular when used in long-term care (LTC) facilities. For example, live animals can cause residents to fall, can take staff away from the care of residents, and not all individuals will react positively to a live animal (Shibata & Wada, 2011). As a result of these challenges social robots have increasingly been considered as an alternative to AAT for older adults and as a means to facilitate social interaction and engagement (Bemelmans et al., 2012).

A social robot is an artificial intelligence system designed to interact with humans by following social behaviours and rules attached to its role (Huber, Lammer, Weiss, & Vincze, 2014). Social robots, in particular animal robots, have similar beneficial effects to live animals, and these robots can elicit the same degree of attachment as a live dog (Banks et al., 2008; Shibata et al., 2001). As social robots are likely to continue to be developed and used in care of older adults it is imperative that the evidence for the use of social robots in geriatric depression is examined.

Over the last decade, many types of social robots have been introduced into aged care settings and their effect on older adults has been explored (Bemelmans et al., 2012; Moyle, Arnautovska, Ownsworth, & Jones, 2017a). Prior to this, social robot research was predominantly technical-based, being undertaken by engineers, software developers, and robotics scientists, and mainly focused on the development of the robots rather than their impact in care. Thus, the uptake of these technologies in clinical practice has been limited. An implication of social robot research has been the resulting mismatch between technical developments and the perceived care need requirements in care facilities (Butter et al., 2008). In addition, many of the studies in care settings have been conducted using non-randomised controlled trials that were unable to elicit the effectiveness of social robots. Bemelmans et al. (2012), in a systematic review that aimed to evaluate the
effectiveness of social robot interventions in older adults, highlighted the limitations of social robot research and concluded that the number of studies was too limited to draw evidence-based conclusions. However, 2013 saw a shift in the methodological approaches and outcomes of social robot research following the publication of the first two randomised control trials (RCTs) using PARO (a baby harp seal robot) for people with dementia and older adults (Moyle et al., 2013; Robinson et al., 2013). Both studies demonstrated that social robots can have beneficial effects on psychological well-being.

An increasing number of studies have since examined the effects of social robots on mental well-being in older adults but, to date, there have been no systematic reviews that evaluate the unique contribution of social robot interventions to mental well-being, particularly depression in older adults. For the successful application of social robots in aged care, the availability of a robot by itself is insufficient, since a social robot developed without the context of the intervention would merely be an entertaining appliance (Bemelmans et al., 2012). Therefore, social robot interventions need to be defined and specified for the target populations, their conditions, such as depressed mood, and their environments. Furthermore, an expectation of their added value within practice must be clarified with rigorous methodological designs. The aim of this study was to systematically review the effect of social robot interventions on depression in older adults.

2.3.3 Method

This review adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement (Moher, Liberati, Tetzlaff, & Altman, 2009) in identifying and selecting existing studies for reporting systematic reviews. The review protocol is registered on PROSPERO (CRD42017069501).
2.3.4 Inclusion and search strategy

To be included, studies had to include: adults aged ≥55 years (this ensured we could include the first original RCT on social robotics and depression, capture younger adults where depression is more common (Fiske et al., 2009), and include studies with young onset dementia); ≥1 type of social robot intervention; ≥1 outcome measure of depression; and be quantitative, with pre- and post-tests, and published in English in peer-reviewed journals.

The search strategy aimed to identify published and full-text articles from January 2000 to April 2017. The start date of 2000 relates to when the first social robot was used as a substitute for a live animal in older adults with cognitive impairment (Kanamori, Suzuki, & Tanaka, 2002). The search strategies were developed in consultation with a health librarian and employed three search methods. First, nine electronic databases (CINAHL, MEDLINE, PsycINFO, PUBMED, Web of Science, Scopus, Cochrane Library, Embase, Proquest) were searched for eligible articles. Second, additional sources were retrieved through the selected articles’ reference lists. Third, due to database-specific rules, CINAHL heading, keyword and MeSH terms were combined with the search strategy. The search terms used were older adults, social robot, and depression (see Table 2.1 for all terms used).
Table 2.1 Search terms used

**Older adults** (elderly OR “older adult” OR elder* OR “older people” OR “older person” OR old* OR eld* OR senil* OR aging OR geriatr* OR later life OR late-life).

**Social robot** (Robot OR Robot* OR robotic OR social-robot OR PARO OR “animal-like robot” OR “robot-animal” OR “socially assistive robot” OR “pet-robot” OR “therapeutic robot” OR “robot therapy” OR “seal robot” OR “robotic therapy” OR “companion robot” OR “emotional robot” OR “pet-type robot” OR “assistive social robot” OR “social robotics” OR “robot-assisted activity” OR “communication robot” OR “sociable robot” OR “AIBO” OR robototherapy OR “robot-assisted activity” OR “human-type communication robot”).

**Depression** (depression OR depress* OR “mood disorder” OR depressive OR mood OR affective OR emotion* OR “psychological distress” OR “mental disorder” OR “depressive mood”).

2.3.5 Study selection, quality of appraisal, and data synthesis

The process for selecting articles was as follows: 1) search results were integrated using Endnote software; 2) duplicate and non-eligible articles were removed based on the title and abstract by two reviewers (SC & CJ); and 3) all potential full-text articles were retrieved and examined against the eligibility criteria, with two reviewers independently assessing their relevance using 0 = no relevance, 1 = unsure, and 2 = relevant. Where consensus was not reached, a third reviewer (WM) was consulted and disagreement resolved through discussion. Assessment of eligible articles, data extraction, and data entry were conducted independently using a predetermined data extraction form. The
accuracy of extracted data was crosschecked by all reviewers. Any incomplete information was sought by contacting the original authors of the included articles. Only two out of seven authors responded to our request for further information regarding methodological quality, raw data for analysis, blinding of treatment allocation, and using intention-to-treat (ITT).

Methodological quality was assessed using the Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument (Joanna Briggs Institute, 2011). This instrument contains 10 questions specific to studies in the field of nursing and medicine. The three independent reviewers performed the methodological validity assessments, with studies requiring “yes” answers to five out of ten items to be recognised as acceptable quality.

Due to the heterogeneity of the results, such as different methodological approaches, different measurements, findings, and a limited number of studies that included a depression outcome, it was not possible to conduct a meta-analysis of these outcomes. Therefore, this review presents a best-evidence synthesis to identify the key results and limitations in each study, and attempts to disentangle the potential effects of social robots on depression.

### 2.3.6 Results

**Study selection.** Figure 2.2 describes the PRISMA flow diagram used in the selection process. A total of 659 records were obtained by searching nine databases. After removal of duplicates, 399 articles were identified. Of these, 76 were assessed for eligibility, and seven were included in this review – six RCTs (Jøranson et al., 2015; Moyle et al., 2013; Petersen et al., 2017; Robinson et al., 2013; Tanaka et al., 2012; Thodberg et al., 2016a)
and one comparison study (Broadbent et al., 2016). In this review, the inter-rater agreement was deemed as moderate ($\kappa = .70$, $p < .001$) between the two reviewers.

**Quality appraisal.** The reporting bias was considered appropriate and acceptable in seven studies that reached at least five points out of ten on the JBI-MAStARI (Table 2.2). The six RCTs presented adequate random sequence generation. Only two studies were blinded to treatment allocation (Jøranson et al., 2015; Moyle et al., 2013) and reported adequate allocation concealment (Moyle et al., 2013; Petersen et al., 2017). Outcome assessment was blinded in two studies (Jøranson et al., 2015; Moyle et al., 2013), and the remaining studies did not report, or there was insufficient information to determine, the risk of bias. The attrition rates and the intention-to-treat approaches in three studies were reported (Broadbent et al., 2016; Moyle et al., 2013; Robinson et al., 2013). In all studies, outcomes were measured in standard and reliable ways, using appropriate statistical analysis.

**Study characteristics.** The characteristics and details of the included studies are summarised in Table 2.2 In total, seven studies were identified, conducted from 2012 to 2017, in LTC facilities (6/7) or at home (1/7), and in five countries: Australia (Moyle et al., 2013), Denmark (Thodberg et al., 2016a), New Zealand (Broadbent et al., 2016; Robinson et al., 2013), Norway (Jøranson et al., 2015), and the US (Petersen et al., 2017; Tanaka et al., 2012).
Figure 2.2 PRISMA flow diagram
Participants. The reviewed studies reported results from a total of 395 older adults. The smallest sample size was 18 participants (Moyle et al., 2013) and the largest was 124 (Thodberg et al., 2016a). The age range was stated in four studies (Broadbent et al., 2016; Jøranson et al., 2015; Robinson et al., 2013; Thodberg et al., 2016a), varying from 55 to 100 years. Four studies had more women than men (Broadbent et al., 2016; Jøranson et al., 2015; Petersen et al., 2017; Thodberg et al., 2016a), and one study only recruited healthy women (Tanaka et al., 2012). The remaining two studies did not report gender characteristics (Moyle et al., 2013; Robinson et al., 2013). Five studies contained people with dementia (76%), and two recruited people from LTC facilities (Broadbent et al., 2016), or healthy women living alone (Tanaka et al., 2012).
Table 2.2 Summary of studies about social robots on depression in older adults

<table>
<thead>
<tr>
<th>Author/ Year/ Country</th>
<th>Study design/ Sample size/ Subjects/ Setting</th>
<th>Robot intervention</th>
<th>Measures time points, Outcome</th>
<th>Outcome follow-up scores</th>
<th>Main findings</th>
<th>JBI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadbent et al. (2016) New Zealand</td>
<td>• Comparison study</td>
<td>• Robot: provided entertainment, communication, health monitoring</td>
<td>Baseline &amp; 12 weeks</td>
<td>GDS 3.7 (3.8) M(SD) vs 3.8 (3.0) M(SD)</td>
<td>After controlling for baseline data, there were no significant differences between groups on any outcome, except a significant increase in job satisfaction in the experimental group (staff) only.</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>• 52 residents and 53 staff</td>
<td>• Six robots placed in activity lounges</td>
<td></td>
<td>QOL-AD 35.9 (7.2) M(SD) vs 36.0 (7.3) M(SD)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• Residential care facility</td>
<td>• 24-hours/12 weeks</td>
<td></td>
<td>QOL-AD-Px 33.8 (7.2) M(SD) vs 33.1 (6.0) M(SD)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• Control: no robot settings</td>
<td></td>
<td>Mobility 4.4 (1.5) M(SD) vs 4.0 (1.9) M(SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Robot: provided entertainment, communication, health monitoring</td>
<td></td>
<td>ADL 21.0 (3.3) M(SD) vs 19.7 (4.8) M(SD)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• Six robots placed in activity lounges</td>
<td></td>
<td>Behavioural scale 30.0 (3.6) M(SD) vs 27.3 (7.5) M(SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jøranson et al. (2015) Norway</td>
<td>• Cluster RCT</td>
<td>• Robot: PARO</td>
<td>Baseline, 12 weeks &amp; 3 months after the intervention(f/u)</td>
<td>CSDD-post 7.9 (6.7) M(SD) vs 8.1 (5.6) M(SD)</td>
<td>Depression and agitation showed a significant difference from baseline to follow-up, but no significance from baseline to end of the intervention.</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>• 60</td>
<td>• Group activity/2 groups</td>
<td></td>
<td>CSDD-f/u 7.2 (6.4) M(SD) vs 9.3 (6.6) M(SD)</td>
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<tr>
<td></td>
<td>• PWD</td>
<td>• Duration: 30 mins/twice a week/12 weeks</td>
<td></td>
<td>BARS-post 20.2 (10.1) M(SD) vs 24.7 (14.0) M(SD)</td>
<td></td>
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<tr>
<td></td>
<td>• NH</td>
<td>• Control: TAU</td>
<td></td>
<td>BARS-f/u 18.2 (7.0) M(SD) vs 24.0 (13.2) M(SD)</td>
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<tr>
<td>Moyle et al. (2013) Australia</td>
<td>• Pilot RCT-crossover design</td>
<td>• Robot: PARO</td>
<td>Baseline, 5 weeks &amp; 10 weeks</td>
<td>GDS 4.7 (2.9) M(SD) vs 4.3 (3.5) M(SD)</td>
<td>Clinical significance in depression score with small effect size, but no statistical significance.</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>• 18</td>
<td>• Group activity/2 groups</td>
<td></td>
<td>QOL-AD 37.2 (8.2) M(SD) vs 26.4 (16.8) M(SD)</td>
<td></td>
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<tr>
<td></td>
<td>• PWD</td>
<td>• Duration: 45 min/twice a week/5 weeks</td>
<td></td>
<td>RAID-Px 12.8 (11.2) M(SD) vs 17.1 (15.1) M(SD)</td>
<td>Moderate to large positive influence on OERS-Pleasure, and negative influence on Anxiety and Sadness in PARO arm.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Residential care facility</td>
<td>• Control: reading activities</td>
<td></td>
<td>AES 38.7 (13.7) M(SD) vs 36.5 (13.7) M(SD)</td>
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<tr>
<td></td>
<td></td>
<td>• Robot: PARO</td>
<td></td>
<td>AWS 46.2 (12.2) M(SD) vs 46.8 (13.0) M(SD)</td>
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<tr>
<td></td>
<td></td>
<td>• Group activity/2 groups</td>
<td></td>
<td>OERS Pleasure 32.7 (17.2) M(SD) vs 21.1 (17.7) M(SD)</td>
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<td></td>
<td></td>
<td>• Duration: 45 min/twice a week/5 weeks</td>
<td></td>
<td>Sadness 12.2 (5.4) M(SD) vs 9.9 (3.9) M(SD)</td>
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<tr>
<td></td>
<td></td>
<td>• Control: TAU</td>
<td></td>
<td>Anger 12.8 (6.0) M(SD) vs 11.6 (5.6) M(SD)</td>
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<tr>
<td></td>
<td></td>
<td>• Robot: PARO</td>
<td></td>
<td>Anxiety 13.2 (5.6) M(SD) vs 10.6 (3.6) M(SD)</td>
<td>Small to moderate effects were found for anxiety in PARO arm.</td>
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<tr>
<td></td>
<td></td>
<td>• Group activity/2 groups</td>
<td></td>
<td>Alert 48.1 (20.3) M(SD) vs 45.1 (21.2) M(SD)</td>
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<td></td>
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<tr>
<td>Petersen et al. (2017) USA</td>
<td>• RCT</td>
<td>• Robot: PARO</td>
<td>Baseline &amp; 12 weeks</td>
<td>CSDD† 2.81 (0.4) M(SD) vs 0.78 (0.4) M(SD)</td>
<td>Depression scores significantly decreased in the treatment group.</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>• 61</td>
<td>• Group activity/2 groups</td>
<td></td>
<td>RAID† 2.5 (0.6) M(SD) vs 0.55 (0.2) M(SD)</td>
<td></td>
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<tr>
<td></td>
<td>• PWD</td>
<td></td>
<td></td>
<td>GDS * † -0.07 (0.03) M(SD) vs -0.06 (0.1) M(SD)</td>
<td>Agitated behaviours were significantly decreased in the treatment group.</td>
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<tr>
<td>Study</td>
<td>Design</td>
<td>Sample Size</td>
<td>Setting</td>
<td>Robot Type</td>
<td>Activity Type</td>
<td>Duration</td>
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<td>Robinson et al. (2013) New Zealand</td>
<td>RCT</td>
<td>40/ PWD/ Retirement home</td>
<td>Dementia units</td>
<td>Duration: 30min/twice a week/12 weeks</td>
<td>Control: standard activity</td>
<td>GSR †</td>
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<td></td>
<td></td>
<td></td>
<td>Duration: 60 min/twice a week/12 weeks</td>
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<td>Oximetry †</td>
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<td></td>
<td></td>
<td></td>
<td>Duration: 12 weeks</td>
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<td></td>
<td>Pulse rate †</td>
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<tr>
<td>Tanaka et al. (2012) USA</td>
<td>RCT</td>
<td>40</td>
<td>Healthy Older females</td>
<td>Robot: Communication robot</td>
<td>Activity type: Individual activity/24-hours/8 weeks</td>
<td>Baseline &amp; 4 weeks &amp; 8 weeks</td>
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<td>Home</td>
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<td>MMSE</td>
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<td>ADL</td>
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<td>Sleep hour</td>
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<td>Appetite</td>
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<td></td>
<td>BMI</td>
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<tr>
<td>Thodberg et al. (2016) Denmark</td>
<td>RCT</td>
<td>124</td>
<td>PWD</td>
<td>Robot: PARO and a live dog</td>
<td>Activity type: Individual activity/3-arm</td>
<td>Baseline &amp; 6 weeks</td>
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<td></td>
<td></td>
<td></td>
<td>NH</td>
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<td></td>
<td>MMSE ‡</td>
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<td>GBS</td>
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<td>BMI</td>
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Note: ADL, activities of daily living; AES, Apathy Evaluation Scale; AMTS, the Abbreviated Mental Test Score; AWS, Revised Algase Wandering Scale–Nursing Home version; BARS, Brief Agitation Rating Scale; BMI, Body Mass Index; CMAI, Cohen–Mansfield Agitation Inventory; CSDD, the Cornell Scale for Symptoms of Depression in Dementia; GDS, Geriatric Depression Scale; GDS*, Global Deterioration Scale; GBS, Gottfries-Bråne-Steen Scale; GSR, Galvanic Skin Response; MMSE, Mini Mental State Examination; OERS, the Observed Emotion Rating Scale; PWD, People With Dementia; Px, Proxy, QOL-AD, Quality of Life in Alzheimer’s Disease; QUALID, Quality of Life in Late-Stage Dementia scale; RAID, Rating Anxiety in Dementia Scale; RCT, Randomised Controlled Trial; sMMSE, Severe MiniMental State Examination; TAU, treatment as usual UCLA-3, UCLA Loneliness scale – 3; †, Differences (post-test-pre-test); ‡, Median [ range]
Interventions. Reported social robot types consisted of PARO (Jøranson et al., 2015; Moyle et al., 2013; Petersen et al., 2017; Robinson et al., 2013; Thodberg et al., 2016a), a communication robot (Tanaka et al., 2012), and a health-monitoring functions robot (Broadbent et al., 2016). Two studies were conducted in one-on-one individualised interaction (Tanaka et al., 2012; Thodberg et al., 2016a); one study placed robots in activity lounges to compare different responses to psychological effects (Broadbent et al., 2016); and four studies used a group intervention led by either a trained nurse or leader (Jøranson et al., 2015; Moyle et al., 2013; Petersen et al., 2017; Robinson et al., 2013). Three studies showed significant results in alleviating depression, including two studies using a group intervention (Jøranson et al., 2015; Petersen et al., 2017), and one study using an individual intervention (Thodberg et al., 2016a). Interventions used in the control condition were treatment-as-usual (Jøranson et al., 2015); a standard activity program (Petersen et al., 2017); alternative activities, such as bus trips or crafts (Robinson et al., 2013); reading activity (Moyle et al., 2013); a placebo human-like boy (Tanaka et al., 2012); a soft toy cat (Thodberg et al., 2016a); and no treatment (Broadbent et al., 2016).

In all studies, the experimental condition included one type of social robot intervention, except in the study by Thodberg et al. (2016a), where a three-arm parallel design, using a live dog, PARO, and a toy cat, was employed.

The intensity and dose of the social robot interventions varied greatly, with each session lasting from 10 to 60 minutes. In four studies, participants engaged in the social robot interventions twice per week (Jøranson et al., 2015; Moyle et al., 2013; Petersen et al., 2017; Robinson et al., 2013), whilst two studies used a social robot for 24-hours (Broadbent et al., 2016; Tanaka et al., 2012), and one provided a one-session intervention fortnightly (Thodberg et al., 2016a). The duration of the intervention period varied
considerably from 5 to 12 weeks.

**Outcomes.** The assessment of the primary outcome of depressive symptomatology was based on two instruments: the Cornell Scale for Depression in Dementia (Jørranson et al., 2015; Petersen et al., 2017) and the Geriatric Depression Scale – Short Form (Broadbent et al., 2016; Moyle et al., 2013; Robinson et al., 2013; Tanaka et al., 2012; Thodberg et al., 2016a).

*The effect of social robot interventions on depressive symptoms.* Three of the seven studies, which included 221 participants, presented promising outcomes for reducing depressive symptoms in older adults after the social robot interventions (Table 2.2) (Jørranson et al., 2015; Petersen et al., 2017; Thodberg et al., 2016a). Jørranson et al. (2015) examined the effect of a group activity with PARO on depression and agitation for people with dementia, finding statistically significant differences in depression from baseline to follow-up with an effect estimate of $-3.9$ (95% CI $0.4 - 7.3$; $p = .028$), but no significant differences from baseline to post-intervention. Petersen et al. (2017) recruited older adults with dementia to receive a PARO intervention, and found a significant reduction in depressive symptoms compared to the control group ($p = .001$). Thodberg et al. (2016a) randomly assigned participants to receive visitations from a person accompanied by either a dog, PARO, or a soft toy cat to compare the effect of the different visitations on the psychiatric well-being of older adults. Whilst depressive symptoms decreased during the experimental period, the visit types failed to reach significance ($F_2, 82 = 0.85; p > .05$) in the reduction of depression.

Moyle et al. (2013) used a pilot RCT crossover design to compare the effects of a PARO intervention and reading activity on emotional states in people with dementia. In this study, the PARO intervention group had higher pleasure scores (Cohen’s $d = 0.7$)
compared to the control activity. There was also a positive change in depression scores with a small effect size (Cohen’s $d = 0.1$), but this was not statistically significant. The remaining three studies reported no significant difference in reduction of depression in older adults after the intervention (Broadbent et al., 2016; Robinson et al., 2013; Tanaka et al., 2012). However, two of these studies presented decreasing trends after the interventions (Broadbent et al., 2016; Robinson et al., 2013). Robinson et al. (2013) examined the psychological effects of PARO in LTC facilities in comparison to a control group and found that, whilst depression scores slightly decreased in the PARO group but increased in the control group, there were no significant differences in depression over time. Broadbent et al. (2016) conducted a comparison study to investigate the benefits of multiple health-care robots placed in LTC facilities. They placed robots in the residents’ lounge and compared results with settings without robots and assessed the influence on depression among residents. The results revealed that depression scores decreased from baseline to follow-up, but did not reach statistical significance. Tanaka et al. (2012) examined the effects of a human-type robot on cognitive function and depression in healthy older women living alone, and found that such a robot increased communication but did not show significant changes in depression.

### 2.3.7 Discussion

To our knowledge, this is the first systematic review examining psychosocial interventions using social robots for depression in older adults. Our review uncovered the potential effects of a social robot intervention on depression, from which several conclusions can be drawn. First, six out of the seven studies yielded positive results, with three studies significantly decreasing depression symptoms, and another three studies showing a reduction trend in depression in older adults. Second, a group activity with the
social robot demonstrated more beneficial effects than an individual activity for older adults. For example, there were four studies using group interventions that indicated promising improvements in a reduction of depression; two demonstrated significant results, and the other two showed trends towards a reduction. The reason for this positive group response might be an encouragement of social interaction between people in a group intervention. Third, it appears that social robots, particularly PARO, are an effective intervention for alleviating depressive symptoms when used frequently, such as twice a week. The cumulative evidence from these studies, however, is still limited given the small pool of studies and varying intervention strategies. There is a paucity of rigorous large-scale RCTs to guide social robot interventions targeting depression in older populations. In spite of the increasing quantity of new studies, the data extracted and analysed in this review is not of a sufficient strength to make definite recommendations on the clinical effectiveness of social robot interventions for older adults with depression. This finding is congruent with a prior review evaluating the effectiveness of social robots in older person care (Bemelmans et al., 2012). Our review suggests that the use of a social robot may result in a reduction in the level of depression. However, further studies are needed before recommendations can be formulated to guide healthcare professionals who provide care to older adults through social robot interventions, and this review highlights a number of areas where research is needed.

The generalisability of these findings is limited for several reasons. First, the sample of reviewed studies ranged from 18 to 124 older adults living in LTC settings, and this population had various clinical conditions, such as different levels of depression and severity of dementia. Four of the studies’ subjects had a lower than average depression score at baseline (Broadbent et al., 2016; Robinson et al., 2013; Tanaka et al., 2012;
Thodberg et al., 2016a). This was particularly evident in the Tanaka et al. (2012) study, as they recruited healthy older women from the community and without cognitive impairment (mean GDS score was low, 2.6 ($SD = 2.9$) at baseline and 2.1 ($SD = 2.1$) at post-intervention in the experimental group). It has been previously indicated that healthier older adults experience less depression than those with more physical conditions (Fiske et al., 2009) and, thus, this may have limited the potential for change in the depression scores. Future studies need to recruit older adults with clinical depressive symptoms to investigate the effect of social robots in those populations. Furthermore, the use of a self-report and non-dementia specific depression scale may not be appropriate for people with dementia. Five studies in this review used the GDS as an assessment instrument with populations that mainly consisted of people with dementia. However, in a previous study, the GDS has been validated for people with mild dementia, but not for those with moderate to severe dementia due to their difficulty in comprehending the questions (Li et al., 2015). Therefore, it is important to carefully consider outcome measures for the specific target population when assessing depression in future studies.

An important issue in these studies was the implementation of a control condition. Two of the reviewed studies implemented standard activity or treatment-as-usual (TAU) as the control group, and they produced significant results (Jøranson et al., 2015; Petersen et al., 2017). TAU is also referred to as usual or routine care in a given setting and has become a generic control condition against which other treatments are compared. Kazdin (2015) asserted that TAU in controlled studies helps to address the key research question, as the new research intervention indeed surpasses in outcome effects what is ordinarily done in given care settings. Furthermore, two studies applied alternative activities rather than TAU, such as group reading (Moyle et al., 2013) and crafts (Robinson et al., 2013),
neither of which presented statistically significant effects on depression. These results need to be interpreted with caution given the interaction or attention of equivalence of the social intervention in two comparison conditions (i.e. intervention vs. alternative activities). Additionally, another two studies used placebo toys (Tanaka et al., 2012; Thodberg et al., 2016a), for which the results showed no significant differences between the intervention and the control group. The definition of placebo effects is that they result from factors other than the active ingredients in the substance itself (Kazdin, 2015). These control treatments are similar to the use of a placebo in medical trials which, given under the guise of treatment, can alter disorders or mitigate their negative impacts (e.g. by reducing the severity of impairment). Therefore, the belief of the patient in treatment, and perhaps belief in the therapist who administers treatment, appear to be related to the change (Finniss, Kaptchuk, Miller, & Benedetti, 2010). In some cases, placebos and their methods of administration might strengthen their effects. As such, there may be a change of outcomes in depression after social robot interventions. In future research, the control group intervention should be carefully selected.

An intention-to-treat (ITT) analysis was not always performed, as only those participants who attended all sessions were included in the analysis. An ITT analysis can be considered more appropriate for achieving a realistic view of the effectiveness of an intervention since non-adhering participants will always be present in practical clinical scenarios (Gupta, 2011). These review results, therefore, need to be interpreted with caution.

Finally, the intervention protocols varied in each of the studies with regards to intervention duration and frequency, the length of the study, and the sample size of the group, and this prohibited data pooling for meta-analysis. Moreover, only three studies
included a power analysis, which is insufficient to assess whether the sample size was large enough to detect the effects of the intervention, and sample sizes were relatively small, with four studies having fewer than 30 participants per group. Given the diverse nature of the interventions analysed, it is difficult to isolate why this review failed to demonstrate strong evidence of improvements in depressive symptoms.

2.3.7.1 Limitations.

One strength of this review is the comprehensive search and selection strategy, which is likely to have identified all relevant published studies. However, we did not include grey literature, such as conference proceedings, and this may have increased publication bias to some extent. Furthermore, articles in languages other than English were not considered, and it is possible that some relevant studies were not identified. Last, it was not possible to combine the results for meta-analysis. This may limit the scope of this review.

2.3.8 Conclusion

As was demonstrated in this review, social robot interventions have the potential to reduce depressive symptoms. The evidence obtained is helpful but cannot be considered strong enough to form a sufficient basis to formulate recommendations on the clinical effectiveness of social robot interventions on depression for older adults. Due to the diversity of interventions and low sample sizes, the evidence suggests the need for rigorous and powered studies that can allow meta-analysis.

2.4 Updated evidence of PARO intervention for depression

A search update was conducted to retrieve any articles published from April 2017 to September 2019. To replicate the previous search strategy, nine databases (CINAHL,
MEDLINE, PsycINFO, PUBMED, Web of Science, Scopus, Cochrane Library, Embase, and Proquest) and Boolean connectors AND, OR, and NOT were used in combination with the search terms displayed in Table 2.1, which was consistent with the original search strategy (Chen et al., 2018). A manual search of the reference lists of the additional articles was also performed. The search results were imported to Endnote before screening. The inclusion/exclusion criteria, the screening procedure, and study selection followed the previous strategy, which was described in sections 2.3.5 and 2.3.6.

The search resulted in 83 records obtained from nine databases. Following the title and abstract screening of the records, seven were retrieved for full-text review. Subsequently, five articles were excluded for the following reasons: conference papers with a single-group design (n = 3), single group (n = 1), and unrelated to depression measurement (n = 1).

Two studies were included. Table 2.3 shows the two studies; one was a pilot RCT (Liang et al., 2017) and the other a cluster-RCT by (Moyle et al., 2017b). Both studies recruited people with dementia and used PARO as a therapeutic tool. The study of Moyle et al. (2017b) was a parallel, three-group, cluster-RCT in 28 LTC facilities with a total of 415 participants. Although this study did not use an instrument to assess the level of depression, it assessed mood through coded video observations, which was considered a rigorous and systematic procedure to assess mood status. Therefore, this study was included due to the important contribution it makes to the evidence that interacting with PARO improves mood. This study aimed to test the effects of individual and non-facilitated PARO intervention on emotional and behavioural symptoms of dementia, in comparison with a look-alike plush toy and usual care. Video observation of participants was used to assess changes in the outcome measurements. The results showed that
participants in both the PARO intervention group and plush toy groups demonstrated greater reductions in mood than usual care, whereas PARO was more effective than usual care in eliciting responses of pleasure. Furthermore, the PARO group was significantly more verbally and visually engaged with the PARO than the plush toy group. The reporting bias using the JBI-MASTARI (Joanna Briggs Institute, 2011) presented a full score of 10 where there is no bias in its design, conduct and analysis of studies.
## Table 2.3 Updated evidence of social robot interventions and depression

<table>
<thead>
<tr>
<th>Author/ Year/ Country</th>
<th>Study design/ Sample size/ Subjects/ Setting</th>
<th>Robot intervention</th>
<th>Measures time points/ Outcome follow-up scores</th>
<th>Main findings</th>
<th>JBI-MAStARI Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liang et al. (2017) New Zealand</td>
<td>• A pilot RCT • People with dementia (PwD) • 30 • Day care centre</td>
<td>• Paro in day-care centre: 3 to 6 participants, unstructured format, 30-min/session, 2-3 sessions/week, for 6 weeks • Paro at home: a Paro provided for each dyad (caregiver and patient), for 6 weeks • Control group: standard activities</td>
<td>Baseline, postintervention (week-6), follow-up (week-12) <strong>Day-care centre</strong> • Facial expressions Happy/smiling Sad Fear Anger/irritation • Social interactions Talk to others Talk to staff Reciprocate Cooperate</td>
<td>Participants in the PARO group not only showed significantly more positive facial expressions; they also talked more to staff and researchers compared to those in the control group. There were statistically significant differences in affective and social outcomes between participants in the PARO and control group at day care. Depressive symptoms showed improvements from baseline to week 6 for PwD in PARO group and the control group. Nevertheless, there was a significant interaction effect, where depressive symptoms significantly increased during follow-up from 6 weeks to 12 weeks for PwD in the PARO group.</td>
<td>6 out of 10</td>
</tr>
<tr>
<td>Moyle et al. (2017) Australia</td>
<td>• Parallel, 3-group, cluster-RCT • 415</td>
<td>• PARO: Individual, non-facilitated, 15-min session three times/week for 10 weeks</td>
<td>Baseline, week-1, 5, 10, and 15 <strong>Mood states</strong> • Anger</td>
<td>PARO and plush toy groups demonstrated greater reductions in neutral affect than usual care. PARO was more effective than usual care in improving pleasure.</td>
<td>10 out of 10</td>
</tr>
</tbody>
</table>

### Baseline, postintervention (week-6), follow-up (week-12) **Day-care centre**

- **Facial expressions**
  - Happy/smiling: 81.9 (17.5) vs. 56.7 (33.8)
  - Sad: 0.30 (1.11) vs. 3.47 (7.67)
  - Fear: 0.42 (1.57) vs. 1.25 (3.95)
  - Anger/irritation: 1.02 (2.63) vs. 0

- **Social interactions**
  - Talk to others: 26.0 (29.2) vs. 17.1 (25.1)
  - Talk to staff: 46.9 (26.5) vs. 25.5 (24.3)
  - Reciprocate: 61.8 (26.7) vs. 41.3 (33.4)
  - Cooperate: 62.4 (28.6) vs. 54.7 (35.2)

### Measures at home: CSDD

<table>
<thead>
<tr>
<th></th>
<th>Baseline: 6.38(5.69)</th>
<th>Baseline: 8.27(6.42)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mood states</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Anger</strong></td>
<td>Baseline: 0.04(1.46)</td>
<td>Baseline:-0.04(1.19)</td>
</tr>
<tr>
<td></td>
<td>Week-1: 0.90(6.97)</td>
<td>Week-1:-0.09(1.06)</td>
</tr>
<tr>
<td></td>
<td>Week-5: 1.11(6.12)</td>
<td>Week-5:-0.03(1.01)</td>
</tr>
<tr>
<td></td>
<td>Week-10: 0.69(4.96)</td>
<td>Week-10:-0.02(0.84)</td>
</tr>
<tr>
<td></td>
<td>Week-15: 0.05(0.51)</td>
<td>Week-15:-0.02(1.48)</td>
</tr>
<tr>
<td></td>
<td>Baseline:</td>
<td></td>
</tr>
<tr>
<td>--------------------</td>
<td>----------</td>
<td>----</td>
</tr>
<tr>
<td>Residents with</td>
<td>-2.41(18.24)</td>
<td></td>
</tr>
<tr>
<td>dementia</td>
<td>-5.90(20.75)</td>
<td></td>
</tr>
<tr>
<td>LTC</td>
<td>-6.53(18.93)</td>
<td></td>
</tr>
<tr>
<td>Plush toy: same,</td>
<td>-4.43(16.94)</td>
<td></td>
</tr>
<tr>
<td>but given PARO</td>
<td>-2.77(17.49)</td>
<td></td>
</tr>
<tr>
<td>with robotic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>features disabled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Usual care</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pleasure: video</td>
<td>0.10 (5.00)</td>
<td></td>
</tr>
<tr>
<td>observation</td>
<td>6.15 (11.63)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.59 (8.86)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.71 (6.99)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.07 (2.98)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.18 (5.35)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0.63 (5.33)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.19 (4.28)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.96 (7.99)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.22 (4.61)</td>
<td></td>
</tr>
</tbody>
</table>

Note: CMAI, Cohen-Mansfield Agitation Inventory; CSDD, the Cornell Scale for Symptoms of Depression in Dementia; NPI-Q, The Neuropsychiatric Inventory Brief Questionnaire Form; PwD, People with Dementia
Liang et al. (2017) conducted a pilot randomised controlled trial to examine the affective, social, behavioral, and physiological effects of PARO for people with dementia in both a daycare centre and a home setting. A 30-minute unstructured PARO intervention at the daycare centre was run two to three times a week for six weeks and participants also had PARO at home for six weeks. Participants in the control group received standard activities such as quizzes, exercise, bingo, and music. The reporting bias using the JBI-MAStARI (Joanna Briggs Institute, 2011) presented a score of six out of ten due to a lack of clarity concerning allocation concealment, lack of blinding of participants, personnel and outcome assessment, as well as unclear reporting of incomplete outcome data. Nevertheless, it is still within the acceptable cut-off score of five (Joanna Briggs Institute, 2011) where a higher score reflects less bias in its design, conduct, and analysis of studies. The study results demonstrated that there were improvements in depressive symptoms from baseline to week-six for people with dementia in the PARO group and the control group. Nevertheless, there was a significant interaction effect, where depressive symptoms significantly increased during follow-up from six to 12 weeks for people with depression in the PARO group only. In addition, there was a significant difference in cognitive scores, where participants who responded positively to PARO had significantly higher cognitive scores compared to those who showed neutral/negative/mixed responses to PARO. These results indicate that PARO may be most beneficial for participants who show mild rather than severe cognitive impairment.

In summary, both studies indicated that PARO shows promise in enhancing mood and social interaction for older people with dementia both in LTC facilities and home settings. Liang et al. (2017) indicated that a PARO intervention could help alleviate the level of depression; however, symptoms of depression were shown to have an increase in the follow-up. This may be related to the removal of PARO. Therefore, this is an important issue to be considered in future research.
2.5 Conceptual framework

The conceptual framework underpinning this study is adapted from the biopsychosocial model developed by Engel (1977) (Figure 2.3). This model describes an interconnection and interdependence process involving biological, psychological, and social aspects of depression. According to this model, depression is caused by biological factors (neurotransmitter, endocrine, and immune systems), psychological factors (characteristic negative patterns of thinking, deficits in coping skills, and judgment problems), and social factors (family relationships, socioeconomic status, and social support) (Garcia-Toro & Aguirre, 2007). Studies have found that interactions with social robots have positive impacts on these three factors (Bernabei et al., 2013; Mordoch, Osterreicher, Guse, Roger, & Thompson, 2013; Wada & Shibata, 2007b). Therefore, this study combines the biopsychosocial model and the effectiveness of the social robot interventions as a conceptual framework.

Figure 2.3 outlines the influence of a social robot PARO intervention on mental well-being based on the biopsychosocial framework. Empirical research has revealed that interaction with a PARO stimulates a physiological response in participants due to an increase in the level of oxytocin, which reduces blood pressure and simultaneously decreases anxiety (Robinson et al., 2015). Moreover, the calming effect of stroking PARO may trigger a biological response, such as an increase in serotonin levels (Petersen et al., 2017) and a reduction in stress hormones (Mordoch et al., 2013), thus alleviating depressed mood.

Regarding the psychological effect, research reveals that the presence of a social robot can provide companionship for older adults, decrease feelings of loneliness, and comfort them when they feel unhappy. Interaction with social robots also can increase the perception of pleasure and
lead to better positive interactions with others (Chang et al., 2013b; Klein & Cook, 2012; Shibata, 2004; Takayanagi et al., 2014). Moreover, the distraction effects of PARO can draw people’s attention away from negative emotions and help older adults stay positive, thus alleviating depressed mood.

Social effects are associated with interpersonal interaction, communication, and activity engagement. The increasing engagement in activities by older adults can be interpreted by the Comprehensive Process Model of Engagement (Cohen-Mansfield, Dakheel-Ali, & Marx, 2009), which describes the relationship between tailored activities and the facilitation of engagement through interaction with perceived interesting stimuli. From this perspective, PARO can be seen as a stimulus that has an impact on engagement. Furthermore, previous studies have shown that older adults increased their communication, social interaction, and motivation by participating in PARO interventions (Robinson et al., 2013; Thodberg et al., 2016b). These results suggest that the social effects of PARO may help reduce depression.

Some studies have shown that depression has a direct association with loneliness and QOL (Cao et al., 2016; Liu et al., 2016). Under these circumstances, reducing depression can also decrease feelings of loneliness and improve QOL. Therefore, the evidence above supports the application of PARO to improve psychological well-being. Furthermore, a meta-analysis showed that at least six sessions of psychological intervention are needed to demonstrate effectiveness in reducing depression and anxiety (Nieuwsma et al., 2012). Consequently, this study adopted a PARO intervention for eight weeks.
Figure 2.3 Bio-Psycho-Social framework for PARO intervention on depression

2.6 Summary of the chapter

The population of older people is growing due to improved healthcare and longer life expectancy, therefore the number of older adults in LTC is expected to increase in the future. Older adults living in LTC appear to experience more emotional distress. From this perspective, geriatric depression has become an important global mental health issue and a growing body of literature has investigated the effects of psychosocial interventions for older adults with depression. Recent
studies indicate promising results with the social robot, PARO, which has been recognised as a potential new intervention for improving mental well-being in older adults. This research sheds new light on the effects of PARO on older adults with depression and fills a gap in the literature by exploring the impact of PARO on depression, loneliness and QOL for older adults with depression who live in LTC.

This systematic review and update aimed to evaluate the effect of social robot interventions on depression for older adults and used the PRISMA guidelines to identify and select potential articles. Nine studies involving 840 participants were included in the review and update. The majority of participants was female and had a diagnosis of dementia. The findings indicated that social robot interventions had a positive effect, as they decreased the level of depressive symptoms among older adults, particularly when using PARO. As a result, further study should be made into whether PARO is an effective means of reducing depression among older adults with depression. In addition, further research should be undertaken to assess the benefits of higher doses of social robot interventions.
Chapter 3 Phase One – Online Survey

This chapter provides details about an online survey of attitudes of health personnel towards the use of social robot for older adults in long-term care. The objectives were to:

(a) modify, translate and validate the Chinese version of Attitudes Towards The Use of Social Robot (ATTUSR-C) questionnaire for use with Taiwanese health personnel; and

(b) investigate the attitudes of Taiwanese health personnel working in LTC towards the use of social robots for older adults.

This manuscript has been published in the International Journal of Social Robotics. Minor modifications and edits were applied to the original publication to fit the thesis formatting.


The International Journal of Social Robotics has a 2018 Impact Factor 2.296 and ranked 15 out of the 26 in the subject category of “Robotics SCIE” (“2018 Journal Citation Reports® Science Edition”, 2019).
Statement of contribution to co-authored published paper

This chapter includes a co-authored paper. The bibliographic details of the co-authored paper, including all authors, are:


My contribution to this paper involved: Critical review of the literature to inform the design of the study, conceptualising and design of the study, modification and translation of the questionnaire, data collection, data analysis, data interpretation, writing of the draft manuscript, and finalisation of the manuscript.

(Signed) Date: 12/12/2019

Shu-Chuan Chen

(Countersigned) Date:12/12/2019

Corresponding author of paper: Shu-Chuan Chen

(Countersigned) Date:12/12/2019

Principal supervisor: Professor Wendy Moyle
Title: Health professionals and workers’ attitudes towards the use of social robots for older adults in long-term care


3.1 Abstract

Aims: The aim of this study was (a) to modify, translate and validate the Chinese version of Attitudes Towards The Use of Social Robot (ATTUSR-C) questionnaire for use with Taiwanese health personnel; and (b) investigate the attitudes of Taiwanese health personnel working in long-term care towards the use of social robots for older adults.

Background: The attitudes of health personnel towards social robots can affect the acceptability of social robots for older adults. An investigation of health personnel’s attitudes towards the use of social robots and the development of a validated Chinese questionnaire is needed.

Design: A cross-sectional design was used to conduct this multi-phase study.

Methods: Data collection was from November 2017 to May 2018. Content validity, internal consistency reliability, and factor analysis of the ATTUSR-C questionnaire were evaluated. Purposive sampling was used. All recruited participants received an email containing study information and a URL link to the survey.

Results: The ATTUSR-C questionnaire had good validity and reliability. A total of 416 health professionals responded to the online survey. Most health personnel had positive attitudes
towards the use of social robots in long-term care facilities, as they considered social robots to be beneficial and practical in psychosocial care for older adults.

**Conclusion:** Positive attitudes towards the use of social robots can increase acceptance and utilisation of social robots. This study strives to support nursing work by providing insights into health personnel’s perceptions of social robots, in order to integrate social robots into the care and lives of older adults.

Keywords: health personnel, attitudes, social robots, long-term care, survey
3.2 Introduction

Advances in technology have led to the introduction of robots into healthcare. In particular, social robots, which are an artificial intelligence system designed to interact with humans by following social behaviours and rules, have increasingly been used with older adults in aged care (McGlynn, Kemple, Mitzner, King, & Rogers, 2017; Moyle et al., 2017b). Recent systematic reviews have highlighted the use of social robots to facilitate social connectedness (Moyle et al., 2017a) and improve psychological well-being for older adults (Abdi, Al-Hindawi, Ng, & Vizcaychipi, 2018). Additionally, studies have shown that social robots could be an alternative option to the use of live animals in nursing homes (Jøranson et al., 2016a; McGlynn et al., 2017). One determinant that influences the uptake of social robots by older people in aged care is the attitudes of health professionals and workers (referred to in this paper as personnel) towards social robots. Despite the recent growth in the development and use of robots in the aged-care sector (Sung, Chang, Chin, & Lee, 2015), few studies have investigated the attitudes of health personnel towards the use of social robots (Rantanen, Lehto, Vuorinen, & Coco, 2018; Vänni & Salin, 2019). In addition, there is no current study that examines health personnel attitudes towards social robots in the Chinese cultural context. Therefore, the purpose of this study was to investigate the attitudes of health personnel working in long-term care (LTC) facilities towards the use of social robots for older adults in Taiwan.

3.3 Background

Campa (2016) defines a social robot as “a physically embodied, autonomous agent that communicates and interacts with humans on an emotional level” (p.106). Social robots are designed to engender beneficial effects and enrichment by helping patients to express their feelings
provide comfort (Backonja et al., 2018); alleviate anxiety and agitation (Pu et al., 2019); reduce loneliness (Robinson et al., 2013), and depression (Chen et al., 2018). For older adults who experience loneliness, a social robot can be a reliable personal companion when care staff are not available for social interaction (Broadbent et al., 2012; Moyle, Bramble, Jones, & Murfield, 2018).

The attitudes of health personnel towards social robots can determine the success or failure in the implementation of social robots in care (Broadbent et al., 2009; Mitzner, Kemp, Rogers, & Tiberio, 2013; Papadopoulos, Koulouglioti, & Ali, 2018). Esmaeilzadeh et al. (2011) reported that when social robots are introduced into a care setting, the robot might impact on health personnel autonomy, their relationships with patients, and their routines and workflow. In addition, Vänni and Salin (2019) investigated the need for service and social robots among health professionals in the healthcare sector. The results demonstrated that health professionals considered that robots were able to increase productivity by lightening their workload, increasing the meaningfulness of work, saving time, improving the quality of work and reducing the mental workload of workers. There is evidence to suggest that positive attitudes of health personnel and patients towards the use of social robots, can lead to a greater potential for the adoption and acceptance of social robots (Costescu & David, 2014).

Attitude is defined as a relatively stable and enduring predisposition to behave or react in a certain manner towards persons, objects, institutions, or issues (Altmann, 2008). Heerink, Kröse, Evers, and Wielinga (2010) indicated that attitudes towards the use of social robots are defined as the user’s positive or negative evaluation of social robots. Research findings suggest that emotions and attitudes strongly impact on human-robot interaction and are linked to acceptance (Stafford et al., 2010). Acceptance, in this instance, is defined as the consensual incorporation of social robots
into an individual’s life (Broadbent et al., 2009). Research further supports the notion that expectations of enjoyment in robot interaction are associated with acceptance by older people or health personnel (Heerink, Kröse, Evers, & Wielinga, 2009).

To date, the Technology Acceptance Model (TAM) (Davis, Bagozzi, & Warshaw, 1989) and the Unified Theory of Acceptance and Use of Technology (UTAUT) model (Venkatesh, Morris, Davis, & Davis, 2003) have commonly been used to study the acceptance of information technology and social robots. The former was used to investigate perceived usefulness and ease of use for end-users; the latter for factors pertaining to end-users’ age, gender, experience, and willingness to use the robots. While the acceptance of technology by end-users is widely discussed in a variety of studies, very few studies focus on health personnel's views on the implementation of social robots.

There are a limited number of questionnaires or instruments developed for measuring attitudes towards the use of social robots. However, the majority of attitude questionnaires currently available were designed to assess the attitudes of patients or older adults towards their use of social robots. For example, the Negative Attitudes towards Robots Scale (NARS), which was developed by Nomura et al., was based on free-form responses from participants about anxieties towards robots (Nomura, Kanda, Suzuki, & Kato, 2004). However, the NARS considered attitudes towards communication robots as a psychological construct and focused on negative attitudes of human-robot interaction in users (Nomura et al., 2004; Syrdal, Dautenhahn, Koay, & Walters, 2009). In addition, the NARS was used to assess end-users rather than secondary users, such as health professionals. Hence, it was not considered an appropriate scale for this study. Heerink et al. (2010) extended the UTAUT model to develop the Almere model to examine the acceptance of assistive social robots by older adults. Even though this questionnaire contains a
sub-dimension on attitude, it was more suited to investigate the attitude of older adults rather than
the attitudes of health personnel.

At present, only a few studies report on health personnel's attitudes towards social robots
conducted a cross-sectional survey to explore the need for service robots among healthcare
workers in Finnish hospitals and homecare nurses using a questionnaire, which included a five-
point scale and open-ended question. Rantanen et al. (2018) examined the attitudes of homecare
personnel towards social robots and focused on assessing the usefulness of care robots for tasks in
homecare and social psychological factors affecting personnel’s intention to introduce care robots.
An 83-item questionnaire with 32 questions directly relating to a care robot was used in their study
(Rantanen et al., 2018). The questionnaires used in both studies were not appropriate for this
current study, as the former focused on service robots while the latter consisted of items focused
on living tasks for older adults in homecare.

To our knowledge, the only developed questionnaire that examines attitudes of social robot
use is one by Costescu and David (2014). They investigated the attitudes of children and adults of
social robot use in mental health services and the impact of information concerning the benefits of
robots on their attitudes. Participants were randomly assigned to either an informed group, who
received information about the benefits of using social robots, or a non-informed group. The results
demonstrated that most participants showed a positive attitude toward the use of robots, but there
were no significant differences between groups (i.e. informed and uninformed groups, as well as
children and adults). However, in this research, the attitudes of health personnel were not
investigated.
To date, the limited studies that have examined the attitudes of health personnel towards social robots used a descriptive qualitative approach and found mixed findings. Broadbent et al. (2012) reported that retirement homecare staff had possessed more negative attitudes towards social robots than residents due to staff fears of losing their job to the robot. Moyle et al. (2018) however, investigated the perceptions of care staff towards the use of a robot-pet and a plush toy in nursing homes and found that care staff had possessed positive perceptions towards the robot-pet. They found that staff believed that the robot-pet increased excitement, had therapeutic benefits, enhanced engagement, and could be an alternative to human companions for older adults living with dementia. Staff suggested that the robot-pet has the potential to improve quality of life of people with dementia when compared to a plush toy (Moyle et al., 2018). Furthermore, a Finnish study found that care personnel’s behavioural intentions towards robot applications in care settings were influenced by their personal appreciation of the usefulness of robots and the expectations of their colleagues and supervisors (Rantanen et al., 2018). The unsuccessful adoption of a social robot in a care setting may therefore be associated with the negative attitudes of care staff towards the social robot (Stafford et al., 2010).

Health personnel attitudes towards social robots are an important and relatively underexplored area of research. There is neither a questionnaire that specifically examines health personnel attitudes towards the use of social robots nor is there a questionnaire available in the Chinese language. This is in spite of the significant increase in robot development and use in Chinese circumstance where, for example, a seal-like robot pet was used to improve communication and interaction skills for older adults in aged care (Sung et al., 2015). Therefore, the findings of this study should make an important contribution to the field of health personnel attitudes towards the use of social robots in a Chinese context.
3.4 Method

3.4.1 Aims

The aim of this study was to (a) modify, translate and validate the Chinese version of Attitudes Towards The Use of Social Robot (ATTUSR-C) questionnaire for use with Taiwanese health personnel and (b) investigate the attitudes of Taiwanese health personnel working in LTC towards the use of social robots for older adults. The research questions were (a) What are the validity and reliability of ATTUSR-C for health personnel? And (b) What are health personnel attitudes towards the introduction of a social robot to older adults in LTC facilities in Taiwan?

3.4.2 Modification, translation and validation of the ATTUSR-C Questionnaire

A cross-sectional design was used to conduct this multi-phase study. The study protocol was reviewed and approved by Griffith University Human Research Ethics Committee (reference number 2017/819).

3.4.2.1 Development of the ATTUSR-C

Costescu and David (2014) developed the original ATTUSR questionnaire (Table 3.1) to investigate the attitudes of children and adults towards the use of social robots in mental health services. The original ATTUSR questionnaire, despite being designed for use by adults and children in mental health services, was chosen for use with health personnel working in LTC facilities, as these are relatively similar environments where people often have a mental health diagnosis and symptoms. The original questionnaire comprises a total of 18 items across three domains that include questions: (1) concerning the use of social robots in society; (2) relating to the effectiveness of the use of social robots in healthcare; and (3) regarding the use of robots in
psychotherapy. The original questionnaire showed excellent internal consistency ($\alpha = .94$) (Costescu & David, 2014).

All questions in the ATTUSR questionnaire were reviewed and modified by the research team for use with health personnel working in LTC facilities that included the rewording of items and response options as well as the removal of redundant items. For example, the term "adults" was replaced by "older adults" and "setting" was changed to "long-term care facility". Of the original 18 items, 15 items were considered to be appropriate for the target population and three items were deleted due to their focus on children and adolescents. With the deletion of the three inappropriate items, the modified version of the ATTUSR questionnaire consists of 15 items (refer to Table 3.2), of which one item was reverse coded (i.e. Item 12). Each item is rated by the respondent on a 5-point Likert type scale from 0 to 4, with 0 and 4 reflecting strong disagreement and agreement respectively.
**Table 3.1** The original questionnaire of attitudes toward the use social robots for adults

<table>
<thead>
<tr>
<th>Item no.</th>
<th>Questionnaire items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Social robots could help with treatment of people with mental illness.</td>
</tr>
<tr>
<td>2.</td>
<td>Social robots could help the psychotherapist to reach his/her objectives in therapy with support for doing homework.</td>
</tr>
<tr>
<td>3.</td>
<td>Social robots could be useful for society because they help people.</td>
</tr>
<tr>
<td>4.</td>
<td>Social robots could help with raising children and childcare.</td>
</tr>
<tr>
<td>5.</td>
<td>Social robots could represent good partners for the elderly.</td>
</tr>
<tr>
<td>6.</td>
<td>Social robots could be useful in mental health services.</td>
</tr>
<tr>
<td>7.</td>
<td>Using social robots in the psychotherapy process could lead to resolving difficulties in less time.</td>
</tr>
<tr>
<td>8.</td>
<td>Using social robots in the psychotherapy process could increase treatment efficiency.</td>
</tr>
<tr>
<td>10.</td>
<td>Using social robots in the psychotherapy process could make the meetings more interesting.</td>
</tr>
<tr>
<td>11.</td>
<td>I would be comfortable if the psychologist would use a social robot.</td>
</tr>
<tr>
<td>12.</td>
<td>I consider that social robots could be a threat for mental health services.</td>
</tr>
<tr>
<td>13.</td>
<td>Social robots could help with the process of diagnosis of people with mental illnesses.</td>
</tr>
<tr>
<td>14.</td>
<td>I would be comfortable if my child would participate at a psychological meeting and the psychologist would use a social robot.</td>
</tr>
<tr>
<td>15.</td>
<td>Use of social robots in the psychotherapy programs designed for children could increase treatment efficiency.</td>
</tr>
<tr>
<td>16.</td>
<td>Social robots could help to diagnose children with mental illness.</td>
</tr>
<tr>
<td>17.</td>
<td>Use of social robots in the psychotherapy programs designed for children could lead to resolving psychological problems in less time.</td>
</tr>
<tr>
<td>18.</td>
<td>I consider that robots could not pose a threat for mental health services designed for children.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Pattern</th>
<th>Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1. Social robots could help with treatment of older people with mental illness.</td>
<td>.552</td>
<td>.547</td>
</tr>
<tr>
<td>A2. Social robots could help the health professional to reach his/her objectives in care with support for daily activities.</td>
<td>.702</td>
<td>.706</td>
</tr>
<tr>
<td>A3. Social robots could be useful for society because they help both health professionals and older people living in long-term care facilities.</td>
<td>.683</td>
<td>.683</td>
</tr>
<tr>
<td>A4. Social robots could help both health professionals and older people in aged care for support.</td>
<td>.706</td>
<td>.705</td>
</tr>
<tr>
<td>A5. Social robots could represent companions for older adults living in long-term care facilities.</td>
<td>.619, -.490</td>
<td>.611, -.480</td>
</tr>
<tr>
<td>A6. Social robots could be useful in mental health services for older adults.</td>
<td>.640, -.471</td>
<td>.633, -.462</td>
</tr>
<tr>
<td>A7. Using social robots could in the health/nursing care process lead to resolving of difficulties in less time.</td>
<td>.687, .343</td>
<td>.692, .353</td>
</tr>
<tr>
<td>A8. Using social robots could in the health/nursing care process increase treatment efficiency.</td>
<td>.723</td>
<td>.727</td>
</tr>
<tr>
<td>A9. Using social robots could reduce health/nursing treatment costs.</td>
<td>.550, .389</td>
<td>.556, .397</td>
</tr>
<tr>
<td>A10. Using social robots in the health/nursing care process could make the care work more interesting.</td>
<td>.639, -.311</td>
<td>.634, -.302</td>
</tr>
<tr>
<td>A11. I think that older adults would be comfortable if health professionals would use a social robot in the care process.</td>
<td>.642</td>
<td>.641</td>
</tr>
<tr>
<td>A12. I consider that social robots could be a threat for aged-care services.</td>
<td></td>
<td>.557, .576</td>
</tr>
<tr>
<td>A13. Social robots could help with the process of diagnosis of people with mental illness.</td>
<td>.445</td>
<td>.449</td>
</tr>
</tbody>
</table>
A14. Social robots could help with the process of diagnosis of people with mental illness.
A15. I consider that robots would not pose a threat for mental health services designed for older adults.

3.4.2.2 Translation of the ATTUSR-C

The modified ATTUSR questionnaire was then translated into Chinese (i.e. Mandarin) by two PhD-prepared nurse researchers (i.e. forward translation) using the WHO process of translation and adaptation of questionnaire guidelines (World Health Organization, 2017). Based on the symmetric method of translation, the translators avoided verbatim translation and considered sociocultural considerations. Equivalence of form and meaning of both the modified English and Chinese versions of the instrument were then reviewed by an individual expert (i.e. a bilingual researcher with a PhD in health) who identified and resolved any inadequate expressions and concepts of the translation. Next, the ATTUSR-C questionnaire was translated back into English by an additional two bilingual and bicultural experts. Any ambiguities and discrepancies regarding the cultural meaning and colloquial expressions in words were discussed and resolved through consensus among the translation team.

3.4.2.3 Establishing Content and Face Validity of the ATTUSR-C

An expert panel consisting of five academic nursing professors with expertise in aged care, mental health care, as well as instrument development and translation, evaluated the content validity of the ATTUSR-C questionnaire. Each expert panel member individually rated the clarity and appropriateness of each item of the 15 items using the 4-point Likert type scale (1 = not relevant to
4 = relevant). The item-Content Validity Index (I-CVI) is computed as the number of experts giving a rating of either 3 or 4 divided by the total number of experts. According to Polit, Beck, and Owen (2007), an I-CVI of 79% or over was appropriate while an I-CVI of 70% to 79% and less than 70% was revised and eliminated respectively. Furthermore, scale-CVI/Average (S-CVI/Ave) was calculated by the average proportion of items given a rating of 3 or 4 by the raters involved. A minimum S-CVI of .90 or higher is acceptable (Waltz, Strickland, & Lenz, 2010).

A further 10 clinical instructors were asked to examine the instrument for face validity. Face validity is defined as the extent to which a test is subjectively viewed as covering the concept which is purported to measure (Cohen & Swerdlik, 2009). This refers to the transparency or relevance of the ATTUSR-C questionnaire as it would appear to target participants. The clinical instructors were asked to specify the clarity of each of the 15 items and whether anything was confusing about each question, and then they were asked to rate each item. Nominal data (clear or unclear) were used to generate face validity ratings for each item. The resulting data revealed the percentage of clinical instructors who had difficulty understanding the items from their perspectives. Items that were found to have an average agreement (clear or unclear) were rated below 80% indicating an unacceptable level of translation face validity which was to be further discussed and resolved through consensus in the translation group.

3.4.2.4 Pilot testing of the ATTUSR-C

Participants. The ATTUSR-C questionnaire was pilot tested with a convenience sample of nurses for cross-cultural adaptation and assessment of its reliability. Nurses who are alumni members of a nursing college were invited to complete the ATTUSR-C questionnaire via an email that asked them to contact the first author if they were willing to participate in the study. Only nurses working
in nursing homes (i.e. residential facilities with registered nurses providing 24-hour nursing and medical care), residential care facilities (i.e. assisted living facilities), day care centres, rehabilitation wards, or home care were included in the study. Based on the ratio of 5–10 participants to one item (Ferketich, 1990), a minimum sample size of 75 registered nurses was targeted.

Procedure. All recruited participants received an email containing information of the study with a URL link to access the ATTUSR-C. Implied consent to participate in the study was reflected via their online completion and submission of the questionnaire. Data was collected from November 2017 to January 2018.

Data analysis. Statistical analysis was performed using version 24.0 of the SPSS software (IBM Corp., 2016). Construct validity of the ATTUSR-C questionnaire was first assessed using exploratory factor analysis, which was performed using the principal components analysis (PCA) with oblimin rotation, and if needed, confirmatory factor analysis to determine the goodness-of-fit of the extracted factor model. Kaiser-Meyer-Olkin and Bartlett's test of sphericity statistic were computed to test the possibility of performing factor analysis. The number of factors to be retained was guided by: (a) Kaiser’s criterion (i.e. eigenvalue > 1); (b) inspection of the scree plot; and (c) Jorn’s parallel analysis (Horn, 1965). Cronbach’s alpha coefficient was computed to assess internal consistency of the ATTUSR-C questionnaire where a value of .7 or greater was considered reliable (Streiner, Norman, & Cairney, 2015).
3.4.3 Investigation of health personnel attitudes towards the use of social robots for older adults in LTC

A cross-sectional study using an online survey was adopted in this study. The online survey was administrated using LimeSurvey tool provided from Griffith University research survey centre. Ethical approval for this study was approved by Griffith University Human Ethics Committee (reference number: 2017/824) prior to the commencement of the study.

3.4.3.1 Participants and recruitment

The inclusion criteria of participants were: (1) health professionals, care workers and management personnel including registered nurses, nursing aides, occupational therapists, physiological therapists, social workers, psychologists, physicians, psychiatrists, administrators, and managers; and (2) working in a LTC facility for at least three months. Health personnel who were not working in LTC were excluded. Using purposive sampling, registered nurses were invited to participate in the online survey via an email or social media from the Council of Nursing and Aged Care. The researcher then contacted managers of LTC facilities who were either introduced by the Dean of the Council of Nursing and Aged Care or listed on LTC websites. Health personnel from these LTC facilities were then invited to complete the online survey via an email or social media from the LTC managers.

3.4.3.2 Data collection

Data were collected in Taiwan without any location limitation via an anonymous online survey. Within the study email invitation, a URL link to access the online survey was provided for interested health personnel to partake in the study. Participation in the online survey posed no
foreseeable risks for respondents. Implied consent was obtained via participants’ submission of their completion online survey. The online survey took approximately 10 to 15 minutes to complete and provided participants with an overview of social robots that included possible features and functions, as well as pictorial examples of social robots to orient participants to the available types and design of social robots. Demographic information, which included age, gender, education, length of work experience, specialty, type of facility, and awareness of social robots, was first sought from respondents. Following that, respondents were asked to complete the ATTUSR-C questionnaire. Survey data were collected from December 2017 to May 2018.

3.4.3.3 Data analysis

Data from the online survey were downloaded and transferred into version 24.0 of the SPSS software (IBM Corp., 2016). A forced response setting was applied for the online survey meaning that participants were not able to submit their survey online if they missed or did not answer a question. Hence, no missing data was recorded. Descriptive statistics were used to reflect demographic characteristics of participants. Relationships between demographic characteristics and participants’ attitudes towards the use of social robots for older adults in LTC were explored using point-biserial correlations and ANOVAs with further post-hoc assessments where appropriate and at a significant alpha of $p < .05$. 
3.5 Results

3.5.1 Validity and reliability of the ATTUSR-C questionnaire

3.5.1.1 Content validity

Good agreement among the five experts for the content validity of the ATTUSR-C questionnaire was found (Fleiss Kappa = .6). However, there was a term and a phrase which were considered to be inappropriate for the Chinese culture by the expert panel, due to vagueness in the Chinese translated modified version of the ATTUSR questionnaire. The term "social robot" in the Chinese translation was reported to be unclear and deemed inappropriate. Hence, the term "social robot" was changed to the Chinese equivalent of "therapeutic robot". For the phrase "can adapt to it and feel comfortable", the experts indicated that the Chinese translation of this phrase was too abstract to understand, so this item was translated into the Chinese equivalent of "comfortable". The I-CVI for each item in the ATTUSR-C questionnaire was found to be equal or greater than .83 with a S-CVI/Ave of .93, reflecting content validity for the ATTUSR-C questionnaire.

3.5.1.2 Face validity

For face validity, the average percentage of agreement in terms of clarity for each item of the ATTUSR-C questionnaire was 81.63% of Fleiss’s kappa in the sample of 10 clinical instructors. According to Auld, Baker, McGirr, Osborn, and Skaff (2017), this result reflected an acceptable level of face validity and further minor changes, such as word order, were made. All of the clinical instructors reported that they understood the wordings used and the meaning of the items. Therefore, the ATTUSR-C questionnaire was used in subsequent psychometrics testing without any further revision.
3.5.1.3 **Psychometric validation**

A total of 95 participants responded to the survey. Most participants were female (95%) and the average age was 44.5 years (SD = 11.9) with an age range of 25 to 63 years. The majority of participants were married (68%). The average clinical working experience was 10 years (SD = 5.5) and 45% of participants worked in residential care facilities, 33% in nursing homes and 22% in rehabilitation wards.

The internal consistency of the ATTUSR-C questionnaire was established with a Cronbach’s alpha of .84. Prior to performing PCA, the suitability of the data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients of .3 and above. The Kaiser-Meyer-Olkin value was .79, and the Bartlett’s test of sphericity reached statistical significance ($p < .001$), supporting the factorability of the correlation matrix.

The PCA revealed the presence of four components with eigenvalue exceeding 1, explaining 35%, 11.3%, 8.2% and 6.7% of the variance respectively. An inspection of the scree plot revealed a clear break after the second component. Only the first two components were retained for further investigation based on the Cattell’s scree test where it showed two factors above the break in the plot (Cattell, 1978). This was further supported by the results of the parallel analysis that showed only the same two components with eigenvalues exceeding the corresponding criterion values for a randomly generated data matrix of the same size.

The two components solution explained a total of 46.3% of the variance, with factor 1 contributing 35% and factor 2 contributing 11.3%. To aid in the interpretation of these two components, oblimin rotation was performed. Following oblimin rotation, the two factors showed a weak intercorrelation ($r = -.31$). The rotation solution revealed the presence of simple structure,
with 13 items loading substantially on only one component. Factor 1 items loaded strongly, and six items also showed cross loadings on factor 2 with mild to moderate correlation (Table 3.1). However, by analysing the pattern and the structure matrix, it is concluded that a two-factor solution does not provide optimal theoretical and methodological structuring of the items. Given evidence of the strong overlap of the two factors, a one-factor model was retained for the ATTUSR-C questionnaire, which is the same as the original English version of the ATTUSR question by Costescu and David (Costescu & David, 2014). Therefore, no confirmatory factor analysis was performed.

### 3.5.2 Attitudes of health personnel towards the use of social robots for older adults in LTC

#### 3.5.2.1 Demographic characteristics of health professionals

In total, 416 health personnel responded to the online survey. Table 3.3 provides an overview of the characteristics of respondents. The mean age of respondents was 39.16 years (SD = 11.37). Of these, the mean length of work experience was 6.12 years (SD = 5.74). About 85.8% of the respondents were female and 14.2% were male. The majority of respondents (75.9%) had obtained a college or above educational degree. Registered nurses (43.5%) and nursing aids (31.7%) were the majority of respondents. Half of the respondents (56.5%) were working in nursing homes, and 25.7% working in residential aged care. However, just over half of respondents (50.7%) were aware that social robots were used in health care settings.
Table 3.3 Demographics of participants (N = 416)

<table>
<thead>
<tr>
<th>Variable</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean, SD)</td>
<td>39.16 (11.37)</td>
</tr>
<tr>
<td>Working experience year (Mean, SD)</td>
<td>6.12 (5.74)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>14.2</td>
</tr>
<tr>
<td>Female</td>
<td>85.8</td>
</tr>
<tr>
<td>Educational level</td>
<td></td>
</tr>
<tr>
<td>Masters and PhD</td>
<td>8.4</td>
</tr>
<tr>
<td>College</td>
<td>67.5</td>
</tr>
<tr>
<td>Senior</td>
<td>18.8</td>
</tr>
<tr>
<td>Junior</td>
<td>4.8</td>
</tr>
<tr>
<td>Primary</td>
<td>.5</td>
</tr>
<tr>
<td>Speciality</td>
<td></td>
</tr>
<tr>
<td>Registered nurse</td>
<td>43.5</td>
</tr>
<tr>
<td>Nursing aid</td>
<td>31.7</td>
</tr>
<tr>
<td>Social worker</td>
<td>8.7</td>
</tr>
<tr>
<td>PT/OT</td>
<td>1.9</td>
</tr>
<tr>
<td>Psychologist</td>
<td>1.0</td>
</tr>
<tr>
<td>Physician/Psychiatrist</td>
<td>.7</td>
</tr>
<tr>
<td>Administration/Managers</td>
<td>9.4</td>
</tr>
<tr>
<td>Nutritionist</td>
<td>3.1</td>
</tr>
<tr>
<td>Facility</td>
<td></td>
</tr>
<tr>
<td>Nursing home</td>
<td>56.5</td>
</tr>
<tr>
<td>Residential aged care</td>
<td>25.7</td>
</tr>
<tr>
<td></td>
<td>Percentage</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Home care</td>
<td>12.7</td>
</tr>
<tr>
<td>Rehabilitation wards</td>
<td>5.0</td>
</tr>
<tr>
<td>Aware of social robots</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>49.3</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>50.7</td>
</tr>
</tbody>
</table>

Note: SD, Standard deviation; PT, Physical therapist; OT, Occupational therapist

3.5.2.2 Results of investigation of attitudes of health personnel towards the use of social robots

The mean ATTURS-C score of respondents was 41.2 (SD = 7.8) out of a total score of 60, indicating health personnel generally possess positive attitudes towards the use of social robots for older adults in LTC. As shown in Table 3.4, 84.4% of respondents agreed or strongly agreed that using social robots in health/nursing care practice could make the care work more interesting (i.e. item 10), and beneficial for society as it helps both health professionals and older adults living in LTC (70.9%; item 3). The majority of respondents believed that not only can social robots help with the diagnosis of people with mental illness (64.9%; item 13), but they can also be useful for older people in LTC who are receiving mental health services (76.4%; item 6) by providing support (76.6%; item 4), acting as a companion (i.e. 81.3%; item 5), helping with treatment (78.3%; item 1), and increasing treatment efficiency (58.9%; item 8). Close to two-thirds of respondents indicated that social robots could help them in achieving their care objectives with support for daily activities (i.e. 63.9%; item 2) and believed that people would be comfortable with the use of social robots during the care process (69.4%; item 11) and as part of a therapeutic activity (76.6%; item 14). Most health personnel considered that robots would not pose threats to mental health services designed for older adults (63%; item 15). Over 50% of respondents agreed that using
social robots could lead to a resolution of difficulties in less time in the process of care (item 7), but only 47.4% of respondents reported that it could reduce health treatment costs (item 9). However, respondents had mixed views as to whether they believe social robots would be a threat to aged-care services (item 12).
Table 3.4 Frequency and percentage of response to questionnaire by participants (N = 416)

<table>
<thead>
<tr>
<th>Items</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>
| 1. Social robots could help with treatment of older people with mental illness. | 2 (.5)            | 12 (2.9) | 76 (18.3) | 241 (57.9) | 85 (20.4) 
| 2. Social robots could help the health professional to reach his/her objectives in care with support for daily activities. | 2 (.5)            | 24 (5.8) | 124 (29.8) | 208 (50.0) | 58 (13.9) 
| 3. Social robots could be useful for society because they help both health professionals and older people living in long-term care facilities. | 2 (.5)            | 15 (3.6) | 104 (25.0) | 218 (52.4) | 77 (18.5) 
| 4. Social robots could help both health professionals and older people in aged care for support. | 3 (.7)            | 10 (2.4) | 84 (20.2) | 236 (56.7) | 83 (20.0) 
| 5. Social robots could represent companions for older adults living in long-term care facilities. | 3 (.7)            | 11 (2.6) | 64 (15.4) | 240 (57.7) | 98 (23.6) 
| 6. Social robots could be useful in mental health services for older adults. | 2 (.5)            | 8 (1.9) | 88 (21.2) | 233 (56.0) | 85 (20.4) 
| 7. Using social robots could in the health/nursing care process lead to resolving of difficulties in less time. | 5 (1.2)           | 32 (7.7) | 165 (39.7) | 177 (42.5) | 37 (8.9) 
| 8. Using social robots could in the health/nursing care process increase treatment efficiency. | 3 (.7)            | 25 (6.0) | 143 (34.4) | 195 (46.9) | 50 (12.0) 
| 9. Using social robots could reduce health/nursing treatment costs. | 7 (1.7)           | 43 (10.3) | 169 (40.6) | 156 (37.5) | 41 (9.9) 
| 10. Using social robots in the health/nursing care process could make the care work more interesting. | 3 (.7)            | 6 (1.4) | 56 (13.5) | 257 (61.8) | 94 (22.6) 
| 11. I think that older adults would be comfortable if health professionals would use a social robot in the care process. | 2 (.5)            | 8 (1.9) | 117 (28.1) | 231 (55.5) | 58 (13.9) 
| 12. I consider that social robots could be a threat for aged care services. | 27 (6.5)          | 151 (36.3) | 129 (31.0) | 92 (22.1) | 17 (4.1) 
| 13. Social robots could help with the process of diagnosis of people with mental illness. | 4 (1.0)           | 17 (4.1) | 125 (30.0) | 225 (54.1) | 45 (10.8) 
| 14. I think that older adults would be comfortable if they participate at a therapeutic activity where the health professional used a social robot. | 2 (.5)            | 9 (2.2) | 87 (20.9) | 257 (61.8) | 61 (14.7) |
15. I consider that robots would not pose a threat for mental health services designed for older adults.
A point-biserial correlation was conducted to explore the relationship between attitudes and awareness of using social robots. Attitudes of respondents towards the use of social robots for older adults in LTC were found to be positively and significantly correlated with their awareness of the use of social robots in nursing homes (rpb = .18, p < .000). Respondents’ attitudes were not correlated with any demographic variables, except for their place of work. Statistically significant differences were found in respondents who worked in different facilities, F(3, 412) = 3.38, p = .02. Turkey’s post-hoc analysis revealed that respondents working in nursing homes (M = 41.91, SD = 8.37) had significantly higher positive attitude scores towards social robots than those in residential aged care (M = 39.45, SD = 6.79, Table 3.5).

Furthermore, factor analysis was conducted using data from the online survey (n = 416). The results were consistent with our previous results indicating that a one-factor model was confirmed for the ATTUSR-C questionnaire with an excellent Cronbach’s alpha of .92.
Table 3.5 Respondents’ characteristics differences using ANOVA

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>p</th>
<th>Tukey HSD</th>
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<tbody>
<tr>
<td><strong>Age groups</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>20y-34y</td>
<td>226.08</td>
<td>2</td>
<td>113.04</td>
<td>1.84</td>
<td>0.16</td>
<td></td>
</tr>
<tr>
<td>35y-49y</td>
<td>25339.01</td>
<td>413</td>
<td>61.35</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>50y over</td>
<td>25565.09</td>
<td>415</td>
<td></td>
<td></td>
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<td><strong>Educational groups</strong></td>
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<tr>
<td>Masters and PhD</td>
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<td>2</td>
<td>10.67</td>
<td>0.17</td>
<td>0.84</td>
<td></td>
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<tr>
<td>College/ Uni</td>
<td>25543.76</td>
<td>413</td>
<td>61.85</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior &amp; Junior</td>
<td>25565.09</td>
<td>415</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Year of working experience groups</strong></td>
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<tr>
<td>&lt;1 year</td>
<td>152.09</td>
<td>4</td>
<td>38.02</td>
<td>0.61</td>
<td>0.65</td>
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<tr>
<td>1-3 years</td>
<td>25179.77</td>
<td>405</td>
<td>62.17</td>
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<tr>
<td>3-6 years</td>
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<tr>
<td>6-9 years</td>
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<tr>
<td>Registered nurse</td>
<td>515.17</td>
<td>4</td>
<td>128.79</td>
<td>2.11</td>
<td>0.08</td>
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<tr>
<td>Nursing aid</td>
<td>25049.92</td>
<td>411</td>
<td>60.95</td>
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</table>
Social worker  
Manager  
Other speciality  

**Facility**  

<table>
<thead>
<tr>
<th>Facility</th>
<th>Between Groups</th>
<th>Within Groups</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursing Home (NH)</td>
<td>613.33</td>
<td>24951.76</td>
<td>25565.09</td>
</tr>
<tr>
<td>Residential Aged Care (RAC)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Home Care (HC)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Rehabilitation Ward (RW)</td>
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<tr>
<td></td>
<td>3 204.44 3.38</td>
<td>412 60.56</td>
<td>415</td>
</tr>
</tbody>
</table>

**NH vs RAC**  
**NH vs HC**  
**NH vs RW**  
**RAC vs HC**  
**RAC vs RW**  
**HC vs RW**
3.6 Discussion

To our knowledge, this is the first study that has focused on modification and validation of a questionnaire for use with health personnel and to examine attitudes towards the use of social robots for older adults in LTC. The ATTUSR-C questionnaire had good validity and reliability suggesting that this questionnaire is a reliable means for measuring attitudes towards social robots amongst Chinese health personnel working in LTC. Good content validity, as reflected by I-CVI and S-CVI/Ave, of the ATTUSR-C questionnaire indicated a consistent semantic equivalence between the Chinese and modified English versions of the questionnaire. Additionally, face validity for the ATTUSR-C questionnaire was also established. Therefore, the ATTUSR-C questionnaire satisfied content validation with its items representing the content concepts. Furthermore, a one-factor model was adopted in this study. This showed congruence with the findings found in previous research by Costescu and David (2014), which used the original English version of the ATTUSR questionnaire, to examine children’s and adults’ attitudes towards the use of a social robot in mental health services. The attitudes of health personnel towards the use of social robots in LTC is underexplored with limited well-constructed and validated instruments being currently available. Therefore, there are no gold standard instruments which could be used to compare the usefulness and appropriateness of the ATTUSR questionnaire. Consequently, this questionnaire has important implications for developing an index for future study.

The main findings of the online survey were that health personnel had positive attitudes towards the use of social robots for older adults in LTC, as they viewed social robots as beneficial and practical in psychosocial care for older adults. Interestingly, the results demonstrated differences in attitudes towards the use of social robots for health personnel working in nursing homes compared to residential aged care. For example, residents in nursing
homes typically live with complex health care conditions that require the assistance of a skilled nurse or a physical assistant. In contrast, residents in residential aged care generally require custodial care where residents need a little help with their activities of daily living by less skilled staff. Therefore, health personnel working in nursing homes have more care burden than residential aged care and insufficient time to interact with residents (Hasson et al., 2008), which may result in the differences between these settings. Furthermore, the results revealed that the attitudes of health personnel towards the use of social robots for older adults in LTC were significantly influenced by their awareness of social robots. These results are in accordance with the study of Turja, Van Aerschot, Särkikoski, and Oksanen (2018) where healthcare personnel with less experience with social robots had more negative attitudes towards them. Evans and Durant (1995) reported that greater knowledge leads to more positive attitudes and informs many practical initiatives in science. Our findings may suggest that more knowledge pertaining to the use of social robots in LTC was associated with more positive attitudes towards the social robots in care settings.

There were no significant correlations in age, gender, educational level, specialty, and working experience among health personnel attitudes towards the use of social robots for older adults in LTC. Prior studies have shown that younger and older adults had similar attitudes regarding the impact of technologies in the United States (Libin & Libin, 2004; Smith, 2014). Our results are in accord with these studies indicating that health personnel in different age groups working in LTC did not show significant differences in attitudes towards the use of social robots. However, Hudson, Orviska, and Hunady (2017) found that females and those who are older and less educated had a less favourable attitude towards the use of robots in the care of older adults in Europe. Therefore, this may suggest that factors affecting attitudes across the use of social robots between different populations may vary.
With regard to gender, there were no significant differences in attitudes towards social robots among health personnel. However, this finding is in contrast with those of previous studies, which have demonstrated that gender is a factor influencing attitudes of robots (Backonja et al., 2018; Hudson et al., 2017). There is evidence showing that men react more positively to robots in practice as demonstrated in a study of reactions of older adults to a conversational robot (Stafford, MacDonald, Li, & Broadbent, 2014). However, the findings of our study do not support the previous research. Another point for consideration is that the majority of health personnel in aged-care settings are female (Mavromaras et al., 2017). Hence, this ratio may have affected the findings of the study. Another interesting finding that emerged from our research is the impact of educational level on attitudes towards the acceptance of social robots. Our outcome is contrary to that of Broadbent et al. (2009) who found that older people who are more educated tend to have more favourable attitudes to robots. This inconsistency may be due to the different target population in our study (i.e. health personnel) and that of Broadbent et al. (2009) (i.e. general older populations), as well as cultural differences in attitudes towards robots. For example, a prior study by Nomura et al. (2008) indicated that university students in Japan considered robots would be more likely to perform nursing, education and social roles than students in Korea and the USA.

In our study, respondents positively indicated that social robots could provide support, companionship, and benefits for older adults in LTC. These results reflect similar outcomes to Moyle et al. (2018) who found that staff perceived social robots had benefits, such as providing a companionship for people with dementia. Furthermore, the health personnel also reported that social robots could help them in achieving care objectives in supporting daily activities, resolving difficulties in less time, increasing treatment efficacy, and making the care work more interesting during the care process. These results are in line with the study of Esmaeilzadeh et
al. (2011) which indicated the robots may impact on health personnel autonomy and relationships with patients during the care process. These results are in line with previous studies (Esmaeilzadeh et al., 2011; Vänni & Salin, 2019), which indicated that robots may impact on health personnel's autonomy and relationships with patients during the care process. However, Broadbent et al. (2012) reported that staff in retirement homes demonstrated more negative attitudes towards the social robot than residents due to fears of their being replaced by robots. This differs from the findings presented here where a majority of respondents disagreed that social robots pose threats for personnel in aged care or mental health services. Although most respondents possessed positive attitudes towards the use of social robots in aged care, only 47.4% of health personnel considered that using them could reduce health/nursing treatment costs and 40% remained neutral. A further study with more focus on cost-effect for using social robots in the care process is therefore recommended.

3.6.1 Limitations

This study had some limitations. First, the measure of attitudes used in the current research does not reflect the intent to use social robots. Future research on attitudes toward robots should also focus on behavioural intentions. Second, the majority of online survey respondents were female (85.8%) and this may give rise to gender response bias that limits the generalisation of the results. Therefore, the results need to be interpreted with caution. Further research, which takes this variable into account, needs to be undertaken. Although health personnel were able to comment on what they envisaged were positive outcomes in the use of social robots for older adults, they had limited exposure to, and experience in, the use of social robots, and this may be a further limitation of this research. Further research is needed to understand the effects of using social robots in psychosocial care to ensure that health personnel have a real experience of using social robots. Finally, the ATTUSR-C questionnaire is a new tool for use by health
personnel. As there is no related Chinese questionnaire to assess convergent validity, further work to examine the convergent validity of this questionnaire is warranted.

3.6.2 Implications for clinical practice

Our findings represent valuable contributions to research concerning attitudes toward social robots for health personnel working in LTC. The questionnaire can be used to assess health professionals’ attitudes towards social robots to improve understanding of the implementation of social robots in health settings. Furthermore, developing an instrument designed to investigate health professionals’ attitudes towards the use of social robots is necessary in order to understand the perceived value of social robots, as this influenced whether care staff would use social robots for facilitating interventions in aged-care facilities. Finally, the ATTUSR-C questionnaire could be used to establish construct validity for different social robotic attitude instruments.

3.7 Conclusion

Social robots have increasingly been used to deliver health and social care in health settings. The evidence indicates that the ATTUSR-C questionnaire is a reliable and valid instrument for assessing the acceptability of social robots for health professionals working in LTC facilities. This study strives to support aged-care work by providing insights into health personnel perceptions of social robots for older adults; these perceptions are important to ensure appropriate and proper integration of robot technologies into older adults’ lives and care in LTC. This present research builds on the fact that positive attitudes might facilitate health personnel's acceptance and adoption of social robots for older people in LTC. Health personnel and nursing researchers can use this study to inspire further interventions using robots to improve the quality of care in care settings.
Compliance with Ethical Standards

Conflict of interest

The authors declare that they have no conflict of interest.

Ethics Statement

Implied consent to participate in the study was reflected via their online completion and submission of the questionnaire. This was a non-clinical study without any harming procedure and all data were collected anonymously.
Chapter 4 Phase Two Methodology

4.1 Introduction

This chapter describes and justifies the use of a mixed methods experimental design to explore the impact of an eight-week 24-hour PARO intervention on depression and well-being in older adults with depression who live in LTC facilities. This chapter first outlines the key elements of a mixed methods experimental design and provides a rationale for adopting this approach. Information regarding the study design, setting, participants, recruitment strategy, sample size, intervention, data collection, outcome measurements, interview, data analysis, and ethical considerations are presented.

4.2 Mixed methods experimental study

Mixed methods research comprises the coordinated use of quantitative and qualitative research approaches to gain a fuller understanding of the research questions (Creswell & Clark, 2018; Teddlie & Tashakkori, 2009). Commonly, quantitative approaches generate statistical and numerical data employing cross-sectional, cohort, quasi-experimental and clinical trials, while qualitative approaches generally generate non-numeric or manuscript data using focus groups, interviews, and case studies (Creswell & Clark, 2018; Teddlie & Tashakkori, 2009). The quantitative approach generally draws on a pool of countable data to reach a conclusion about hypotheses using deductive reasoning, whereas the qualitative approach focuses on the context and meaning of an individual’s experiences for the purpose of inductive inference (Creswell, Klassen, Clark, & Smith, 2011; Teddlie & Tashakkori, 2009).

Mixed methods research has been commonly used in the nursing and social science fields, and it is also well suited to help aged-care researchers understand complex clinical practice, generate new insights into the care process and deepen their understanding of quantitative...
results. Based on the typology, researchers focus on different types of decisions and features of mixed methods designs when determining the data collection strategy, such as timing, priority, and integration (Creswell & Clark, 2018). Timing refers to the order of the quantitative and qualitative data collection, and is implemented in the mixed methods design (i.e. sequential or concurrent) (Creswell & Creswell, 2018). Priority is the weight or importance assigned to the quantitative and qualitative strands in addressing the study’s purpose by using terminology such as “qualitative driven” (Morse, 2009) or “equivalent status” (Tashakkori & Teddlie, 1998). Integration, which is the process whereby the researcher "mixes" the data (Creswell & Creswell, 2018), can take place during data collection, analysis, interpretation, or at a time determined by the researcher (Creswell & Clark, 2018). These designs can be implemented in mixed methods research depending on the aim of the design, reasons for choosing the design, philosophical assumptions and theory use, procedures, points of integration in the study, and the variants of each type of design.

The mixed methods experimental study embeds the collection, analysis, and integration of both quantitative and qualitative data within an experimental quantitative research design (Caracelli & Greene, 1997; Greene, 2007). The main design in the mixed methods experimental study is a quantitative experiment or intervention trial. The qualitative data is added as a secondary component to this design before, during, or after the intervention to enrich the experimental findings according to the study purpose (Creswell & Clark, 2018; Teddlie & Tashakkori, 2009). Sandelowski (1996) first introduced the concept of the supplemental qualitative component occurring before, during, or after the primary experimental intervention. The reason for adding qualitative data into this quasi-experiment was to gather data about personal qualitative experiences from the participants along with the quantitative outcome measures.
4.3 Study design

A mixed methods experimental design (Creswell & Clark, 2018) was applied, whereby a quasi-experimental approach and an embedded individual interview were used to gain insights into statistical associations and individual perspectives in this study. The aim of the quantitative approach was to investigate the effect of a PARO intervention on depression and on the well-being of depressed older adults living in LTC facilities via a single group, before and after a quasi-experimental design. The qualitative component used embedded semi-structured interviews to explore participants’ experiences in the PARO intervention (Figure 4.1).
Figure 4.1 Diagram of mixed methods experimental design
In this study, each participant took part in an initial eight-week of observation (i.e. stage 1) and eight-week of a 24-hour PARO intervention (i.e. stage 2) for a total of 16-weeks, where each participant served as his or her own control. The purpose of stage 1 was to observe the normal mood, behaviour, and activities of participants, while in stage 2, a 24-hour PARO intervention was introduced to participants to evaluate its effects on depression and mental well-being. At the end of the intervention, an individual interview was conducted with all participants to gain an understanding of their experience and perceived benefits or limitations of the PARO intervention, as well as their readiness to accept a PARO into their lives.

4.3.1 Justification of the mixed methods experimental design

The mixed methods experimental design was selected for this study, because this was the first study that used a 24-hour PARO intervention with older adults to explore its impact on mental well-being. The results aimed to provide insights into the complex effects of the PARO intervention, as mixed methods research incorporates both deductive and inductive processes to help harness the strengths of both in order to deepen understanding about a particular experience or conception in the study (Hansen, O’Brien, Meckler, Chang, & Guise, 2016). In this study, the researcher started with quantitative data collection in order to examine the effect of the PARO intervention on depression and mental well-being in older adults with depression. Accordingly, quantitative data were collected using three scales that measured the variables of depression, loneliness, and quality of life. The data were collected and analysed using statistical procedures to examine the hypotheses. With the intention of gaining a better understanding and to explain the results from the quantitative stage, individual interviews were undertaken after the intervention to gain an insight into participants’ experiences.

A quasi-experimental approach is an empirical interventional method used to test interventions for their effectiveness in many real-world settings without random assignment.
(Handley, Lyles, McCulloch, & Cattamanchi, 2018). In real-world circumstances, a randomised controlled intervention may not be possible, or fully under the control of investigators, due to practical, ethical, social, or logistical constraints. As evaluation of the effectiveness of the intervention in a real-world setting requires an increased focus on external validity (i.e. consideration of factors influencing intervention uptake by diverse subpopulations), investigators need interventional research designs that are more relevant to the potential treatment population and that achieve a better balance between internal and external validity, compared with a randomised controlled study. Quasi-experimental designs, which first attained prominence in social science research (Thyer, 2012), are increasingly used to satisfy this research need. According to the literature, there is evidence that social robot interventions have beneficial effects on the mental well-being of older adults and those living with dementia (Chen et al., 2018; Pedersen, Reid, & Aspevig, 2018; Pu et al., 2019). As a result, the implementation of the social robot intervention (i.e. PARO intervention) may be broadened and used with people with mental health issues, such as older adults with depression.

With a single group pre-test-post-test design, the first two pre-tests (T1 and T2) measure the dependent variables prior to manipulation of the independent variable (PARO intervention). Following the experimental manipulation of the independent variable, a mid-point and post-test were administered where the dependent variables were measured again to examine changes of outcome variables between the periods (T3 and T4). Moreover, this research design was used to minimise the statistical demand for a large sample size, as studying multiple outcomes for each subject allowed each subject to be his or her own control. Due to the lack of eligible depressed older people without cognitive impairment, a limited number of social robots, and the 24-hour duration of the PARO intervention, a single group with before and after tests was employed in this study. As a result, this design can be used to identify the changes of the PARO
intervention during different time periods.

A meta-analysis study showed that at least six sessions of psychological intervention are needed to be effective in reducing depression and anxiety (Nieuwsma et al., 2012). In addition, a systematic review of the effectiveness of a social robot for alleviating depression in older adults (Chen et al., 2018) presented promising outcomes for reducing depressive symptoms in older adults following social robot interventions. This review reported that the intensity and dose of the social robot interventions varied greatly, ranging from 10 minutes to 90 minutes per week (Jøranson et al., 2015; Moyle et al., 2013; Petersen et al., 2017; Robinson et al., 2013), or for 24-hours (Broadbent et al., 2016; Tanaka et al., 2012). The duration of the intervention period varied from five weeks to 12 weeks. And the outcomes concerning a reduction in the level of depression were varied. The most favourable result was from the study of Tanaka et al. (2012) who conducted a randomised controlled trial using a communication robot with healthy older females for eight weeks, 24-hours per day to examine cognitive function, sleep, subjective fatigue, motivation, and healing. The results showed that cognition, judgement, and verbal memory were improved after the intervention. Consequently, based on the systematic review of Chen et al. (2018) and Tanaka et al. (2012) study, an eight-week 24-hour PARO intervention was adopted in this study.

The individual interviews were embedded within the quantitative design and were conducted at the end of the PARO intervention. The qualitative data, which played a subservient role within the quantitative method, helped the researcher to understand the experiences and perspectives of the participants who experienced the PARO intervention for older adults with depression.
4.3.2 Limitations of the mixed methods experimental design

There are some challenges associated with the mixed methods experimental design. First, researchers need expertise in both experimental research and qualitative research (Creswell & Clark, 2018). Therefore, a variety of collaborators is required to conduct mixed methods research. Building a qualified team is an important factor in conducting successful mixed methods research, since the team might affect the richness of the study findings and interpretation (Curry, Nunez-Smith, & Publications, 2015). Second, mixed methods research is costly and time consuming. Due to the time needed for both the quantitative and qualitative components, financial and human resources are one of the limitations to mixed methods research (Curry et al., 2015). Furthermore, additional time may be required to resolve discrepancies in the interpretation of findings between team members (Curry et al., 2015). However, for this study the PhD student investigator was assisted by an experienced supervision team to help resolve these particular challenges.

The crucial limitation of quasi-experimental approach is the lack of random assignment of participants into test groups. This leads to non-equivalent test groups, which can limit the generalisability of the results to a larger population (Bärnighausen et al., 2017). Besides the lack of randomisation and internal validity, conclusions about causality are not definitive in quasi-experimental designs (Handley et al., 2018), as they do not eliminate the problem of confounding variables. Furthermore, due to a lack of a control arm, the outcome of before and after the quasi-experimental single group design cannot be compared with the outcome of other groups, thereby affecting the interpretation of results (Ruble, 2017). When all participants receive the same experimental manipulation, the researcher is unable to determine conclusively whether any change in outcome dependent variables was due to the experimental manipulation or other intervening factors, such as maturation over time (Ruble, 2017).
4.4 Setting

This study was conducted at four accredited LTC facilities in Southern Taiwan, each with more than 100 beds. According to the assessment of an accreditation system in Taiwan, the four participating facilities were rated level A, indicating a high standard of care in 2018. The average registered nurse-patient ratio was 1:15 and personal care worker-patient ratio was 1:5. Around half the personal care workers were foreign care workers. These four facilities were private nursing homes, which offered different types of accommodation in the form of double rooms, multiple occupancy rooms or single units for couples, depending on residents’ requirements. All four facilities adopted a patient-centred approach, provided a safe environment, protected patients’ rights, and met core measures of quality in the process of care according to the policy of the Department of Health in Taiwan. Furthermore, these four facilities provided a range of social and recreational activities, and rehabilitation support for older adults residing in their facilities.

4.5 Participants

The inclusion criteria of participants were: (1) aged 65 years or over; (2) with a score higher than 6 out of 15 on the Chinese version of Geriatric Depression Scale-Short Form (GDS-SF) (Chan, 1996); (3) no cognitive impairment as determined by the Chinese version of Mini-Mental State Examination (MMSE) score by educational level (Zhang et al., 1990); (4) able to communicate in Mandarin or Taiwanese; and (5) had been living in the LTC facility for at least three months. According to Hoover et al. (2010), residents exhibit a higher prevalence of depression on admission into an LTC facility during the first three months and the depression, in this case, may be relocation related (McSweeney & O'Connor, 2008). Participants who: (1) had severe difficulty in communication; (2) were totally dependent on carers for daily activity; (3) had a diagnosed infectious disease; (4) had a diagnosis of dementia; and/or (5) had a
diagnosis of severe mental illness, such as schizophrenia and delusional disorder, were excluded.

4.6 Recruitment strategy

The researcher (SCC) first promoted the study to the LTC facilities in Southern Taiwan via email or telephone. Contact was then made with the directors of the LTC facilities who had expressed their interest in being involved in the study. Due to the limited number of older adults with depression, each group (5 participants) was recruited from four LTC. Directors of the four participating LTC facilities identified and provided a list of potential residents to the researcher who met the study criteria. Initially, the manager introduced the researcher to these potential participants and the researcher subsequently contacted them one by one and in person. The aims and details of the study were then explained, and written consent or verbal consent was sought from each participant before the start of the study. No participant was unable to sign or give informed consent. The researcher screened all participants to determine their levels of depression and cognition using the Chinese version of GDS-SF and MMSE. Only participants who met the inclusion criteria were accepted into the study, and the researcher personally notified those who did not meet the criteria.

4.7 Sample Size

The sample size calculation was based on a previous study that examined the effect of a PARO intervention on depression (Moyle et al., 2013) and was influenced by the estimated number of observations or time points at which data were collected. According to the Power and Sample Size calculation software version 14 (2015), a sample size of 40 achieved 80% power with a .05 alpha level to detect a significant change of 0.7 in the Geriatric Depression Scale score for a before-and-after quasi-experimental study design. To allow for a 10% attrition rate,
this study sought to recruit 22 participants, and as each participant served as his or her own control, this doubled the sample size to 44.

4.8 Intervention

4.8.1 The study protocol

In stage 1, participants received usual care or activities in their LTC facility without any research intervention for eight weeks to ascertain their habitual mood, behaviour, and activities. In stage 2, each participant was given a PARO by the researcher to keep for 24-hours, seven days a week, for eight weeks. Participants could choose a suitable time to interact with the PARO, depending on their preferences, but the robot did not have any way of recording actual interaction times. The PARO could be held in participants' arms, or placed in their laps, or beside them on their bed. During the first visit, participants were introduced to the PARO and encouraged to make contact and interact with it both verbally and by touching it. The researcher introduced the PARO to each participant using a short script according to the protocol. For example, “Look Mrs/Mr X, this is PARO (or PARO’s name). You can stroke, cuddle, or talk to PARO if you like. PARO can move and produce sounds when you stroke or touch him/her. PARO can recognise your voice when you speak to him/her. PARO can also give a response when you make eye contact with it. PARO will stay with you for 24-hours, seven days a week, for eight weeks”. During the introduction, participants were encouraged to touch the PARO and to talk about how the fur felt. Due to the limited number of PARO (only five PAROs were available in each round), this study had to conduct at least four rounds to reach the sample size (Figure 4.2).
The researcher trained two staff members from each LTC facility on how to operate the PARO, introduce it to the participant’s family, and solve potential problems that may arise while using the PARO. For example, residents who had not been recruited into the study asked to have a PARO and some residents argued that care staff were not treating them equally, because they were not receiving a PARO intervention.

For hygiene and safety reasons, care staff in the LTC facilities were introduced to guidelines for infection control measures when using a PARO (refer to Appendix O). The guidelines included: equipment use and maintenance, daily cleaning routine, and additional information such as avoiding contact between PARO and open wounds, fluids, and food. The care staff had to confirm that participants had conducted the daily cleaning routine with the PARO and complied with infection control and safety measures related to its use.

During the last week of the intervention (on Monday or Tuesday), the trained staff informed participants that the PARO would be leaving them the following Friday. This was to
manage participants’ reactions to the PARO’s removal and to help prevent or minimise separation anxiety or other negative psychological effects when the PARO was withdrawn. On the last day, the researcher gave each participant 10 minutes to say his or her farewell to the PARO, using a short script. For example, “PARO will leave after 10 minutes. PARO looks like she/he enjoyed being with you. Did you enjoy being with her/him? Would you also like to say something to PARO, Mrs/Mr X?”.

4.8.2 Treatment fidelity

Treatment fidelity was monitored by the researcher’s weekly checks of the intervention at each participating LTC facility. These procedures included three steps. First, the PARO’s condition was checked to ensure it was charged and operating correctly. Second, participants’ interactions with the PARO in the activity room or bedroom were observed. The researcher sat in a corner to observe participants’ behaviour and mood and kept notes of each visit. These notes were used to help the researcher understand the participants’ experiences and to interpret the results, but they were not used as part of the data analysis. This step included how often, and when, participants used the PARO, how they interacted with PARO (i.e. stroking, patting, chatting with PARO), their non-verbal expressions (i.e. happy, smiling, eye contact), and whether they had any questions when they used PARO. Third, any issues raised by the participants to the care staff were discussed with the researcher to ensure care staff could resolve them. Issues included switching off PARO at night and managing other residents who wanted to borrow the PARO.

4.9 Data Collection

Demographic data and health-related information were collected at baseline. Outcome measurements included the Chinese version of the GDS-SF (Liu, Lu, Yu, & Yang, 1998), the
Chinese version of UCLA Loneliness Scale Version 3 (UCLA-3) (Chang & Yang, 1999) and the Chinese version of the World Health Organization Quality of Life Questionnaire for older adults (WHOQOL-OLD) (Liu et al., 2013). The researcher administered these at four time points (Table 4.1): a week before the start of the eight-week observation (T1 – Week 0), immediately at the end of the eight-week observation (T2 – Week 8), mid-point of the PARO intervention (T3 – Week 12), and immediately at the end of the eight-week PARO intervention (T4 – Week 16). After the PARO intervention, a face-to-face individual interview took place with participants to understand their experiences of using the PARO.

*Table 4.1 Measurement time points and instruments*

<table>
<thead>
<tr>
<th>Time point</th>
<th>Week</th>
<th>MMSE</th>
<th>Demographics</th>
<th>GDS</th>
<th>UCLA</th>
<th>QOL</th>
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</tr>
<tr>
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<tr>
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<td>End of the study</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Interview</td>
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4.10 Outcome measurements

4.10.1 Demographic data and health-related information

Participant demographics, such as age, gender, education level, religion, number of children, length of stay in the LTC and previous pet ownership were collected. Health-related information collected from records included: the type of depressive disorder, any other chronic disease, a medication audit including anxiolytics, antidepressants and other medications, the Barthel score and mobility.
4.10.2 The Chinese version of Geriatric Depression Scale-Short Form (GDS-SF)

The GDS-SF, developed by Yesavage and Sheikh (1986), consists of 15 items with 10 positive items and five negative items. The Chinese version of GDS-SF was translated by Yeh et al. (1995). The GDS-SF has been found to be a useful tool to detect depressive symptoms in older populations (Greenberg, 2007). Each item requires a "yes" or "no" response and one point is scored for each bolded answer selected. The scores range from 0–15 and a cut-off point of 6 or more indicates the presence of depression (Chan, 1996). The sensitivity and specificity of the original scale were 84% and 95% respectively (Yesavage & Sheikh, 1986). This scale has good reliability with Cronbach’s alpha of internal consistency reported at .89 in the original version and .90 in the Chinese version (Lee et al., 1993).

4.10.3 The Chinese version of UCLA Loneliness Scale version 3 (UCLA-3)

The UCLA-3 is a 20-item scale, developed by Russell (1996). Chang and Yang (1999) translated the Chinese version of UCLA Loneliness Scale version 3. It is used to measure a person’s subjective feelings of loneliness and feelings of isolation. Each item on the scale is rated from 1 (never) to 4 (often) with a total score ranging from 20 to 80. The scale does not identify a cut-off score that defines loneliness. The higher the score, the more severe the person’s feelings of loneliness. This scale has good reliability with Cronbach’s alpha of internal consistency ranging from .89 to .94 in the original scale (Russell, 1996). Moreover, studies have established good reliability when using the UCLA Loneliness with older adults in LTC facilities with a Cronbach alpha ranging from .86 to .90 (Adams, Sanders, & Auth, 2004; Bergman-Evans, 2004; Hawthorne, 2008) and .85 to .90 in the Chinese version for older adults (Chang & Yang, 1999; Chou, Jun, & Chi, 2005).
4.10.4 The World Health Organization Quality of Life Questionnaire-OLD (WHOQOL-OLD)

The WHOQOL-OLD (Power et al., 2005) is derived from the World Health Organization Quality of Life Questionnaire-BREF (THE WHOQOL GROUP, 1998). Liu et al. (2013) translated the Chinese version of WHOQOL-OLD. This questionnaire consists of 24 items with six domains: Sensory Abilities (SAB); Autonomy (AUT); Past, Present and Future Activities (PPF); Social Participation (SOP); Death and Dying (DAD); and Intimacy (INT). Responses are rated on a 5-point Likert scale with a higher score indicating a better quality of life. Internal consistency as measured by Cronbach’s alphas of all subscales was between .72 and .91 in an original study involving 5,566 participants (Power et al., 2005). In the Chinese version, the Cronbach’s alpha was between .72 and .95 (Yao & Chien, 2013b).

4.10.5 The Chinese version of Mini-Mental State Examination (MMSE)

The Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975) is a widely used tool that screens for levels of cognitive impairment, using the concepts of orientation, registration, attention and calculation, recall, and language. The MMSE has been translated into Chinese with small modifications based on the sociocultural differences of the Chinese population, and has been utilised as a dementia screening instrument for epidemiological studies (Zhang et al., 1990). The MMSE has good internal consistency with a Cronbach alpha of .91 (Marioni, Chatfield, Brayne, & Matthews, 2011). In a previous study, the MMSE has shown good sensitivity of 78.4% and a specificity of 87.8 % in primary care (Mitchell, 2008). The Cronbach alpha was .83 to .84 in older Taiwanese populations (Chung, Chiou, & Chou, 2009; Lou, Dai, Huang, & Yu, 2007). The MMSE score ranges from 0 to 30. In general, a cut-off point higher than 24 indicates normal cognition; 20–23 mild cognitive impairment; 10–19 moderate cognitive impairment; and 0–9 severe cognitive impairment. In this study, the cut-
off point was based on a study by Zhang et al. (1990) in which the level of cognitive impairment varies according to educational level: 17/18 for older people without formal education, 20/21 for those with 1–6 years of education (primary school), and 24/25 for participants with more than six years of education (middle school or higher) in Chinese older adults.

4.11 Interviews

The main quantitative study investigated the impact of the eight-week 24-hour PARO intervention on depression and mental well-being (i.e. loneliness and quality of life) in older adults with depression living in LTC facilities. A semi-structured individual interview was conducted with the older adults following the end of the PARO intervention and this took place in the participant’s room. With the assistance of an interview protocol (Appendix P), the interview explored participants’ actual experiences and perceptions of participating in the PARO intervention, and to enhance understanding of the outcomes underlying the use of PARO intervention purported to bring about a change in mental well-being. Each interview took approximately 30 to 40 minutes and was recorded digitally and transcribed verbatim. The open-ended interview questions are presented in Table 4.2.

Table 4.2 Interview questions

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>What did you think of or feel about PARO initially?</td>
</tr>
<tr>
<td>2.</td>
<td>Do you still think of or feel about PARO in the same way? If not, how do you currently think of or feel about PARO?</td>
</tr>
<tr>
<td>3.</td>
<td>How much time did you spend with PARO each day?</td>
</tr>
<tr>
<td>4.</td>
<td>How did PARO make you feel? [Probe: happy, excited, tearful, sad, anxious, relaxed]</td>
</tr>
<tr>
<td>5.</td>
<td>What were your most memorable moments with PARO?</td>
</tr>
</tbody>
</table>
6. What did you get out of interacting with PARO?
7. What did you like or dislike about PARO?
8. Is there anything that you would change about how you interact with PARO?
9. Is there anything else you would like to tell me about PARO?

4.11.1 Trustworthiness

Trustworthiness or the rigour of research refers to the degree of confidence in data, interpretation, and methods used to ensure the quality of a study (Polit & Beck, 2014). The quality criteria outlined by Lincoln and Guba (1985) are generally accepted by qualitative researchers. These criteria include credibility, transferability, dependability, and confirmability. The use of multiple methods helped to support the credibility of the study findings. Creswell (2007) outlines eight steps of trustworthiness and these include: triangulation, peer debriefing, member checking, negative case analysis, persistent observation, rich, thick description, and audit trail. Creswell and Clark (2018) recommend that researchers fulfil at least three aspects of trustworthiness. First, in this study, monitoring of the rigour of the study was carried out by peer debriefing at regular meetings with the supervision team. The process and results of qualitative data were reviewed and discussed by all members of the research team throughout the study. Second, weekly persistent observation was used as a strategy to ensure trustworthiness during the data analyses. In this study, the researcher regularly observed the intervention process, took notes to describe phenomena as they occurred during the observations and discussed these with the supervisory team during regular meetings to assist with gaining an understanding of what was taking place during the intervention. During data analysis, the researcher constantly read and reread the text, coded the data,
relabelled the codings, analysed the data, discussed the data with the supervision team, and revised the concepts accordingly until the final themes provided the intended depth of insight.

Third, an audit trail, which was a transparent description of the qualitative research steps taken from the commencement of the study to the development and reporting of the findings, was used to establish confirmability of the qualitative results. Details of the process of data collection, analysis, verbatim quotes, and findings from the transcripts are presented in this thesis. To enhance confidence, the analysis process was undertaken under the direction of the researcher’s supervisors to allow discussion, advise and to ensure suitability of the themes. In addition, comparison of this study's findings with existing literature is undertaken in the Chapter 6, the discussion chapter, in order to explore the consistency of the findings with other research evidence.

4.12 Data analysis

4.12.1 Quantitative data

Quantitative data were analysed using the Statistical Package for Social Science (SPSS) for Windows software version 25 (IBM Corp., 2017). Collected data were reviewed for completeness and consistency within a single data form. During the data entry process, all data were checked for accuracy and consistency and any errors were corrected. Screening and cleaning of the data were conducted before data analysis. Examining the frequencies of each variable using SPSS software identified errors and out-of-range responses. The last observation carried forward method was used to manage missing data at random (Kang, 2013). An intention-to-treat approach (Gupta, 2011), in which all participants’ data were analysed according to their enrolment, was used.

The normality of data distribution for outcome variables was examined using probability
plots and the Shapiro-Wilk test. Descriptive statistics were used to demonstrate demographic characteristics for categorical variables (i.e. frequency and percentage) and continuous variables (i.e. mean, standard deviation, and range). Relationships between demographic characteristics (i.e. age, number of years living in LTC, and Barthel score) and outcome measures were explored using Pearson’s correlations. Cronbach’s alpha was computed to ensure the internal consistency (i.e. reliability) of all instruments.

As the scores of depression and loneliness showed normal distribution, repeated multivariate analysis of variance (MANOVA) were used to examine the changes of these variables before and after the PARO intervention. However, the scores of quality of life revealed abnormal distribution, therefore the Friedman test was used to examine changes to quality of life. The Friedman test is the non-parametric alternative to the one-way repeated measures of analysis of variance and measured on the same scale (i.e. QOL) at different time periods in one sample of participants before and after the PARO intervention. Further post-hoc analysis using the paired sample t-test (parametric) and Wilcoxon signed ranks test (non-parametric) were conducted where appropriate. Cohen's $d$ of 0.20, 0.50, and 0.80 were used to represent small, moderate and large effects, respectively. The significance level was set at $p < .05$.

### 4.12.2 Qualitative data

All interviews were audio recorded digitally and transcribed verbatim in Chinese for data analysis by a research assistant under the direction of the PhD candidate (principal researcher). The researcher checked the quality of transcription by selecting a transcript and re-listening to the digital recording while reading the transcribed text. To ensure accuracy, the principal researcher translated the Chinese transcripts into English based on verbatim translation while acknowledging sociocultural considerations. A bilingual, doctorate qualified health researcher
identified and resolved any inadequate expressions and inaccuracy in the translation. Any ambiguities and discrepancies regarding the translation, meaning, and colloquial expressions were discussed and resolved through consensus between the two researchers to produce a validated English version of the transcription. Both researchers were fluent in both English and Chinese.

Qualitative data analysis was guided by the method of thematic analysis (Braun & Clarke, 2006) to provide an insight into the understanding of participants’ experiences and perception when receiving the PARO intervention. The qualitative data were analysed thematically using the six steps based on: (i) familiarising with data; (ii) generating initial codes; (iii) searching for themes; (iv) reviewing themes; (v) defining and naming themes; and (vi) producing the report.

The principal researcher read through the qualitative data to obtain a sense of their overall views and wrote memos about their initial perceptions of the data. An initial coding framework was developed by the researcher (SCC) based on an initial analysis of the first three participant transcripts, using inductive coding and a constant comparative approach guided by Braun and Clarke's (2006) thematic analysis approach. Another researcher (CJ) checked the accuracy of the language translation of the manuscript and assisted the researcher (SCC) to recognise important phrases or experiences mentioned by participants, following a reading of the transcripts. The researcher coded each transcript once a comprehensive coding framework was agreed upon. Regular meetings were held with the research team to raise and discuss any questions about the coding process. Differences in coding were discussed, resolved, and used in the further development of the coding framework. Themes and sub-themes were compiled together with verbatim quotations. To support reflexivity, the research team discussed the developing themes and their connections until consistency was achieved.
4.13 Ethical Considerations

Ethics approval for the study was obtained from the Griffith University Human Research Ethics Committee (Griffith Reference Number: 2017/911) before the commencement of the study. This study upheld the guidelines for the conduct of ethical research developed by the National Health and Medical Research Council (NHMRC, 2007). The ethical principles addressed and underpinned in this study are beneficence, respect for human beings, and justice (National Statement on Ethical Conduct in Human Research, 2018). Furthermore, confidentiality was an important issue in this study; hence it is also highlighted in this section.

4.13.1 Beneficence

Beneficence, which is an act of charity, mercy, and kindness, denotes doing good to others and invokes a wide array of moral obligations (Kinsinger, 2010). In line with the principle of beneficence, there were no foreseeable risks for participants associated with involvement in the intervention. For example, participants might directly benefit from the social robot intervention, through a reduction in depression and feelings of loneliness, and an improvement in quality of life. Furthermore, the detailed information in the informed consent package described the participants’ right to freedom from harm, discomfort, and risk. To safeguard this right, staff working in LTC facilities were trained to use the PARO, such as charging and cleaning them in order to prevent misuse and risk of harm. The researcher also visited participants every week to ensure the PARO was functioning correctly and that any questions from residents, staff or family were addressed.

4.13.2 Respect for human beings

Respect for human beings is an acknowledgement of their intrinsic value. It is the right of all individuals to be respected and valued for their own sake and to be treated ethically (Polit &
Beck, 2004). In accordance with the principle of respect for human beings and informed consent, the researcher informed the participants about the aims and objectives of the research study and what their participation would involve. Participants were assured that (a) their participation was on a voluntary basis and they were under no obligation to participate; (b) they were free to withdraw from the study at any time without explanation, penalty or compromising their relationship with the LTC; and (c) the researcher verbally explained information about the study to potential participants to help them to understand the process of the study and to ensure any issues were addressed before they signed the consent form. Signed informed consent was sought from each participant. No participant was unable to sign or give informed consent.

4.13.3 Justice

Justice requires an impartial selection of participants and fair treatment, and research participants who undertake interventions must be likely to benefit from the research (Pieper & Thomson, 2013). To avoid coercion, research participants were informed they had the right to decide whether to participate or not and that they could withdraw from the study at any time without any penalty. In particular, they were informed that their health care and service in LTC facilities would not be affected by their participation in this study. As all participants received the same PARO intervention, which has been shown to have beneficial effects for older adults, the principle of justice was upheld in this study.

4.13.4 Confidentiality

Confidentiality refers to a condition in which the researcher knows the identity of research participants, but then takes steps to protect their identity from being revealed to others (Wiles, Crow, Heath, & Charles, 2008). In this current study, all data collected from both phases were
treated in the strictest confidence. Only the investigators in the research team have authority to access the data collected. Electronic data are stored with password-protection to prevent unauthorised access. All hardcopy data and related documents will be kept in a key-locked cabinet for five years before being destroyed. Although demographic data were collected, participants remain anonymous in terms of privacy and confidentiality. For quantitative data, each participant was allocated a code, which only the researcher was able to identify. All data were de-identified at data entry and results are reported in general terms. For qualitative data, the digital interview files were deleted after transcription. Data were de-identified with codes and stored on the researcher’s password-protected computer. Anonymity was maintained by using pseudonyms for direct interview quotes that are used in the reporting of findings. For the dissemination of data, all the information has been disseminated in the form of de-identified and aggregated results.

4.14 Summary of the chapter

This chapter presented the elements of the mixed methods experimental design, in which a quasi-experimental approach and an embedded individual interview were used to gain insights into statistical associations and individual perspectives in the PARO intervention. A two-stage intervention, which included an eight-week observation stage and an eight-week 24-hour PARO intervention, was undertaken. Following the described research methods, data were collected according to reliable and valid instruments and analysed using appropriate statistical and thematical methods. Ethical issues such as beneficence, justice, respect, human dignity, and confidentiality were considered throughout the study. The results from the eight-week 24-hour PARO intervention and its effects on depression, loneliness, and the quality of life of older adults with depression living LTC facilities are reported in Chapter 5.
Chapter 5 Phase Two Results

5.1 Introduction

This chapter presents the results of an eight-week 24-hour PARO intervention on depression and well-being in older adults living in LTC facilities in Taiwan. The results of this study are presented in two parts: quantitative results and qualitative results. The aim of the quantitative component was to examine the effect of a PARO intervention on depression and mental well-being. Findings from the quasi-experimental design and results of statistical analyses are presented in this chapter. Descriptive statistics were used to describe the demographic characteristics of participants, including: gender, education, religion and health information, such as chronic diseases, type of depression, and medications. Inferential statistics were used to examine the effects of the PARO intervention on depression, loneliness, and quality of life. The findings of the qualitative data analyses are presented in the second section of this chapter. The aim of the qualitative approach was to gain a greater understanding of participants’ experiences of the PARO intervention and to give participants the opportunity to share, in their own words, the impact of the intervention on their well-being. To achieve the aim of the qualitative component of the study, a semi-structured interview was conducted with all participants immediately after the PARO intervention. The emergent themes are outlined in the second section. Names in this chapter have been changed to protect the participants' confidentiality. Quotes are included using participants' own words, to add validity to the themes being discussed.
5.2 Quantitative Results

5.2.1 Response rate

Thirty-two older adults with depression, who met all eligibility criteria, were approached before the start of the study. Of these, 12 older adults declined to participate; six declined due to a lack of interest, two did not return the consent form, three were stressed and therefore did not want to participate, and one did not provide any reason. Finally, 20 participants consented to participate in this study, all of whom completed the study (Figure 5.1). There was no missing data and therefore all data was included in the data analysis.

![Flow diagram of the progression of the participants through the phases of the intervention](image)

**Figure 5.1** Flow diagram of the progression of the participants through the phases of the intervention
5.2.2 Demographic characteristics and health information of the sample

The participants' demographic characteristics and health information are summarised in Table 5.1. The participants were aged between 65 and 93 years with the mean age of 81.1 years ($SD = 8.2$). The majority of participants were female (65%) and were widowed (65%). Most participants were either Buddhist (55%) or Daoist (40%). Around 25% of participants had not completed any education, 45% had completed primary school, 20% had completed high school, and 10% had completed university. The majority of participants (70%) reported that they did not have a pet before they moved into the LTC facility and, on average, they had lived in the LTC facility for 3.4 years ($SD = 2.3$). Just over half (55%) of participants’ family members visited them once per week, and 60% of participants used a wheelchair as their primary means of mobility. The mean baseline Barthel score was 54.5 ($SD = 31.4$) indicating moderate dependency in self-care and activities of daily living among participants.

Table 5.2 presents health information about the participants. All participants had experienced at least one chronic disease or illness such as diabetes (35%), hypertension (35%), cardio-vascular disease (30%), cancer (15%), respiratory disease (5%), and/or other type of chronic disease (30%). The majority of participants had a diagnosis of mild depression (75%), but only 5% took antidepressants, and none received other forms of treatment for depression, such as cognitive or electroconvulsive therapy. However, some participants took other medications such as anxiolytics (15%), hypnotics (40%), and medications for acute anxiety and psychotic conditions (85%).
Table 5.1 Demographics of participants (n = 20)

<table>
<thead>
<tr>
<th>Variable</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Continuous Variables</strong></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>35</td>
</tr>
<tr>
<td>Female</td>
<td>65</td>
</tr>
<tr>
<td>Religion</td>
<td></td>
</tr>
<tr>
<td>Buddhist</td>
<td>55</td>
</tr>
<tr>
<td>Daoist</td>
<td>40</td>
</tr>
<tr>
<td>Christian</td>
<td>5</td>
</tr>
<tr>
<td>Level of Education</td>
<td></td>
</tr>
<tr>
<td>No education</td>
<td>25</td>
</tr>
<tr>
<td>Primary</td>
<td>45</td>
</tr>
<tr>
<td>High school</td>
<td>20</td>
</tr>
<tr>
<td>University/college</td>
<td>10</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
</tr>
<tr>
<td>Single/never married</td>
<td>5</td>
</tr>
<tr>
<td>Married</td>
<td>20</td>
</tr>
<tr>
<td>Widowed</td>
<td>65</td>
</tr>
<tr>
<td>Separated</td>
<td>10</td>
</tr>
<tr>
<td>No of children</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>1-3</td>
<td>40</td>
</tr>
<tr>
<td>&gt; 4</td>
<td>55</td>
</tr>
<tr>
<td>Frequency of family visits</td>
<td></td>
</tr>
<tr>
<td>Every day</td>
<td>10</td>
</tr>
<tr>
<td>Twice/week</td>
<td>10</td>
</tr>
<tr>
<td>Once/week</td>
<td>55</td>
</tr>
<tr>
<td>1-2/month</td>
<td>25</td>
</tr>
<tr>
<td>Type of mobility</td>
<td></td>
</tr>
<tr>
<td>Full mobility</td>
<td>10</td>
</tr>
<tr>
<td>Walker</td>
<td>30</td>
</tr>
<tr>
<td>Wheelchair</td>
<td>60</td>
</tr>
<tr>
<td>Had pet before moved in</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>70</td>
</tr>
<tr>
<td>Yes</td>
<td>30</td>
</tr>
<tr>
<td><strong>Continuous Variables</strong></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>M = 81.1 (SD = 8.2)</td>
</tr>
<tr>
<td>Barthel score</td>
<td>M = 54.5 (SD = 31.4)</td>
</tr>
<tr>
<td>No. years living in LTC</td>
<td>M = 3.4 (SD = 2.3)</td>
</tr>
</tbody>
</table>
Table 5.2 Participants’ health information (n = 20)

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic diseases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td>Diabetes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>13</td>
<td>65</td>
</tr>
<tr>
<td>Yes</td>
<td>7</td>
<td>35</td>
</tr>
<tr>
<td>Hypertension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>7</td>
<td>35</td>
</tr>
<tr>
<td>Yes</td>
<td>13</td>
<td>65</td>
</tr>
<tr>
<td>Cardio-vascular disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>14</td>
<td>70</td>
</tr>
<tr>
<td>Yes</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>Cancer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>17</td>
<td>85</td>
</tr>
<tr>
<td>Yes</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Respiratory disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>19</td>
<td>95</td>
</tr>
<tr>
<td>Yes</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Other disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>14</td>
<td>70</td>
</tr>
<tr>
<td>Yes</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>Type of depression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression with anxiety</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Depression (not specified)</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>Mild depression</td>
<td>15</td>
<td>75</td>
</tr>
<tr>
<td>Taking antidepressants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>19</td>
<td>95</td>
</tr>
<tr>
<td>Yes</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Having other treatment for depression</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td>Taking anxiolytics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>17</td>
<td>85</td>
</tr>
<tr>
<td>Yes</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Taking hypnotics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>12</td>
<td>60</td>
</tr>
<tr>
<td>Yes</td>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td>Taking other medication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Yes</td>
<td>17</td>
<td>85</td>
</tr>
</tbody>
</table>
The baseline scores of cognition, depression, loneliness, and quality of life are shown in Table 5.3. At baseline, participants had an average MMSE score of 26.5 (SD = 2.1) ranging from 22 to 30, which was adjusted by education level based on the Chinese version (Zhang et al., 1990). The Chinese version of the GDS-SF (Yesavage & Sheikh, 1986) score had a mean score of 10.3 (SD = 2) ranging from 7 to 14. The reliability of the instruments were examined with the reliability coefficient of Cronbach’s alpha of .45 in the Chinese version of the GDS-SF, .56 in the Chinese version of UCLA-3, and .74 in the Chinese version of WHOQOL-OLD in this present study.

Table 5.3 Baseline score of instruments (n = 20)

<table>
<thead>
<tr>
<th>Instrument</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMSE</td>
<td>26.50</td>
<td>2.12</td>
<td>22-30</td>
</tr>
<tr>
<td>GDS-SF</td>
<td>10.25</td>
<td>1.97</td>
<td>41-21</td>
</tr>
<tr>
<td>UCLA-3</td>
<td>53.80</td>
<td>3.29</td>
<td>49-62</td>
</tr>
<tr>
<td>WHOQOL-OLD</td>
<td>32.05</td>
<td>5.28</td>
<td>16-41</td>
</tr>
</tbody>
</table>

Note. MMSE = the Chinese version of Mini-Mental State Examination; GDS-SF = the Chinese version of Geriatric Depression Scale – Short Form; UCLA-3 = the Chinese version of the UCLA Loneliness Scale Version 3; WHOQOL-OLD = the Chinese version of the World Health Organization Quality of Life Questionnaire

Pearson’s correlation was used to examine the correlation between continuous variables of demographic characteristics such as age, length of stay in LTC facilities, Barthel score, and baseline scores of depression, loneliness, and quality of life. The results show that depression and quality of life did not show a significant correlation with continuous variables. However, there was a significant negative correlation between the
length of stay in LTC facilities and loneliness ($r = -.577; p = .008$), indicating that the longer a participant lived in a LTC facility, the less loneliness he or she felt.

5.2.3 Effects of 24-hour PARO intervention on depression, loneliness, and quality of life

5.2.3.1 Mean score of depression, loneliness, quality of life at each time point

The changes in depression, loneliness, and quality of life at each time point are presented in Figure 5.1. In the observation stage (from T1 to T2), the results showed there were slight changes in depression, loneliness, and quality of life. However, in the 24-hour PARO intervention (from T2 to T4), the results revealed significant positive changes in these three variables.

![Graph showing changes in depression, loneliness, and quality of life over time](image)

*Figure 5.2 Mean score of depression, loneliness, and quality of life*
5.2.3.2 The effects on the eight-week 24-hour PARO intervention

Using the probability plots and Shapiro-Wilk test, the GDS-SF and UCLA-3 scores showed normal distribution ($p = .201$). Therefore, a parametric test of repeated MANOVA was used to examine the differences in depression and loneliness over time. Mauchly's Test of Sphericity indicated that the assumption of sphericity had not been violated in both depression ($p = .54$) and loneliness ($p = .32$). Repeated MANOVA revealed statistically significant difference for both depression, $F(3, 57) = 87.26; p < .000$ and loneliness, $F(3, 57) = 61.7; p < .000$ over time (refer to Table 5.4). Post-hoc examination using paired sample $t$-tests was undertaken to determine the differences for depression and loneliness over the four time points (Table 5.5). The results showed that there was no significant difference between time 1 and time 2 (i.e. stage 1 observation) in depression, indicating there was no change in depression during the observation stage. After the eight-week 24-hour PARO intervention (from T2 to T4, stage 2 intervention), there were significant differences in every time point comparison: (a) T1 vs T3 ($p < .000$); (b) T1 vs T4 ($p < .000$); (c) T2 vs T3 ($p < .000$); (d) T2 vs T4 ($p < .000$); and (e) T3 vs T4 ($p < .015$). As indicated in Figure 5.2, the results showed that there was a decreasing trend in depression for older adults with depression after eight-week of a 24-hour PARO intervention over time.

For loneliness, a significant difference was found across all four time points: (a) T1 vs T2 ($p = .027$); (b) T1 vs T3 ($p < .000$); T1 vs T4 ($p < .000$); T2 vs T3 ($p < .000$); T2 vs T4 ($p < .000$); T3 vs T4 ($p = .023$). Again, as indicated in Figure 5.2 the results showed that there was a decreasing trend in feelings of loneliness for older adults with depression after the eight-week 24-hour PARO intervention over time.
Table 5.4 Repeated MANOVA for depression and loneliness (n = 20)

<table>
<thead>
<tr>
<th>Source</th>
<th>MANOVA with-subject</th>
<th></th>
<th></th>
<th></th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SS</td>
<td>df</td>
<td>MS</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td><strong>Depression</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>769.45</td>
<td>3</td>
<td>256.48</td>
<td>87.26</td>
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<tr>
<td></td>
<td>Sphericity Assumed</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Error</td>
<td>167.55</td>
<td>57</td>
<td>2.94</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sphericity Assumed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Loneliness</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>2240.74</td>
<td>3</td>
<td>746.91</td>
<td>61.70</td>
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</tr>
<tr>
<td>Error</td>
<td>690.01</td>
<td>57</td>
<td>12.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Assumed</td>
<td></td>
<td></td>
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</tbody>
</table>

Note. Mauchly’s Test of Sphericity indicated that the assumption of sphericity had not been violated in both depression ($\chi^2 = 4.09, p = .54$) and loneliness ($\chi^2 = 5.92, p = .32$).
Table 5.5 Post-hoc analysis of depression and loneliness over time using paired sample t-tests

<table>
<thead>
<tr>
<th></th>
<th>Paired sample t-tests</th>
<th>95% CI</th>
<th>M</th>
<th>SD</th>
<th>LL</th>
<th>UL</th>
<th>t</th>
<th>df</th>
<th>p</th>
<th>Cohen’s d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Depression</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1 vs T2</td>
<td></td>
<td></td>
<td>0.30</td>
<td>2.64</td>
<td>-0.93</td>
<td>1.53</td>
<td>0.51</td>
<td>19</td>
<td>.617</td>
<td>0.14</td>
</tr>
<tr>
<td>T1 vs T3</td>
<td></td>
<td></td>
<td>5.75</td>
<td>2.59</td>
<td>4.54</td>
<td>6.96</td>
<td>9.92</td>
<td>19</td>
<td>&lt;.000</td>
<td>3.17</td>
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<td>T1 vs T4</td>
<td></td>
<td></td>
<td>6.85</td>
<td>2.80</td>
<td>5.54</td>
<td>8.16</td>
<td>10.96</td>
<td>19</td>
<td>&lt;.000</td>
<td>3.69</td>
</tr>
<tr>
<td>T2 vs T3</td>
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<td>2.21</td>
<td>4.41</td>
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<td>&lt;.000</td>
<td>2.93</td>
</tr>
<tr>
<td>T2 vs T4</td>
<td></td>
<td></td>
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<td>5.45</td>
<td>7.65</td>
<td>12.46</td>
<td>19</td>
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<td>3.44</td>
</tr>
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<td>T3 vs T4</td>
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<td></td>
<td>1.10</td>
<td>1.83</td>
<td>0.24</td>
<td>1.96</td>
<td>2.68</td>
<td>19</td>
<td>.015</td>
<td>0.65</td>
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<tr>
<td><strong>Loneliness</strong></td>
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</tr>
<tr>
<td>T1 vs T2</td>
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<tr>
<td>T1 vs T3</td>
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<td></td>
<td>9.65</td>
<td>4.32</td>
<td>7.63</td>
<td>11.67</td>
<td>9.99</td>
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<td>T1 vs T4</td>
<td></td>
<td></td>
<td>12.90</td>
<td>5.46</td>
<td>10.35</td>
<td>15.45</td>
<td>10.57</td>
<td>19</td>
<td>&lt;.000</td>
<td>3.16</td>
</tr>
<tr>
<td>T2 vs T3</td>
<td></td>
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<td>7.55</td>
<td>3.82</td>
<td>5.76</td>
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<td>8.84</td>
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<td>T2 vs T4</td>
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<td>8.47</td>
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<td>2.50</td>
</tr>
<tr>
<td>T3 vs T4</td>
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<td>5.87</td>
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<td>6.00</td>
<td>2.48</td>
<td>19</td>
<td>.023</td>
<td>0.75</td>
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</tbody>
</table>

Note. CI = Confidence interval; LL = lower limit; UL = upper limit; T, time point.

As shown in Table 5.6 below, a nonparametric Friedman test was used to examine changes in quality of life over time due to an abnormality of data distribution, which was examined using probability plots and the Shapiro-Wilk test (p = .02). The results demonstrate that there was a significant difference in quality of life for participants over
time ($\chi^2 = 30.28, p < .000$). Consequently, post-hoc analysis using the Wilcoxon signed-rank test was conducted to examine the differences in quality of life over the four time points (Table 5.7). There was no significant difference from time 1 to time 2 (i.e. stage 1 observation), indicating there was no change during the observation stage. After the eight-week PARO intervention (from T2 to T4, stage 2 intervention), there were significant differences between: (a) T1 vs T3 ($p < .000$); T1 vs T4 ($p < .000$); T2 vs T3 ($p = .001$); T2 vs T4 ($p < .000$). However, no significant difference was found between T3 vs T4 ($p = .33$). As reflected in Figure 5.2 the results show that there was an increasing trend in quality of life for older adults with depression after the eight-week PARO intervention.

Table 5.6 Friedman test for quality of life (n = 20)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean Rank</th>
<th>$\chi^2$</th>
<th>df</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>QOL_T1</td>
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<td>QOL_T2</td>
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<td></td>
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<td></td>
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<tr>
<td>QOL_T3</td>
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<td></td>
</tr>
<tr>
<td>QOL_T4</td>
<td>3.38</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Quality of life was measured using WHOQOL-OLD; T, time point
Table 5.7 Post-hoc analysis of quality of life over time using Wilcoxon signed-ranked test (n = 20)

<table>
<thead>
<tr>
<th>Test Statisticsa</th>
<th>T2–T1</th>
<th>T3–T1</th>
<th>T4–T1</th>
<th>T3–T2</th>
<th>T4–T2</th>
<th>T4–T3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>-.28b</td>
<td>-3.56b</td>
<td>-3.77b</td>
<td>-3.42b</td>
<td>-3.57b</td>
<td>-.98b</td>
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<tr>
<td>p</td>
<td>.78</td>
<td>&lt;.000</td>
<td>&lt;.000</td>
<td>.001</td>
<td>&lt;.000</td>
<td>.326</td>
</tr>
<tr>
<td>Cohen’s d</td>
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<td>0.56</td>
<td>0.60</td>
<td>0.54</td>
<td>0.57</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Note. a = Wilcoxon signed ranks test; b = based on negative ranked, T = time point

5.3 Qualitative Results

Twenty older adults completed the eight-week 24-hour PARO intervention and took part in a 30- to 40-minute individual face-to-face interview with the researcher. The qualitative analysis was used to explore participants’ experiences and perceptions further through the interviews; these included the experience of participation, engagement with PARO, changes in mood and mental well-being, benefits and challenges of participation, and the meaning associated with participation.

Three themes emerged from the interviews: (i) humanising PARO by referring to personal experiences and engagement; (ii) increased social interaction with other people through using PARO; (iii) companionship that resulted in improved mental well-being. Exemplar quotations from participants are used to support these themes. Participants are referenced by their number followed by gender (F = Female; M = Male) and age (e.g. Case 1, F84).
5.3.1 Theme 1: Humanising PARO by referring to personal experiences and engagement

Humanising PARO is defined as attributing human-like qualities to a robot. Naming of PARO was an important first step for this intervention as it determined how participants perceived PARO and in turn affected how they interacted with PARO. Humanising PARO by giving it a name related to personal experience and engaging in a meaningful way with PARO through interactions were important for all participants. PARO, which can simulate human emotional reactions, evokes a psychological response, or enrichment effects, as a mental commitment robot. Most of the participants exhibited a range of positive responses related to PARO’s emotional reactions. They felt it was interesting and fascinating, and they humanised PARO by giving it a name that related in some way to their prior experiences. This was demonstrated by the interaction between participants and PARO. Participants gave PARO a name that had meaning for them as they regarded it as a valuable object, automatically stimulating them to interact with it. These names were positive identities, related to a close family member, a pet, a nickname, or a memorable object from their childhood. This is evident in the following two descriptions: “I called him Brown Sugar Cake [PARO], because that was the only dog I had... It [PARO] reminded me of him. I miss my dog very much” (Case 5, M65). “I called it Xiao Ying [PARO], because that was the nickname my husband had for me” (Case 13, F75).

Assignment of a meaningful name appeared to affect the role participants assigned to PARO, as well as influencing how participants interacted with it and their attitudes towards it. Hence, humanising PARO not only helped participants feel closer to it, but also helped them engage with it.

Engagement is the process by which participants start, maintain, and end their
connection to each other during an interaction. The process includes verbal communication and non-verbal behaviours, all of which support the perception of connectedness between interactors. Most of the participants reported that they interacted with PARO by means of conversation, making eye contact, paying attention, stroking, and hugging it. The direct interaction experience with PARO allowed participants to discover PARO's functions and usefulness; thereby, enhancing their engagement with PARO. This is illustrated by the following quotations from two participants:

Little cute [PARO] always looked at me, and sometimes I looked at it secretly. It not only looked at me but also made sounds. It was trying to catch my attention. When I didn’t respond, it would continue to make sounds. I found it was very interesting and cute. (Case7, F74)

I looked at its eyes, then touched its whiskers and head. Its head would move, and its eyes would open. It enjoyed being touched very much...

When I touched it and called its name Xiao Ying [PARO], it would make sounds. Haha~~. (Case13, F75)

During data analysis, important positive experiences for these older adults who engaged with PARO were characterised. Several participants indicated that PARO provided a positive experience for them during the intervention. In broad terms, the positive engagement experiences included perceived benefits, such as the feeling of warmth and of their life being more meaningful. One participant stated: “I had a good time with PARO and the experience I had with it was great” (Case 6, M89). Another participant also expressed the view that: “Xiao Jin [PARO] has many benefits. It was helpful to residents living here. It was considered to be a more positive experience" (Case
Furthermore, one male participant clearly described that he had a positive attitude towards PARO, as it seemed to exhibit human traits such as warmth and a kind of transcendent interaction. This can be found in the following description:

Interaction with Little White (PARO) was a very good experience. I felt it has some warmth. It felt like we were together. It had a sense of presence, another level of spiritual interaction, a higher level of interaction with the soul. (Case 10, M84)

As a consequence, humanising PARO was a key factor in the first step towards interacting and engaging with PARO by the participants.

**5.3.2 Theme 2: Increased social interaction with other people through using PARO**

This theme involves how PARO provided an opportunity to help participants improve social interactions. Interacting with PARO provided the opportunity to improve verbal responses among older adults within the facility. For instance, participants talked to the PARO directly or chatted with other residents or other visitors who were attracted by PARO. Several participants exhibited increased verbal communication, as well as increased non-verbal communication gestures while holding and talking with PARO. They liked to talk with PARO, make eye contact, and pay attention to it. An example is: “I loved to chat with Da Xiong [PARO] in Japanese, Mandarin, and Taiwanese. If there were a loud sound, it would lift its head and look for where the sounds were coming from” (Case 18, M88).

One participant articulated that PARO provided opportunities to encourage conversations with others, since other residents would come to interact with her when she
was with PARO. This would not occur when she did not have PARO. This is demonstrated in the following description: "I think I have more conversations with other people because of Xiao Jin [PARO]. For example, an old lady comes over to see and touch Xiao Jin every day" (Case 1, F81).

Most participants highlighted that PARO provided an opportunity to help them improve their social interaction. Several participants reported the benefits of using PARO as a means of connection to other residents, family members, or care staff. This is because PARO can play the role of promoter or intermediary to connect participants with other people. Thus, PARO can help older adults with depression to expand their interpersonal interaction. This is illustrated by the following quotations from two respondents:

A resident who sat next to me loved to play with Da Xiong [PARO] with me. She said she felt happy when she interacted with PARO. Another resident was unsure how to play with PARO, so I taught him how to interact with PARO. I touched it and it made a sound. When the family came to visit residents, some of them saw Da Xiong, and took pictures with their mobile phones. I felt pretty happy about this. I would chat with those visitors and showed them how to interact with PARO. Sometimes I took it out and showed it to the office staff. They were also happy to interact with Da Xiong ~ Hahaha~. (Case 18, M88)

When I took it outside, some residents came to play with Du Du [PARO] and some staff took pictures with it. There was one woman, in particular, who always came to play with Du Du when I took it into the living room. (Case 4, F86)
5.3.3 Theme 3: Companionship resulted in improved mental well-being

This theme refers to how PARO provided companionship for older adults with depression and considers how PARO helped participants improve their mood and well-being. This study has suggested that companionship is an important factor for the improvement of mental well-being. In addition, the relationship with PARO was a key element in determining what participants perceived to be positive or negative experiences during the intervention. Hence, this theme consisted of three elements that are interrelated: companionship, relationship, and mood improvement.

**Companionship.** Companionship for this intervention is defined as participants feeling a sense of closeness with PARO. This involved PARO being there, about wanting PARO there, enjoying its company and then developing a relationship naturally. Having good companionship is important for both mental and physical well-being; it helped these older adults feel relaxed and comfortable. Participants had PARO as a companion during a 24-hour intervention, which provided sufficient time for participants to interact with the robot, according to their preference without any limits. Most of the participants expressed the view that PARO could provide companionship and give them the feeling someone needed them and that someone was waiting for them. For example: “I had a lot of affection for Xiao Ying [PARO], it felt like an emotional attachment, like someone was waiting for me and needed me” (Case 13, F75).

In addition, most participants thought PARO could comfort them through companionship, and participants reported experiencing a more meaningful life in LTC as PARO blended into their daily routines. For example, a description from a male was:
When it [PARO] stayed with me, I don’t felt like a silly old person living here. When it lived here, it made sounds. I felt that time flew faster, life is more meaningful and there was companionship. Otherwise, I would have just watched TV all day long. That’s so sad. I looked at them [other residents] watching TV till they fell asleep. When PARO was here, I was very happy. Having PARO next to me, I could hold it while it was wagging its tail and moving its head. (Case 6, M89)

Some participants saw PARO as a meaningful presence, as opposed to just being one of the scheduled activities in LTC, and another participant illustrates this:

Steven [PARO] helped me to kill time and to forget about things. It should be said that it gave us some level of comfort, like my loved ones, such as my son and wife. They are all busy. They come to see me in the morning, and then go to work. However, I don't want to bother them. They need to do some errands every day and take care of their children. That is to say, we didn't think of it as just killing time when Steven was with me. We regard it as a companion and it is comforting. (Case 3, M65)

As mentioned previously, the results demonstrated the importance of companionship to mental well-being. Most participants articulated that PARO could reduce the feeling of loneliness through direct interaction such as stroking, petting, and conversation with PARO or indirect interactions, such as putting PARO next to them or by just being in the same room. A female said: “I don’t feel as bored because I could talk to Little Cute [PARO]. I was able to overcome the feelings of loneliness because I felt that there was someone accompanying me" (Case 7, F74). Another female indicated, “I felt that there
was a person [PARO] together with me, and I did not feel bored. I could touch it, pat it. Sometimes if I were not sleeping, I would put it next to me" (Case8, F84). Some participants claimed that even though PARO was just next to them or with them in the same room, they felt they had a companion and were less lonely. A female expressed that: “I felt less lonely because Yan Yan [PARO] accompanied me and stayed with me all day" (Case 2, F82).

**Relationship.** Relationship refers to how participants perceived a relationship, emotional bond, or connection with PARO during the intervention. Participant-PARO relationships might correlate with companionship. As participants perceived good companionship with PARO, they would also perceive a close relationship with PARO and vice versa. The concepts of companionship and relationship were interwoven for some participants. These relationships could be found between participants and PARO during their interactions. Participants interacted with PARO differently as they ascribed different meanings to their relationship with the robot. Many participants indicated that they had developed a connection with PARO through their interactions as indicated by these quotes:

I felt I had a bond with Little Cute [PARO] and established a relationship with it because when it looked at me, it felt like it was conveying some affection for me. (Case 7, F74)

I interacted with Chubby [PARO] throughout the weeks. It could respond to me, and after interacting with it for a long time, I felt I had a bond with it and formed an emotional connection with it. (Case 8, F84)
The majority of participants expressed the view that they had formed an emotional bond with PARO through their interactions. In some participants, the emotional bond gradually grew between themselves and PARO during the intervention, particularly if participants did not feel a sense of belonging in a nursing home, as in the following example:

The use was related to the mindset of the user [resident]. I have some connection with Little White [PARO] and I have established an emotional bond with it. Sometimes emotions can't be expressed. I don't think this is a place where I feel a sense of belonging. Therefore, I formed an attachment with it [PARO], and I felt a change in my being. (Case 10, M84)

Difficulty with disengagement from PARO indicated the existence of a rewarding relationship between the participants and PARO after the termination of the intervention. Although participants enjoyed the opportunity to engage with PARO, some of the participants reported that they encountered difficulties with disengagement when the social robot was removed. Participants reported that they experienced disappointment and sleep disturbance due to the removal of PARO. However, these symptoms presented for only one to two days, and then they returned to their usual activities prior to their time with PARO. Examples follow:

After Chubby [PARO] left, I felt lonely and disappointed. The care staff teased me and said: "Since Chubby went back, I cannot fall asleep". I used to get up at 5:30 in the morning, but now I get up at 4:30. I haven’t sleep
well in the last few days. It’s affected my sleep a little. I feel like I have lost a companion. But after a day or two, I felt better. (Case 8, F84)

When you took it away, I wasn’t used to it because something was missing. When it left, I missed it because Little White [PARO] was once there but now gone. Since its departure, it felt like something is missing in my heart. I formed an attachment with it [PARO], and felt change to my being. (Case10, M84)

However, a few participants experienced a number of barriers to forming a relationship or connection with PARO, as they did not perceive any benefit from it. Participant-PARO interaction varied and was influenced by individual personal histories, experiences and social roles, such as masculinity. The traits of participants or their attitudes towards a toy or pet affected their acceptance of PARO. One participant commented, “My personality is such that I don’t like animals” (Case14, F91). Their past experiences also influenced the participant-PARO bond, as negative memories directly or indirectly, affected how participants interacted with PARO: “When I was a child, I didn't like animals very much. A dog once chased me, so I didn’t like animals” (Case 11, F78). Furthermore, gender and age were factors that influenced participants’ interaction with PARO. This is illustrated by the quotes from two participants: “I resisted at first, because I felt that it [PARO] was not suitable for playing with. I felt that I didn't need this very much. I felt strange at first because males can't hug and play with it” (Case 3, M65). Another resident said, “In the beginning, some residents told me I was too old to play with this kind of toy. It affected how I interacted with PARO” (Case 15, F78). These results assisted in the understanding of those factors that impeded the establishment of a
participant-PARO relationship.

**Mood improvement.** Mood improvement refers to an emotional state of mind, or feeling that is, in this study’s case, ameliorated mood through the use of PARO. In this study, improved mood encompassed a decreased level of depression and an increased positive mood. Improving mood is crucial for older adults with depression since feelings of worthlessness, guilt, or self-blame are common symptoms of depression. Most participants claimed that interaction with PARO had many psychological benefits. Participants expressed the view that PARO engendered positive psychological effects and provided warmth and companionship to boost their mood and to lift their spirits. One male participant said: “I felt that there was an improvement in my mood, and this has continued. There are many good things about Xiao Qiu [PARO], it will be helpful to residents living here” (Case 16, F76). Another male participant also indicated, “I felt more positive and happier when it [PARO] was here. PARO gave me more positive feelings and feelings of warmth” (Case 10, M84). These positive perceptions derived from the PARO companion, which could compensate for participants’ homesickness or negative emotions. This is illustrated by a quote from one male participant:

> In fact, it can reinforce some psychological effects. Steven [PARO] can help us (residents) in a way that other people can’t. Its main function is to help those residents whose relatives have not visited for a long time, and it [PARO] can make up for some feelings of homesickness. We are all human beings, thus we all have negative emotions such as feeling unsafe about certain things and people. However, when PARO came, I felt I had a companion. It was able to improve my mood. (Case 3, M65)
Furthermore, participants felt their depression was alleviated as a result of the companionship provided by PARO. These findings support the quantitative outcomes, which showed that the PARO intervention had beneficial effects on depression, and loneliness for the participants in LTC facilities. PARO companionship directly helped to reduce depression and boredom for participants, as PARO provided opportunities for interaction. One participant stated: “I was less depressed when it [PARO] was next to me. It would make me feel better and dispel my inner negative feelings" (Case 13, F75). Another female said, “I got along well with Yan Yan [PARO] for eight weeks, I felt that my mood is improved. When I interacted with it, and hold it in my arms and hear its sounds, I felt very happy” (Case 2, F82).

5.4 Summary of the chapter

The findings from the quantitative component of the study demonstrated that there were significant changes in depression, loneliness, and quality of life for older adults with depression after an eight-week 24-hour PARO intervention. Twenty participants consented to participate and complete this study. The mean age of participants was 81.1 years. The majority of participants were female and widowed. The average length of living in the LTC facility was 3.4 years. All participants had experienced at least one chronic disease. Scores on depression, loneliness, and quality of life demonstrated significant positive changes over time. As the GDS-SF and UCLA-3 scores showed normal distribution, repeated MANOVA was used to examine the changes in both depression and loneliness. The results revealed statistically significant differences in both depression and loneliness over time. Paired sample t-tests were used for post-hoc examination in both depression and loneliness over the four time points. The results showed no significant difference in the observation stage, but there were significant
differences at each time point comparison in depression during the intervention stage. With respect to loneliness, the results of the post-hoc examination showed that there was a significant difference in the observation stage and intervention stage at each time point comparison. A nonparametric Friedman test was used to examine changes in quality of life over time, due to the score of quality of life showing abnormality of data distribution. The results demonstrate that there was a significant difference in quality of life over time. The Wilcoxon signed-rank test was conducted to examine the differences in quality of life over the four time-points for post-hoc analysis. The results revealed that there was no significant difference in the observation stage, but there were significant differences in the intervention stage at each point of comparison.

All participants took part in a 30- to 40-minute individual face-to-face interview with the researcher. The qualitative analysis allowed for further exploration of participants’ experiences and perceptions as discussed during the interviews, including their experience of participation, engagement in activity, changes in mood and mental well-being, benefits and challenges of participation, and the meaning associated with participation. Three themes emerged from the interviews: humanising PARO by referring to personal experiences and engagement, increased social interaction with other people through the use of PARO, and companionship resulting in improved mental well-being. These outcomes demonstrate that a 24-hour PARO intervention has the potential to improve mental well-being for older adults with depression living in LTC facilities.
Chapter 6 Discussion

6.1 Introduction

There were two phases in this current study. Phase one was an online survey and phase two a mixed-methods experimental study. The first aim of the online survey was to modify, translate, and validate the Chinese version of the Attitudes Towards the Use of Social robot (ATTUSR-C) questionnaire for use with Taiwanese health personnel. The second aim of the online survey was to investigate the attitudes of Taiwanese health personnel working in long-term care (LTC) towards the use of social robots for older adults. The results of the online survey were presented in Chapter 3 and the manuscript has been published by the International Journal of Social Robotics. Phase two, a mixed method experimental design, explored the impact of an eight-week 24-hour PARO intervention on depression and well-being for older adults with depression in LTC in Taiwan. This study was unique, because it was the first known study to use a 24-hour intervention to help gain a better understanding of the effect of PARO on the mental well-being of older adults with depression. The purpose of this study was two-fold. First, to investigate potential changes in depression and well-being in older adults. Second, to explore older adults' perceptions and experiences after participating in the PARO intervention. This chapter provides a discussion and interpretation of the study findings in relation to attitudes towards the use of social robots for health personnel and the literature on the effects of a social robot intervention for older adults with depression. This chapter begins with a summary of the study findings including the online survey and PARO intervention. Following this, the overall findings are discussed in the context of existing research and the study's contribution to new knowledge, and the insights are also highlighted. Finally, research strengths and limitations are described.

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6.2 The validity and reliability of the ATTUSR-C questionnaire for use with health personnel – research question one

This study is the first study we know of that targeted development and validation of the Chinese version of the Attitudes Towards the Use of Social Robot (ATTUSR-C) questionnaire among health personnel in the Chinese cultural context. This instrument also has a preliminarily focus on the nursing value of social robots. The results of the psychometric analyses showed that the Chinese version of the ATTUSR obtained good reliability and validity among health personnel in aged care facilities. The results of these findings have been published by the International Journal of Social robotics in 2019.

With increasing use of socially assistive robots in healthcare environments, it is important to evaluate health personnel’s attitudes towards the use of social robots. Currently, many studies have adopted technology acceptance modelling (TAM) to investigate attitudes toward the use of social robots by patients or users for commercial purposes (Gagnon et al., 2012). TAM provides a theoretical base for explaining or predicting the factors that cause a person to accept or reject computerised systems by investigating ‘perceived usefulness’ and ‘perceived ease of use’ (Davis, 1989). Furthermore, Davis (1993) also indicated that perceived usefulness is more important than perceived ease of use. Previous studies have shown that perceived usefulness has consistently been found to be a strong determinant of usage intentions; nevertheless, perceived ease of use has clearly demonstrated a less consistent effect across studies (Chen et al., 2008; Chow et al., 2012; Venkatesh & Davis, 2000). However, TAM is not appropriate to use for evaluating professionals’ attitude. Therefore, a validated questionnaire, such as the ATTUSR-C, is a unique questionnaire for evaluating health professional and personnel attitudes towards using social robots. The ATTUSR-C is ready
for use to assess health personnel’s attitudes towards social robots and in particular before a social robot is implemented in care practice.

On the other hand, some studies have used a qualitative approach to understand health personnel attitudes toward the use of social robots (Broadbent et al., 2012; Moyle et al. 2018) or focused on patients’ perception (Broadbent et al. 2010). However, a quantitative and objective assessment instrument will be useful for health personnel in both research and the clinical setting. Additionally, such an instrument should concern the use of social robots and focus on nursing evaluations. The ATTUSR-C can provide reliable feedback and insights into areas where further development is indicated in clinical settings and could facilitate future researchers to examine the impact of social robots on target participants, and expand knowledge for implementation of robots in healthcare.

However, there were two major limitations identified of the ATTUSR-C when used in this study. First, the ATTUSR-C questionnaire is a new tool used to evaluate health personnel’s attitudes. There is no related Chinese questionnaire to assess convergent validity. Further work to examine convergent validity of the ATTUSR-C questionnaire is therefore warranted. Second, there may have been bias in the selection of participants. For example, nurses and health personnel who seemed friendly or easily approachable may have been more likely to be asked to participate. In summary, the ATTUSR-C provides an opportunity to investigate health personnel attitudes towards social robots in Taiwan before social robots are in wide use in LTC. Although this study was focused in Taiwan, the findings have broader implications, and further study could continue to examine this questionnaire in different countries.
6.3 Investigation of the attitudes of health personnel working in LTC towards the use of social robots – research question two

The results of the online survey revealed that assessment of health personnel’s attitudes toward social robots could offer new insights for healthcare organizations, as well as for robot designers and policymakers. The majority of issues related to the attitudes of health personnel working in LTC towards the use of social robot was discussed in Chapter 3. The results of online survey have been published by the International Journal of Social Robotics in 2019. Furthermore, the data analysis examined whether there was a difference of attitudes towards the use of the social robot between early responders and late responders, or after reminders. The findings demonstrated that there were no differences between early responders and late responders.

Recent studies have shown an increased interest in an investigation of the use of social robots by health personnel (Rantanen, Lehto, Vuorinen, & Coco, 2018; Turja, Rantanen, & Oksanen, 2019; Vänni & Salin, 2019). Most recently, Vänni and Salin (2019) conducted a cross-sectional survey among health workers in Finland hospitals and housing services to investigate the attitudes of health personnel toward the need for assistive and social robots in the healthcare sector. The survey focused on how much need there was for service robots by health workers, the need to develop direct and indirect nursing care, the benefits and possibilities of service robots for patients, and workers’ perceived work ability and physical and mental workload. Additionally, using open-ended questions they asked workers which robots could be used in their facilities. The results demonstrated that 37% of respondents reported the robots could be used for motivating and activating residents through stimulating activities. Only a few respondents (6%) considered that robots had no potential use in the facilities.
Rantanen et al. (2018) adopted a cross-sectional study conducted by questionnaire to examine the attitudes of Finnish homecare registered nurses, licensed vocational nurses and other health and social care personnel towards the introduction and use of care robots in homecare. Their questionnaire contained a total of 83 questions. First, it included care robots. Second, it focused on three different attitudes towards care robots such as robots as promoters of safety, robots as helpers in practical homecare, robots as guides and prompters, and the use of robots to reduce the anxiety and loneliness of an older person. Finally, behavioural intention, perceived behavioural control, and a subjective norm were adopted to evaluate acceptance of robots in this questionnaire since these three variables were considered important influences for acceptance of technological innovations. However, we did not adopt and modify these two questionnaires for this current study as Rantanen et al. (2018) focused on homecare settings and Vänni and Salin (2019) included service robots and assistive robots. Furthermore, they had different purposes and backgrounds compared to the current study that aimed to explore the use of social robots.

In Taiwan, there is an increase in the use of social robots or service robots in the healthcare sectors; therefore, the online survey focused on attitudes towards the use of the social robot for all health personnel in LTC in order to understand the possibility and availability of the use of social robots in LTC in Taiwan.

In summary, the findings of the current online survey provide new evidence to support that health personnel perceived that social robots were able to increase productivity and efficiency when providing care for older people. Consequently, the results of the online survey demonstrated that a future study to assess health personnel’s attitudes toward social robots could offer new insights for healthcare organizations such as hospitals, as well as for robot designers and policymakers.
6.4 Summary of the PARO intervention findings

This mixed methods experimental design comprised of a single group, quasi-experimental approach and an interview conducted in four nursing homes in southern Taiwan. This study aimed to explore the impact of an eight-week 24-hour PARO intervention on depression and well-being for older adults with depression. Using purposive sampling, 20 older adults, who had mild to moderate depression with a GDS-SF score ranging from 7 to 14, completed the PARO intervention and an interview. The majority of older adults were female, widowed, and Buddhist. All of them had at least one chronic disease. The majority of older adults suffered from mild depression, and a few took antidepressants, but none received any other form of psychosocial intervention for depression. The quantitative results demonstrated significant reductions in depression and feelings of loneliness, and improved quality of life for older adults with depression following participation in the PARO intervention. However, there were significant differences in feelings of loneliness shown during the initial observation stage of the research prior to the PARO intervention. Qualitative findings identified that humanising PARO by participants' references to personal experiences and engagement, increased social interaction with other people through the use of PARO. Furthermore, companionship influenced mood and resulted in improved mental well-being.

A paper outlining the study findings has been published online in the International Psychogeriatrics and can be found in Appendix T. International Psychogeriatrics has a 2018 Impact Factor of 2.478, and is ranked 43 out of the 130 journals in the subject category of “Psychology, Clinical” (2018 Journal Citation Reports © Clarivate Analytics).
Statement of contribution to co-authored published paper

This chapter includes a co-authored paper. The bibliographic details of the co-authored paper, including all authors, are:


My contribution to this paper involved: Critical review of the literature to inform the design of the study, conceptualising and design of the study, data collection, conduct intervention, data analysis, data interpretation, writing of the draft manuscript, and finalisation of the manuscript.

(Signed) Date: 05/03/2020

Shu-Chuan Chen

(Countersigned) Date: 05/03/2020

Corresponding author of paper: Shu-Chuan Chen

(Countersigned) Date: 05/03/2020

Principal supervisor: Professor Wendy Moyle
6.5 The effects of the 24-hour PARO intervention on mental well-being

6.5.1 The effects of the 24-hour PARO intervention on depression – Phase two research question one

The quantitative data, collected using the GDS-SF (Yesavage & Sheikh, 1986), demonstrated that there was no significant change in depression during the observation stage. However, in the PARO intervention stage, the results indicated that there was a significant decrease in the level of depression at mid-point (week 12) and after the intervention (week 16) with large effect sizes. These findings correspond with the qualitative data, in which most participants reported that interaction with PARO improved their mood and alleviated depression. The quantitative results are consistent with those of previous studies, which have demonstrated that participation in the PARO intervention could decrease depressive symptoms (Kargar & Mahoor, 2017; Petersen et al., 2017; Thodberg et al., 2016a). Such findings suggest that PARO has a calming effect, improves relaxation, and comfort, which ultimately improves mood. In a randomised controlled trial conducted by Liang et al. (2017), the observation results showed that participants increased their smile and affect after interaction with PARO compared to a control group. Petersen et al. (2017) conducted a randomised block study with repeated measurements to examine the effect of a PARO intervention on anxiety, depression, cognitive, and physiological functions, as well as medication measurements among older people with dementia living in residential facilities. The results indicated that anxiety and depression were significantly decreased compared to residents in the control group, who received their usual care. In addition, Thodberg et al. (2016a) recruited 100 residents from nursing homes, who were randomly assigned to receive biweekly visits for six weeks by a person accompanied with a live dog, a PARO, or a soft toy cat. The aim was to compare the
differences in psychiatric measures (e.g. cognitive function, depression, confusion, and other behavioural symptoms), sleep measures, and weight and height (BMI) measures. Their results showed that there was a decrease in depression while cognitive impairment worsened during the experimental period. Moyle et al. (2013) conducted a pilot randomised controlled study to compare the effect of PARO on emotions during participation in an interactive reading group conducted with people living with dementia in a residential care setting. Despite a lack of statistical significance, a clinical significance in depression scores with a small effect size was found in the study. Furthermore, these results are in line with previous qualitative research (Moyle, Bramble, Jones, & Murfield, 2019a), which reported that PARO had the potential to reduce behavioural and psychological symptoms of dementia, such as agitation and mood disturbance. Studies using other social robots have shown similar results. For example, Kargar and Mahoor (2017) conducted a pilot study using an eBear socially assistive robot. The eBear can show facial expression, head gestures, understands users’ emotions using audio-visual sensory inputs and machine learning, shows relatively accurate visual speech, and can have dialog with people. The Kargar and Mahoor (2017) study aimed to investigate the effects of happiness and mood in seven older adults with no to moderate depression. The results demonstrated that eBear successfully interacted with older adults with depression and that eBear has the potential to uplift mood and happiness for the participants. Tanaka et al. (2012) employed a randomised controlled trial to examine the effect of a human-type communication robot on cognitive function and sleep, depression, and subjective fatigue in older women living alone. However, the results did not show statistical differences in depression and sleep, but there was a decreased trend in depression with use of the robot. Furthermore, Moyle et al. (2016) conducted a feasibility study using a companion animal robot called CuDDler (Teddy bear) to encourage social
engagement and reducing behavioural and psychological symptoms of dementia for five participants. The results demonstrated that positive emotion was identified more than negative emotion for all participants when they were with CuDDler. However, the effectiveness of CuDDler for improving participants’ engagement was limited as some participants thought this robot was too heavy and rigid (Moyle et al., 2016). It can be concluded that PARO appears to be one of the most appropriate companion robots currently for older adults in LTC. Therefore, this supports the justification why PARO was chosen in the current study.

However, this positive outcome in depression contrasts with those of other previous studies (Jøranson et al., 2015; Robinson et al., 2013), which indicated that there were no significant changes in levels of depression after a PARO intervention. For instance, a group PARO activity was conducted for 30 minutes twice a week for 12 weeks by Jøranson et al. (2015) to examine the effects on symptoms of agitation and depression in older people with cognitive impairment. The findings showed no significant immediate effects on agitation and depression between the experimental group and control group before and after the intervention, while interestingly there was a statistically significant difference before and three months post-intervention in people with severe dementia. In addition, Robinson et al. (2013), who conducted a randomised controlled trial to investigate the psychological effects of a PARO companion in rest homes, found that there were no significant differences in depression between residents in the PARO intervention group and the control group (who received alternative activities, such as craft, movies, or bingo) after the intervention. This discrepancy could be attributed to the lower score of depression recorded using different instruments at baseline in these two studies (Jøranson et al., 2015; Robinson et al., 2013). For example, the Cornell Scale for
Depression in Dementia (CSDD) was used in the study of Jøranson et al. (2015) where the mean score of depression at baseline was 9.0 in the experimental group and 6.9 in the control group, respectively. Robinson et al. (2013) study, using the Geriatric Depression Scale (GDS), the mean score of depression at baseline was 4.88 in the experimental group and 3.33 in the control group, which was below the GDS cut-off for depressive symptoms. Thus, participants’ level of depression was unlikely to improve due to the lower baseline scores of CSDD and GDS where the flooring effect may have confined the potential for a reduction in the level of depression in both studies. In this current study, the use of purposive sampling, where only participants with GDS-SF scores greater than six (i.e. mean score of 10.25 in depression) were recruited, ensured the potential of the PARO intervention to reveal whether it can alleviate depression and improve well-being. Nevertheless, future studies should consider other statistical phenomenon such as flooring, ceiling and regression to the mean effects that may have affected the study outcomes and its interpretation.

6.5.2 The effects of the 24-hour PARO intervention on loneliness - Phase two research question two

Loneliness, which is a common problem encountered by residents in LTC facilities, essentially is a subjective perception. With regard to feelings of loneliness, the current study results have shown that there was a significant change during the observation stage. The results showed that the mean score of loneliness in the first round was higher than in the other rounds, and higher than at baseline. A possible explanation for this might be that data collected from participants in the first round coincided with Chinese New Year. In terms of Chinese collectivistic cultures, the Chinese New Year is the most important holiday since it emphasises cohesiveness among family members. However, due to
physical disabilities, participants needed to stay at the LTC facility rather than go to a family reunion at home. Therefore, the loneliness score was slightly higher in the first round of participants, meaning they felt lonelier. As only five PAROs were available, and in order to achieve the minimum sample size of 20 participants, four rounds of the PARO intervention with five participants in each round were needed. Each round of recruitment took place in four different months: January, March, May, and July. Therefore, there is the potential for differences between those recruited earlier in the process and those recruited later (Spencer & Heneghan, 2017). This could be the reason for differences and account for why participants in the first round had a higher score of loneliness than others. Therefore, the outcomes of this current study should be interpreted with caution. In future studies, other design such as stepped-wedge cluster randomised trials could be considered to address the above issue as it offers data analysis such as the modelling of time effect on the effectiveness of an intervention and provides an insight into the underlying context of the data (Copas et al. 2015).

The quantitative results reveal that following the PARO intervention there was a significant decrease in the feeling of loneliness for older adult participants with depression at the midpoint and the end of the intervention. This is congruent with the qualitative findings where many older adults indicated that companionship with PARO resulted in a reduction of feelings in loneliness. These outcomes are also consistent with those of Robinson et al. (2013), who indicated that older people living in a residential facility showed significant decreases in feelings of loneliness compared to the control group, through their interaction with PARO. Moreover, a previous study compared the effects of a real dog, a robot dog (AIBO), and control group in the treatment of loneliness in older people living in LTC settings (Banks et al., 2008). Their results showed statistical
differences in the real dog group and AIBO group in feelings of loneliness compared to
the control group, but there were no significant differences between the real dog group
and AIBO group. Therefore, the use of PARO in LTC to reduce the feelings of loneliness
is feasible.

Our outcomes are echoed by Banks et al. (2008), who suggested that animal-assisted
therapy and social robots were effective methods in decreasing loneliness in LTC. The
positive mechanism of PARO might relate to three important factors (Banks et al., 2008).
First, older adults become psychologically engaged with PARO through biological
presence or animistic underpinning encouraging their engagement. Second, participants’
intention, positive feelings, and psychological states were improved when caring for
PARO. Third, social standing was improved in terms of communication, connections, and
companionship to PARO (Friedman, Kahn & Hagman, 2003). These factors combined
resulted in a reduction in feelings of loneliness for participants.

6.5.3 The effects of the 24-hour PARO intervention on quality of life – Phase two
research question three

The quantitative results have shown that there was a significant improvement in residents’
QOL during the PARO intervention stage. The findings are consistent with previous
research on PARO interventions in people with dementia (Jøranson et al., 2016b; Moyle
et al., 2013). In this study, the WHOQOL-OLD questionnaire was used to assess the
quality of life of older adults with depression. This instrument consists of six domains,
including: sensory abilities, autonomy, past, present and future activities, social
participation, death and dying, and intimacy. The quantitative results showed that PARO
has a moderate effect in improving quality of life as reflected in the significant increase
in the mean score of WHOQOL-OLD from the beginning to the end of the intervention.
The sub-domains of WHOQOL-OLD, such as autonomy, past, present and future activities, and social participation, are important components of quality of life and these each improved following participation in the PARO intervention. PARO has also had an effect on quality of life in people with dementia. A cluster-randomised controlled trial by Jøranson et al. (2016b) used the Quality of Life in Late-Stage Dementia scale (QUALID) to assess quality of life in people with severe dementia. The results highlighted the beneficial effects of group activity with PARO in improving quality of life for older people with severe dementia due to socially stimulating activities and positive pastimes with a social robot (Jøranson et al., 2016b). In addition, the study by Moyle et al. (2013) used the Quality of Life in Alzheimer’s Disease Scale (QOL-AD) to compare the effect of PARO on those participating in a reading group, in terms of quality of life of people living with moderate to severe dementia in a residential care setting. The results demonstrated that PARO was beneficial for people living with moderate to severe dementia, since the PARO intervention resulted in the stimulation of communication and evoked positive emotions, which are important aspects of quality of life.

Furthermore, the current study quantitative results were in line with the qualitative findings, which demonstrated that PARO might be an effective intervention for enhancing social interaction and meaningfulness of life in depressed older adults, as well as improving quality of life. Participants reported more positive life experiences and claimed their lives were more meaningful as a result of the companionship they felt with PARO. Some participants also indicated an increased interaction or communication with PARO and/or other people as well as a change in their regular activities, which involved incorporating PARO into their daily lives within the LTC facilities. Also, a fulfilment of the need for meaningfulness in life and a sense of self-worth were noted by older adults.
after they had participated in the PARO intervention. Nevertheless, the results of the current study are contrary to those of previous studies, which have demonstrated that there were no effects related to a PARO intervention on quality of life in people with mild/moderate dementia (Jøranson et al., 2016b; Robinson et al., 2013). The study of Robinson et al. (2013), which also used QOL-AD to investigate the effects of the PARO on quality of life for residents with dementia in a nursing home, indicated that there were no significant differences between the PARO group and the control group. As a result, population types, the severity of disease, and varying assessment tools used may have a bearing on the outcomes of the intervention, therefore further investigations are warranted.

In summary, in the current study, both the quantitative and qualitative findings demonstrated that the 24-hour PARO intervention has the potential to immediately reduce levels of depression and feelings of loneliness as well as to improve quality of life in older adults with depression in LTC.

6.6 Experience and perceptions of older adults with depression after the PARO intervention – Phase two research question four

6.6.1 Humanised PARO by giving it a name

The humanisation of robots, which is defined as the representation of robots as humans and/or conferring human-like qualities or attributes to robots (Robert, 2017), impacts people’s expectations of robots. There are two ways robots are humanised. The first is through their physical appearance and the ways they interact. This includes physical features that make robots appear and sound more human. This also includes programs that simulate human personality and make them appear to behave like humans. The second is through their roles in society. Robot roles as co-workers, friends, and pets
invoke emotions often associated with humans (Robert, 2017). However, humanising a robot does not necessarily imply choosing an anthropomorphic appearance, and social robots do not duplicate the full range of human activities or simulate human emotions (Sciutti, Mara, Tagliasco, & Sandini, 2018). The qualitative analysis showed that participants humanised PARO by giving it a name that related to their personal experiences and that they engaged with the robot in a meaningful way. This was the result of an initial step to facilitate interaction and engagement with PARO. Naming is an important component of the initial intervention, since this process can help older adults recall previous positive experiences related to an important event, object, or person in their early life. Humanisation impacts people’s expectations of how they will interact with robots and their view of what is, or what is not, an appropriate use of robots and this varies according to the extent to which they are perceived as human (Robert, 2017). Older adults had the opportunity to name the PARO to facilitate building ownership, which would hopefully motivate interaction and engagement with the social robot. This experience affected their connection and interaction with PARO during the initiation, which influenced the type and the frequency of interactions participants had with PARO in the weeks that followed. Robert (2017) indicated that humanisation impacts users’ response to robots, which may initiate a range of feelings from “affection” when robots are less humanised to deeper and stronger emotions such as “love” when robots are more humanised.

6.6.2 Increased social interaction and communication

Older adults with depression normally exhibit low mood, loss of interest and enjoyment, and poor concentration. These symptoms cause clinically significant stress or impairment in social, psychological, occupational, or other important areas of functioning (Dow, Lin,
Depressed older adults also have lower levels of social engagement (Achterberg, Pot, Kerkstra, & Ribbe, 2006; Min, Ailshire, & Crimmins, 2016), more behavioural and vocal disturbance (Dwyer & Byrne, 2000; Fiske et al., 2009), and poor quality of life (Sivertsen et al., 2015). Impairments in social functioning contribute strongly to the increased burden of depression (Charara et al., 2017; Grandes et al., 2011) and predict depressive relapse and recurrences (Jha et al., 2016; Solomon et al., 2004). However, PARO could provide support to older adults with depression since there is evidence suggesting that use of the PARO can bring social benefits to this population (Pu et al., 2019). The qualitative findings in this study have shown that the PARO can improve social dynamics, by increasing the opportunity for interaction among older adult participants, care staff, and their relatives and lead to an increase in social exchanges in LTC settings (Wada & Shibata, 2007a). The qualitative findings revealed that older adults increased communication and social interaction with other residents, care staff, and relatives through PARO. These results are in line with previous studies, which revealed that PARO might function as an icebreaker and help to facilitate conversation in a group activity (Robinson et al., 2015; Takayanagi et al., 2014). These findings suggest that PARO can be a mediator or facilitator to help improve social interaction and communication among older adults in LTC.

6.6.3 Companionship and mood improvement

Sullivan (1953) indicated that the need for companionship begins in childhood and continues throughout life; it is a desire to be involved with others in mutually interesting interactions and enjoyable activities (Sullivan, 2013). Rook (1987) indicated that companionship had an important effect on psychological well-being and a buffering effect on minor life stress, while a lack of companionship produces negative reactions. A
deficit of companionship is the most common factor related to depression and loneliness in LTC facilities (Prieto-Flores et al., 2011). The clinical environment of residential settings and lack of alternative approaches to care have also been identified as risk factors for depression (Dixon, Holoshitz, & Nossel, 2016; Zeiss, 2005). Institutional factors that may contribute to depression include: loss of privacy and frustration over shared rooms, noise, lack of stimulating social programs, and a dearth of close relationships (Choi, Ransom, & Wyllie, 2008; Dixon et al., 2016; Hyer, Carpenter, Bishmann, & Wu, 2005; Zeiss, 2005). In this current study, companionship is referred to as a shared leisure activity that was undertaken primarily for the intrinsic goal of enjoyment, such as a feeling of closeness with PARO. This involves PARO being there, people wanting PARO to be there to enjoy its company and so develop a relationship naturally. PARO, which behaves like a pet by encouraging interaction and engagement, delivers companionship and affection to individuals (Wada et al., 2005). PARO, as an intervention, alleviates depression and improves well-being by helping older adults feel relaxed and comfortable, and these are findings supported by both the quantitative and qualitative results in this current study. As PARO has a function of psychological enrichment, it can be utilised as a means of psychosocial support for users.

The qualitative findings indicated that PARO could comfort participants through companionship and help them experience a more meaningful life in LTC, as PARO blended into their daily routines and played an important and varied role in sustaining emotional well-being. Therefore, companionship through using a PARO to improve well-being is acknowledged by older adults with depression living in LTC facilities and is consistent with earlier findings whereby the use of social robots was found to assist in overcoming feelings of loneliness and social isolation in older adults (Banks et al., 2008;
Robinson et al., 2013), and was found to be as effective a companion as a pet (Abdi et al., 2018). As a consequence, the PARO companion intervention might be an appropriate strategy for treating depression in older adults in LTC. Social robots such as PARO are useful in encouraging people to interact with each other, and they initiate a calming effect on mood and provide companionship, motivation, and enjoyment.

In summary, both quantitative and qualitative results could support the conceptual framework, biopsychosocial model, which was adopted in the current study reflecting that PARO has the potential to reduce depression, loneliness, and improve QOL through psychological and social approaches.

6.7 The influential factors related to use of PARO for older adults

The social robot, PARO, offers a technological support for psychological care and managing difficult behavioural symptoms. However, the participant-PARO interaction varied in this study and was influenced by a range of factors, including individual personal experiences, and attitudes towards animals and gender. The qualitative findings of this study found that an individual’s previous experience with animals could influence their attitude towards, and interaction with, PARO. One participant feared dogs due to a negative experience in her childhood. For this reason, she hesitated to interact with PARO during the introduction. Furthermore, the qualitative findings showed that personal preferences also affected participants’ interaction with PARO. A participant said she did not like to interact directly with an animal, but she could stay with, and talk to, a PARO. These are in line with the findings of a previous study by Shibata (2012), which posited that the person’s biography, attitudes and past experiences with might influence the reception towards and uptake of PARO for people with dementia.
Gender also plays a role in terms of reactions towards a robot. It was noted that a number of male participants experienced difficulties forming a relationship or connection with PARO, as they did not perceive any benefit from it and were embarrassed about interacting with PARO in front of others. These findings are in accordance with previous studies indicating that men seem to respond less positively to social robots (Thodberg et al., 2016b; Wada, Shibata, Musha, & Kimura, 2008; Wada et al., 2005). A possible explanation for this might be related to perceived cultural roles associated with being a male. Male participants may think that interaction with PARO might represent infantilisation and emotionality, which often are not considered to be masculine features. However, the findings to date are mixed, as a recent descriptive qualitative study reported that male residents had a positive response to PARO (Moyle et al., 2018).

According to the qualitative results, there is likely no cultural difference in the ways PARO is used by older adults. In this study, PARO became a common topic of conversation among the participants, family members, and care staff in LTC. Participants treated PARO as a companion and interacted with it by touching and stroking it, and they greeted PARO while smiling and calling out the name they had given it. These behavioural findings of social interaction between participants and PARO were congruent with those of previous studies that were conducted in Asia, such as Japan (Shibata, Wada, Saito, & Tanie, 2008; Wada et al., 2005), as well as in Western countries, such as Australia (Moyle et al., 2019a), Denmark (Thodberg et al., 2016b), New Zealand (Robinson et al., 2013), Norway (Jøranson et al., 2016b), and the USA (Petersen et al., 2017).

A prior single survey study of users’ subjective evaluation of PARO was carried out in seven countries (i.e. Brunei, Italy, Japan, South Korea, Sweden, and the UK) by Shibata, the developer of PARO, and his colleagues (2009). The results were comparable across
the seven counties. The principal component analysis was carried out to extract factors from a 13-item questionnaire. One factor, that is “comfortable feeling like interacting with real animals”, was highly evaluated by respondents from the UK, Sweden and Italy while another factor, “favourable impression to encourage interaction”, was highly evaluated by respondents from Japan and South Korea. The results posited that the subjective evaluation of the social robot may, to a degree, be influenced by cultural differences concerning attitudes towards animals, for example, and the extent to which an individual is comfortable with interacting with real animals (Shibata et al., 2009). Another cross-cultural study investigated three different nationalities of university students (i.e. Dutch, Chinese, and Japanese) and their negative attitudes toward robots. The results showed that the Dutch and Chinese participants rated lower scores in attitude towards the social influence of robot than the Japanese, indicating that negative attitudes were significantly influenced by participants’ cultural backgrounds (Bartneck, Nomura, Kanda, Suzuki, & Kennsuke, 2005).

While it appears that an individual’s attitude towards a robot can be influenced by cultural elements, there have been few empirical investigations into the influence of cultural backgrounds on the implementation of social robot interventions. Thus, future research should examine the issue of cultural differences in the implementation of social robots in care practices.

6.8 Methodological issues

6.8.1 Research design

A mixed methods approach was adopted in this current study. This approach collected quantitative and qualitative data to illustrate representation of the phenomenon of a social
robot intervention for depressed older adults living in LTC. The main design in the mixed methods experimental study is a one-group repeated measures experiment and the qualitative data is added as a secondary component to this design after the intervention to enrich the experimental findings according to the study purpose. This study did not recruit a control group due to the challenges of recruitment of an adequate sample of depressed older adults in the same facility and to avoid experiment/control group participants inter-contaminant within the same facility. Knapp (2016) claimed that uncontrolled matters was a weak design for testing the effect of an independent variable (X) on a dependent variable (Y) that is measured at Time 1 and Time 2 and affected causal interpretability. An uncontrolled design means that changes in depression, loneliness, and quality of life could be due to history (an intervening event) and/or demand characteristics (Knapp, 2016). For example, participants’ may report better functioning at least in part because they believe that this is what the experimenters want. In order to resolve this issue, a two-stage (observation stage and intervention stage) design was used in this study. As participants were his/her own control, two stages of design were used to compare the relationship of target variables. Although the one-group experimental design has some limitations, this design continues to be used in clinical research for several reasons. For example, some clinical studies are difficult to conduct random assignment to an experimental or control group for practical or ethical reasons. In addition, as this study was an eight week 24-hour PARO intervention for older adults with depression, the use of this design was considered as a pilot effort for future studies in the field of mental health. Therefore, in a future study a randomized controlled trial is needed to determine the psychological effect of the intervention.
6.8.2 Instrument issues

A review by Balsamo and colleagues (2018) stated that the GDS-SF (Yesavage & Sheikh, 1986) is the preferred instrument to assess the severity of depression for cognitively intact or mildly cognitively impaired people over 65 years. The GDS-SF has been found to be reliable and valid for use with older medically ill outpatients and hospitalised older people (Dennis, Kadri, & Coffey, 2012). However, the self-reported instrument has its limitations, such as being susceptible to response bias and misinterpretation due to ambiguous language (Balsamo et al., 2018). For example: Item 5: Are you in good spirits most of the time? and Item 13: Do you feel full of energy? Terms such as "good spirits" and "energy" may not be fully understood or interpreted in the same manner by older adults. Moreover, due to the constrained care environment and shortage of care staff in LTC facilities, most older adults are unable to go out independently or engage in new activities without the assistance of others. This situation can lead to negative responses to certain questions in the GDS-SF, such as Item 9: Do you prefer to stay at home, rather than going out and doing new things?

In addition, since the instruments used in this current study (i.e. GDS-SF and UCLA-3 & WHOQOL-OLD) were initially constructed based on a Western conceptualisation of depression and illness, the translation of the instruments from one language to another can reduce the content validity and generate conceptualisation errors in meaning as well as the measurement of the selected variables (Esposito, 2001). It is possible then that the instruments were not appropriate for users in other ethnic populations. In this study, not only did the PhD student assist participants in their interpretation of the questions during the administering of the instruments, the reliability coefficient was low in the Chinese version of the GDS-SF and the UCLA-3, with a respective Cronbach’s alpha of .45
and .56. A possible explanation for this may be the lack of a sufficient sample size (Bujang, Omar, & Baharum, 2018). Nevertheless, the Chinese version of the GDS-SF, UCLA-3, and WHOQOL-OLD provided acceptable reliability and validity in other Chinese population studies (Chou et al., 2005; Lee et al., 1993; Yao & Chien, 2013a), and these were described in Chapter 4.

### 6.8.3 Intervention

The novelty effect of an intervention has the potential to influence participants (Shadish et al., 2002). In this intervention some of the older adults initially showed enthusiasm in their interaction with PARO for the first two weeks, and then showed a slightly decreased interest in interacting with PARO in the following weeks. This phenomenon was similar to the study of Moyle et al. (2017), who conducted a cluster-randomised controlled trial with three-groups (Paro group, plush toy group, usual care group) in 28 nursing homes in Queensland, Australia over 10 weeks. The results demonstrated that participants presented a gradual reduction in the level of positive behavioural engagement in both the PARO and plush toy groups. However, in our study, with exposure, most participants increased engagement with PARO, but some of them presented a fluctuation in their interest of interaction with PARO. Nonetheless, a low level of interest in PARO largely dissipated in week seven to eight due to the anticipated date of the PARO intervention termination. Conversely, participants increased their interaction with PARO during the last two weeks. Interventions in LTC will most likely have an influence during the initial weeks, and motivation to participate may decline over the course of the study due to the age of participants (Peels et al., 2020).

These study findings raise the question of whether a longer-term non-facilitated individual intervention is appropriate for older adults with depression due to the
symptoms of depression such as apathy. Future research might look at rigorous research methods such as RCT using small group activities. Although PARO group activities are not recommended with people with dementia to date there is no evidence of PARO group activities not being appropriate for people with depression.

6.9 Ethical dilemmas

The use of social robots in clinical practise or research with a vulnerable population requires a cautious benefit or risk assessment and careful consideration of ethical issues (Slaughter, Cole, Jennings, & Reimer, 2007). The literature on ethical issues regarding the use of social robots in aged care puts forward different perspectives. Some scholars hold optimistic views about how social robots can resolve challenges related to the growing gap between increasing numbers of older adults who need aged-care services and the shortage of care staff (Vandemeulebroucke, Dierckx de Casterlé, & Gastmans, 2018). On the other hand, other researchers express the view that the use of social robots involves deceiving older adults, particularly people with dementia, and therefore is unethical (Calo, Hunt-Bull, Lewis, & Metzler, 2011; Misselhorn, Pompe, & Stapleton, 2013). The ethical arguments regarding the use of social robots in aged-care settings are diverse and diametrically opposed; therefore, this particular aspect of the use of social robots is addressed in the following section.

An ethical dilemma that arose from the current research is associated with potential adverse reactions among participants following the removal of PARO at the end of the intervention. Withdrawal of a pleasant activity from older people in LTC can cause displeasure and lead to adverse reactions or outcomes. In this study, the qualitative findings indicated that an increased feeling of companionship leads to more negative reactions being noted at the time of disengagement from PARO. The qualitative results
demonstrated that the companionship, which developed between older adults and PARO in this study, was an important mediator to improve mood for this population. Given that PARO is specifically designed for the purpose of companionship, people are likely to develop an emotional affinity toward it (Bemelmans et al., 2012). This study involved a 24-hour PARO intervention for eight weeks and provided sufficient time and opportunity for older people with depression to interact with PARO. Many participants reported that they had established a good relationship with PARO and perceived benefits from it as a companion. This can happen when an intervention involves an object to which a person becomes attached and feels a sense of ownership (Moyle et al., 2019b). Consequently, a question was raised through this study as to whether participants, who formed a close relationship or found companionship with PARO, would be more likely to experience separation anxiety following the removal of the social robot. For instance, two participants reported negative experiences such as sleep disturbance and disappointment following the removal of the PARO, even though the standard procedures of the removal of PARO were administered to manage those reactions of disengagement, such as preparation and warning about the removal of PARO one week before, frequent observations of participants' mood by care staff, and by having the researcher provide companionship after the intervention or the provision of a stuffed toy. Similar negative reactions were found in previous studies following the use of social robots among people with dementia, who expressed displeasure and distress after the removal of PARO (Liang et al., 2017; Moyle et al., 2019b). From this perspective, it is suggested that observation and assessment of the companionship or attachment to PARO is an important indicator to predict the negative effect of removal of the social robot. In addition, a companionship scale for artificial pets (Luh, Li, & Kao, 2014) and the Pet Attachment Questionnaire (Zilcha-Mano, Mikulincer, & Shaver, 2011) could be used to assess the level of
companionship and attachment with PARO. Therefore, these factors should be taken into consideration in future intervention studies involving social robots.

6.10 Research strengths and limitations

6.10.1 Research strengths

There are several research strengths in this current study. First, the breadth and depth of data gained was an advantage of the mixed methods design used in this study, which led to an understanding and corroboration from both the quantitative and qualitative approaches. The data collected is normally richer, and of greater depth, than those found through randomised controlled trial designs. A qualitative design produces a more nuanced picture (Polit & Beck, 2004), in addition to also describing the content of conversations among participants, which were analysed and produced other insights in this study. The qualitative findings were interpreted in conjunction with the quantitative results to understand the effects of PARO, as well as the experiences and perceptions of PARO use among older adult participants with depression. This interpretation helped to gain an understanding of why depression may be alleviated by participation in a PARO intervention. For example, in this current study, the results drawn from the qualitative approach indicated that naming the robot, and increasing social interaction and companionship, were important factors in alleviating depression and improving well-being for older adults with depression. The qualitative results also provided an understanding of the variables, such as humanising PARO, increasing interaction with PARO, and companionship, that contribute to the mental health of the cohort. Furthermore, these qualitative results also supported the quantitative results, which showed significant changes in depression and well-being in older adults with depression in LTC.
Second, a quasi-experimental approach was used as the design is more practical and feasible to conduct research in clinical settings. This design is often integrated with individual case studies in which the results generated allow for the reinforcement of findings, and permit the statistical analysis to be conducted. Utilising quasi-experimental approaches can minimise threats to ecological validity, since natural environments do not generate the same problems of artificiality when compared to a well-controlled laboratory. As a result, this allows researchers to evaluate the impact of the independent variables under naturally occurring conditions. Given that participants were their own control, the observation and intervention stages were designed to investigate changes in depression and well-being among individual participants. This design could maintain internal validity due to a reduction in individual differences, but it reduced external validity due to the small sample size. The mixed methods experimental study was deemed as the most appropriate design to collect sufficient and saturated data from both quantitative and qualitative approaches to answer the research questions. Given that quasi-experiments are natural experiments, findings from the research can be applied to other populations and settings, so limited generalisations can be made about the population. These results provided evidence that a randomised controlled trial could be undertaken in a future study. It can also help researchers adapt ideas and produce novel hypotheses that can be used for future testing.

Finally, this research was the first study known to employ a 24-hour PARO intervention in older adults with depression. It showed significant effects on mental health and confirmed the feasibility of the implementation of PARO in aged mental health practice. As there is very little research on this specific topic in older adults with depression, this study provides new insights and evidence to implement a social robot.
intervention for older people with mental illness. The research outcomes not only provided the theoretical foundations of the use of PARO in depression and well-being among older adults with depression for further studies, but also filled the gaps in the knowledge and highlighted the need for further development in this area of study.

6.10.2 Research limitations

There are some limitations in this current study. First, the study had a small sample size of a specific population and the majority of the participants were female. This limits the extent to which these findings can be generalised to other older adults with depression living in LTC facilities. Caution is needed when generalising results beyond the sample in this study due to the specific population of the study.

Second, due to recruitment, time constraints, budget and human resource limitations inherent in a doctoral study, the conduct of a full-scale study with a large sample size or the assessment of long-term or sustained effects were not possible. For instance, it took the PhD student 12 months to complete the data collection for both phases: four months for phase one (online survey) and ten months for phase two (PARO intervention). This impeded the researcher's ability to determine the sustained effects over time with the 24-hour use of PARO.

Third, the 24-hour PARO intervention lasted for eight weeks, but participants used the PARO for varying amounts of time. There were difficulties in recording the amount of time participants spent interacting with PARO within a 24-hour time period, due to a lack of human resources and the lack of an inbuilt function in PARO to record interaction time. Therefore, it is conceivable that the amount of time interacting with a PARO might be a mediator that impacts the outcome of the intervention.
Fourth, there was no follow-up assessment after the end of the PARO intervention; hence, uncertainty remains as to whether PARO has sustained effects on depression and loneliness. Findings of a cluster RCT in Norway (Jøranson et al., 2015) demonstrated no immediate effect of a PARO intervention in decreasing depression but interestingly found a significant sustained effect on depression three months after the PARO intervention was withdrawn. In contrast, studies by both Moyle et al. (2017) and Liang et al. (2017) found no evidence of longer-term sustained effects of PARO on mood improvements post-intervention. Furthermore, while PARO interactions can positively reduce loneliness (Robinson et al., 2013), there is a lack of studies to assess the longer-term sustained effects of PARO on loneliness. Further research is thus needed to determine the sustained effects of PARO interventions on depression, mood, and loneliness.

Finally, given that the current study was a pilot, and focused on data- and information-generation, it did not compare changes in participants’ psychological responses against a comparison or control condition. Thus, the cause and effect cannot be robustly established in this study and a randomised controlled trial is needed to determine the psychological effect of a 24-hour PARO intervention. Even though the study has some limitations, the mixed methods study investigating the effect of an eight-week 24-hour PARO intervention brought forth information-rich data, enabling in-depth knowledge about changes in depression and well-being for older adults after they had participated in this study.

### 6.11 Summary of the chapter

This chapter has discussed the findings of the validity and reliability of the ATTUSR-C, the investigation of the attitudes of health personnel working in LTC towards the use of
social robots, and the effects of the 24-hour PARO intervention on depression, loneliness, and quality of life and participants’ experiences and perceptions during the intervention. From the online survey, the Chinese version of the ATTUSR obtained good reliability and validity among health personnel in aged care facilities. In addition, the findings of the online survey provides new evidence to support that health personnel perceived that social robots were able to increase productivity and efficiency when providing care for older people. A future study to assess health personnel’s attitudes toward social robots could offer new insights for healthcare organizations such as hospitals, as well as for robot designers and policymakers.

The mixed methods experimental design was comprised of a single group, quasi-experimental approach and an interview conducted in LTC in southern Taiwan. The quantitative results showed significant reductions in depression and feelings of loneliness, and improved quality of life for older adults with depression following participation in the PARO intervention. Qualitative findings identified that humanising PARO by participants’ references to personal experiences and engagement, increased social interaction with other people through the use of PARO. Furthermore, companionship was one of the key factors, which influenced mood and resulted in improved mental well-being. Nonetheless, the study had a small sample size of a specific population and the majority of the participants were female; thus, caution is needed when generalising the results. In addition, since there was no follow-up assessment after the end of the PARO intervention, whether sustained effects of the PARO intervention on depression and loneliness remains an uncertainty. Further research is thus needed to examine the sustained effects of PARO interventions on depression and loneliness.
Chapter 7 Conclusions and Recommendations

7.1 Introduction

In this final chapter, an overview of the study and conclusions are illustrated. Furthermore, recommendations for clinical practice, research, and nursing education are presented. Finally, a summary of the chapter is presented.

7.2 Overview of study

This study aimed to examine the impact of a PARO intervention on depression and well-being in older adults in long-term care in Southern Taiwan. The biopsychosocial model (Engel, 1977) was adapted as the conceptual framework in this current study. A systematic review was used to investigate current knowledge of the effect of social robot interventions for depression in older adults. In addition, a cross-sectional design was used to conduct an online survey, which aimed to modify, translate, and validate the Chinese version of Attitudes Towards the Use of Social Robot (ATTUSR-C) questionnaire for use with Taiwanese health personnel, and investigate the attitudes of Taiwanese health personnel working in LTC facilities towards the use of social robots for older adults. Finally, a mixed-methods study with a single group, before and after quasi-experimental design were used to examine the effect of an eight week 24-hour PARO intervention on depression and well-being in older adults in LTC facilities in Taiwan and explore participants’ experiences and perceptions following participation in the intervention.

7.3 Conclusions drawn from the study

Conclusions of the study are presented as follows:
1. The systematic review results highlight that social robot interventions have the potential to reduce the level of depression. The evidence obtained is helpful but cannot be considered strong enough to form a sufficient foundation to formulate recommendations on the clinical effectiveness of social robot interventions on depression for older people.

2. From the outcomes of the modification, translation and validation of the ATTUSR-C questionnaire, the internal consistency of the ATTUSR-C questionnaire was established with a Cronbach’s alpha of .84. The results indicated that the ATTUSR-C questionnaire is a reliable and valid instrument for evaluating the acceptability of social robots for health personnel working in LTC facilities.

3. The ATTUSR-C questionnaire can be used to assess health personnel’s attitudes towards social robots to improve an understanding of the implementation of social robots in the health setting. Due to the limited number of questionnaires available that assess the attitudes of health personnel to social robots, the ATTUSR-C questionnaire could also be used as an index to compare attitudes relating to the usefulness and appropriateness of different types of social robots.

4. The results of the online survey report that health personnel generally possess positive attitudes towards the use of social robots for older adults in LTC. They agree/strongly agree that using social robots in health/nursing care practice could be beneficial for society as social robots can help both health personnel and older adults living in LTC.

5. Health personnel reported that social robots could assist them in achieving their
care objectives in supporting daily activities, resolving difficulties in less time, increasing treatment efficacy, and making the care work more interesting during the care process.

6. The findings of this mixed methods experimental study provided new insights into the PARO intervention in geriatric depression in LTC. The quantitative results indicated that a PARO intervention has the potential to alleviate depression and loneliness and improve the quality of life for older adults living in a LTC facility. In addition, according to the qualitative findings, humanising the PARO by giving it a meaningful name was an important factor in initiating engagement with it. Moreover, PARO can be raised as a topic of conversation or can function as an icebreaker to improve social interaction and communication in a constrained environment. As a consequence, these results indicated that interaction with PARO could also improve quality of life for older adults with depression.

7. Using PARO for companionship might be a key factor in decreasing depression and loneliness as it provided comfort and calming effects for older adults with depression in this study. This study, which was the first study known to utilise a 24-hour PARO intervention in older adults with depression, revealed promising effects on mental well-being and confirmed the feasibility of the implementation of PARO in aged-care settings. As a result, the research outcomes of this study provided the theoretical foundations for the use of PARO in older adults with depression for further studies; it filled gaps in knowledge and presented the need for further development in this area. However, with a small sample size, caution is raised, as the findings may not be generalisable to other populations. Therefore, a randomised clinical trial with a larger sample size is recommended to establish
evidence-based research on the subject in the future.

8. Given that there was no follow-up assessment after the termination of the PARO intervention, uncertainty remains as to whether PARO has sustained effects on depression and loneliness. Further research is thus essential to determine the sustained effects of PARO intervention on depression, mood, and loneliness.

In summary, the results of the online survey study found that positive attitudes towards the use of social robots could increase health personnel’s acceptance and utilisation of this technology in LTC. This study endeavors to support nursing work by providing understandings into health personnel’s perceptions of social robots to integrate social robots into the care and lives of older adults. The PARO intervention had significant effects as a psychosocial intervention with the purpose of improving mental well-being in older adults with depression. Furthermore, older adults indicated positive experiences with PARO and mood improvement during the intervention. The findings provide a sound foundation for meaningful future research.

7.4 Recommendations

This current study significantly contributes to the body of knowledge regarding provider awareness of evidence-based results of PARO intervention in managing depressive symptoms among older adults living in LTC. The following section discusses the implications of the research in relation to recommendations for clinical practice, research, and education.

7.4.1 Recommendations for clinical practice

Based on both quantitative and qualitative findings, a 24-hour PARO intervention
has promising effects on mood improvement for older adults with depression. These findings contribute to clinical practice, as they show PARO can provide calming effects and buffer stress through companionship. Mental health guidelines advocate the application of multi-component psychosocial interventions, coupled with individualised support in managing depressive symptoms among older adults (Forsman et al., 2011a). A number of psychosocial interventions, such as music therapy, animal assisted therapy, and reminiscence therapy, have shown efficacy for managing depressive symptoms in this population group. As significant improvements in mental well-being were noted in this study, there may be advantages to delivering a PARO intervention in conjunction with a suite of other psychological interventions, or as an individualised PARO intervention. Furthermore, a person-centred approach to care planning is one of the best clinical practice guidelines, which is recommended for older people living with a mental disorder in LTC facilities or hospitals (Delaney, 2018). Thus, clinicians and care workers should select the most appropriate psychosocial intervention for older adults with depression according to their needs, preferences, skills, and abilities. Furthermore, before conducting a social robot intervention such as PARO, it is crucial to understand older adults’ experiences, preferences, and traits, as these are indications of whether they will accept such an intervention. In addition, pertinent training for care staff in the use of PARO is vital in clinical practice, since it influences the effectiveness of a social robot intervention for older adults in LTC.

### 7.4.2 Recommendations for research

There are some limitations in this study, which were discussed in Chapter 6. However, the study findings do make clear contributions for the development of a social robot intervention in the mental health field and they also raise many additional questions,
which can be addressed in future research. Therefore, it is recommended that future research efforts clarify (a) how a 24-hour PARO intervention may be optimised for symptom management; (b) how a PARO intervention can best serve older adults with depression along with a geriatric depression treatment trajectory; (c) what unique contributions a PARO intervention could add to the care of older adults with depression living in LTC facilities, and (d) what is the mediating role of companionship in identifying the mechanism that underlies an observed relationship between an independent variable (i.e. PARO) and a dependent variable (depression or loneliness), via the inclusion of a third hypothetical variable (companionship).

LTC facilities often have limited funding and staff resources, and this may impede the introduction of an individual and innovative intervention for older adults. Therefore, an individualised 24-hour PARO intervention may be the most feasible approach for older adults to experience, enjoy, become fascinated by, and comforted by PARO. These recommendations support those of Moyle et al. (Moyle et al., 2019b; 2017b), who stressed the importance of individualised interactions with PARO, as well as the impact of effective interactions on mood improvement, for extending this area of social robot research. Although the 24/7 PARO intervention resulted in immediate positive impact on depression, loneliness, and quality of life in older adults with depression, there was a lack of evidence regarding any sustainable and long-term effects once the PARO was removed. Therefore, it is important to consider whether there is the potential for the level of depression to increase after the removal of PARO. Any future studies should take this into account.

The small sample size is another potential limitation for generalising results and determining the cause and effect relationship (Tipton, Hallberg, Hedges, & Chan, 2017).
between the PARO intervention and the reduction in depression and loneliness. Therefore, a randomised controlled trial with a large sample size is recommended for future studies. The results of this current study can be utilised to determine the power and estimate the appropriate sample size for future studies (Moore, Carter, Nietert, & Stewart, 2011).

Further robot advancements could also progress social robot capacities beyond limited tasks or services. For example, robot vision or computer vision can reganised faces, movements, and activities and detect changes in physiological arousal and emotions (Voulodimos, Doulamis, Doulamis & Protopapadakis, 2018; Tarnowski, Kolodziej, Majkowski & Rak, 2017). Artificial intelligent designers may integrate or develop these functions, which Implant in a social robot. Consequently, future healthcare studies can focus on these kinds of social robots to investigate its effectiveness for older adults.

7.4.3 Recommendations for nursing education

The current study also makes recommendations concerning nursing education. As advances in technology transform the way nurses deliver patient care, it is important for nurse educators to keep pace with rapid changes in healthcare technology, which are designed to provide support, safety, and companionship and ultimately to improve patient outcomes. Although the use of a social robot has shown promising effects for people with dementia and its use is increasing in LTC settings (Bemelmans et al., 2012; Chen et al., 2018; Pu et al., 2019), the use of this technology is not common for people with a mental disorder. In addition, there is a paucity of social robot education. To date, there is little formal nurse education and few training programs that include social robot care for health professionals, therefore some nurses may lack the skills and confidence to implement social robots for patient use. Thus, improving nursing education concerning the use of
social robots and training nurses in how to provide companionship and psychosocial support through social robots, such as PARO, is an important aspect of nursing education and preparation in the future. Accordingly, there is a need to develop an educational support program for mental health and aged-care nurses, starting from types of social robots, functions, and benefits, to how to use a social robot in nursing practice. Hence, there is a need to educate nursing students about social robots for managing psychological distress, such as depression, in patient care plans.

In addition, compared to the industrial robotic ecosystem, the ecosystem for social robots is still uneven in nursing education. There are common subjects related to robot for designers, manufacturers and traders but social robot education is not yet a common subject in the curricula of healthcare studies in universities (Vänni & Salin, 2019). Courses for healthcare students, which focus on the implementation, usage, and development of social robots from the employees’ and the end-users’ points of view are rare. In Europe, an increase in productivity in the healthcare field demands that graduate students are familiar with social robots and application areas (Vänni, 2017; Vänni & Salin, 2017). In addition, healthcare workers may need vocational or extra courses on implementing and using social robots at work (Diep et al., 2015; Vänni & Salin, 2017, Vänni, Cabibihan, & Salin, 2018). Therefore, it is imperative that provides robot care courses in all healthcare fields is an inevitable consequence in the future.

7.5 Summary of the chapter

This chapter presented the conclusions and recommendations of this study. It consisted of an overview of the study, methods, major findings, and recommendations for clinical practice, research, and nursing education. This study is the first study to employ a 24-hour PARO intervention among older adults with depression in LTC facilities. The results
of the online survey study found that positive attitudes towards the use of social robots could increase health personnel’s acceptance and utilisation of this technology in LTC. This study strives to support nursing work by providing insights into health personnel’s perceptions of social robots to integrate social robots into the care and lives of older adults. Results from the mixed methods experimental design provided valuable information regarding the design and implementation of a 24-hour PARO intervention for use in older adults with depression in LTC facilities to help ameliorate their mental well-being. Both quantitative and qualitative approaches provide a number of unique contributions that help gain an understanding of the effects of the intervention on depression and well-being for older adults with depression. The findings provide a sound foundation for meaningful future research.
Appendices

Appendix A: Questionnaire translation information sheet for experts

Chinese translation of the attitude towards the use of social robots questionnaire

INFORMATION SHEET

Research Team

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<thead>
<tr>
<th>Principal Investigator</th>
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<td>College of Medicine,</td>
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<td>Outcomes, Griffith University</td>
<td>Health Outcomes,</td>
<td>National Cheng Kung</td>
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<td>ext.5845</td>
<td>Email: shu-chuan.chen</td>
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<td></td>
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Why is the research being conducted?

Evidence has shown that healthcare professionals and patients with positive attitudes towards using social robots are most likely to adopt and accept social robots. Therefore, it is essential to understand the attitudes of healthcare professionals toward social robots because their attitudes will determine the success or failure of the implementation of social robots in aged care settings. While Costescu and David (2014) have developed an English scale to examine “the attitude towards using social robots in mental health questionnaire”, there is no scale available in the Chinese language to examine Taiwanese healthcare professionals’ attitudes towards social robots in aged care. The purpose of this
research is to translate the questionnaire of attitudes towards social robots into Mandarin and to evaluate the reliability and validity of the questionnaire with health professionals in Taiwan. We believe that this questionnaire could be a useful instrument in aged care settings in the future study.

**What you will be asked to do**

If you agree to take part in this research, you will be asked to evaluate the content validity of the Chinese questionnaire. You will be asked to evaluate the validity of the Chinese version in terms of appropriateness, clarity, and readability using the 4-point Likert scale. The evaluation will take you approximately 50 minutes to complete.

**The basis by which participants will be selected or screened**

You are selected to participate in this research because you are as an expert in the field of aged care or mental health nursing in Taiwan.

**The expected benefits of the research**

You may not directly benefit from this research; however, we hope that your participation in the research may help to establish the validity of the Chinese questionnaire. This information may improve the positive introduction of technologies and psychological well-being of older adults in long-term care in the future.

**Risks to you**

We believe there are no known risks associated with this research as anonymous data collection will be used in this survey.

**Your confidentiality**
Anonymous data collection will be used in this online survey. Survey responses will be stored in a computer file with password protection for 5 years and will only be accessible by members of the research team. Only group results will be published. Your anonymous data may be used in future studies similar to this one.

**Your participation is voluntary**

Your participation in this study is completely voluntary and you can withdraw at any time. Although we are interested in all of your answers you are free to skip any question that you choose not to answer.

**Mechanism for distribution and return / Web backend**

The experts will be recruited via word of mouth from colleagues in Taiwan. The experts will be sent an email requesting their support that they can decide whether to respond directly to. If experts are willing to participate in this study, The student researcher will send to them an email containing information about the study, an invitation to participate, and the questionnaire. The experts’ responses will return to Griffith University when they reply their responses and data will be stored in a database at the Griffith University.

**Questions / further information**

If you have any questions about this study, please do not hesitate to contact Shu-Chuan Chen on 886-6-2110600 ext. 707 (Taiwan) or +61-0488488180 (Australia) or shuchuan.chen@griffithuni.edu.au.

**The ethical conduct of this research**

Alternately, if you have any concerns or complaints about any ethical conduct aspects of the research project, you may also contact the manager of Research Ethics at Griffith University on + 61 7 3735 4375 or research-ethics@griffith.edu.au. If you have any concerns or complaints about any ethical conduct aspects of the research project in
Mandarin, you may also contact the professor Jing-Jy Wang on +886-6-2353535 ext.5845 or ns127@mail.ncku.edu.tw.

**Feedback to you**

A summary report of the overall research findings will be made available to you at the completion of the study. If you are interested in the results of the research, you would welcome to email to the student researcher and make a requirement to receive a summary of the results.

**Dissemination of findings**

Results from this study will be published in a Griffith University PhD dissertation and peer-reviewed publications as well as disseminated at national and international academic conferences.

**Expressing consent – anonymous information**

Your responses will be confidential and we do not collect identifying information such as your name, email address or IP address. If you complete the survey, you will be deemed to have consented to your participation in this study.
Appendix B: Questionnaire translation consent form for experts

Chinese translation of the attitude towards the use of social robots questionnaire

CONSENT FORM

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By signing below, I confirm that I have read and understood the information package for this research and in particular:

- I understand that my involvement in an evaluation is to evaluate the validity of the Chinese version questionnaire in terms of appropriateness, clarity, and readability;
- I have had any questions answered to my satisfaction;
- I understand the risks involved;
- I understand that there will be no direct benefit to me from my participation in this research;
- I understand that my participation in this research is voluntary;
- I understand that if I have any additional questions I can contact the research team;
• I understand that I am free to withdraw at any time, without explanation or penalty;
• I understand that anonymous data collection will be used and my survey responses will be stored in a computer file with password protection for 5 years and only able to be accessed by members of the research team.
• I understand that only group results will be published.
• I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on +61 7 3735 4375 (or research-ethics @griffith.edu.au) or Jing-Jy Wang on +886-6-2353535 ext.5845 (or ns127@mail.ncku.edu.tw), if I have any concerns about the ethical conduct of the project; and

☐ I agree to participate in the research. Implied consent will be reflected via my completion and reply of the questionnaire.
Appendix C: Questionnaire translation information sheet for translators

Chinese translation of the attitude towards the use of social robots questionnaire

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QLD, 4111
Phone: +61 07 3735 5526
Email: w.moyle@griffith.edu.au |
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Menzies Health Institute,
Queensland-Optimising
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Griffith University
School of Nursing and
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in Taiwan. We believe that this questionnaire could be a useful instrument in aged care settings in the future study.

**What you will be asked to do**

If you agree to take part in this research, you will be asked to translate the questionnaire. You will be asked to translate the questionnaire from English into Chinese and/or from the Chinese into English. The translation will take you approximately 50 minutes to complete.

**The basis by which participants will be selected or screened**

You are selected to participate in this research because you are proficient in both English and Mandarin.

**The expected benefits of the research**

You may not directly benefit from this research; however, we hope that your participation in the research may help to establish the validity of the Chinese questionnaire. This information may improve the positive introduction of technologies and psychological well-being of older adults in long-term care in the future.

**Risks to you**

We believe there are no known risks associated with this research as anonymous data collection will be used in this survey.

**Your confidentiality**

Anonymous data collection will be used in this research. The questionnaire responses will be stored in a computer file with password protection for 5 years and will only be accessible by members of the research team. Only group results will be published. Your anonymous data may be used in future studies similar to this one.
Your participation is voluntary

Your participation in this study is completely voluntary and you can withdraw at any time. Although we are interested in all of your answers you are free to skip any question that you choose not to answer.

Mechanism for distribution and return / Web backend

The translators will be recruited via word of mouth by the student researcher. The student researcher will invite them to participate in this study. If translators are willing to participate in this study, the student researcher will send to participants an email containing information about the study, an invitation to participate, and the questionnaire. Your responses will return to Griffith University when you reply your responses and data will be stored in a database at the Griffith University.

Questions / further information

If you have any questions about this study, please do not hesitate to contact Shu-Chuan Chen on 886-6-2110600 ext. 707 (Taiwan) or +61-0488488180 (Australia) or shuchuan.chen@griffithuni.edu.au.

The ethical conduct of this research

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A summary report of the overall research findings will be made available to you at the completion of the study. If you are interested in the results of the research, you would
welcome to email to the student researcher and make a requirement to receive a summary of the results.

Dissemination of findings

Results from this study will be published in a Griffith University PhD dissertation and peer-reviewed publications as well as disseminated at national and international academic conferences.

Expressing consent – anonymous information

Your responses will be confidential and we do not collect identifying information such as your name, email address or IP address. If you complete the survey, you will be deemed to have consented to your participation in this study.
Appendix D: Questionnaire translation consent form for translators

Chinese translation of the attitude towards the use of social robots questionnaire

CONSENT FORM

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By signing below, I confirm that I have read and understood the information package for this research and in particular:

- I understand that my involvement in the research is to translate the questionnaire;
- I have had any questions answered to my satisfaction;
- I understand the risks involved;
- I understand that there will be no direct benefit to me from my participation in this research;
- I understand that my participation in this research is voluntary;
- I understand that if I have any additional questions I can contact the research team;
- I understand that I am free to withdraw at any time, without explanation or penalty;

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• I understand that anonymous data collection will be used and my survey responses will be stored in a computer file with password protection for 5 years and only able to be accessed by members of the research team.

• I understand that only group results will be published.

• I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on +61 7 3735 4375 (or research-ethics @griffith.edu.au) or Jing-Jy Wang on +886-6-2353535 ext.5845 (or ns127@mail.ncku.edu.tw), if I have any concerns about the ethical conduct of the project; and

☐ I agree to participate in the research. Implied consent will be reflected via my completion and reply of the questionnaire.
Appendix E: Questionnaire translation information sheet for clinical instructors

Chinese translation of the attitude towards the use of social robots questionnaire

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Why is the research being conducted?

Evidence has shown that healthcare professionals and patients with positive attitudes towards using social robots are most likely to adopt and accept social robots. Therefore, it is essential to understand the attitudes of healthcare professionals toward social robots because their attitudes will determine the success or failure of the implementation of social robots in aged care settings. While Costescu and David (2014) have developed an English scale to examine “the attitude towards using social robots in mental health questionnaire”, there is no scale available in the Chinese language to examine Taiwanese healthcare professionals’ attitudes towards social robots in aged care. The purpose of this research is to translate the questionnaire of attitudes towards social robots into Mandarin and to evaluate the reliability and validity of the questionnaire with health professionals.
in Taiwan. We believe that this questionnaire could be a useful instrument in aged care settings in the future study.

**What you will be asked to do**

If you agree to take part in this research, you will be asked to evaluate a questionnaire. You will be asked to specify which items you have difficulty in understanding or have questions about. The questionnaire will take you approximately 20 minutes to complete.

**The basis by which participants will be selected or screened**

You are selected to participate in this research because you are a clinical instructor nurse in the nursing college in Taiwan.

**The expected benefits of the research**

You may not directly benefit from this research; however, we hope that your participation in the research may help to establish the validity of the Chinese questionnaire. This information may improve the positive introduction of technologies and psychological well-being of older adults in long-term care in the future.

**Risks to you**

We believe there are no known risks associated with this research as anonymous data collection will be used in this survey.

**Your confidentiality**

Anonymous data collection will be used in this online survey. Survey responses will be stored in a computer file with password protection for 5 years and will only be accessible by members of the research team. Only group results will be published. Your anonymous data may be used in future studies similar to this one.
Your participation is voluntary

Your participation in this study is completely voluntary and you can withdraw at any time. Although we are interested in all of your answers you are free to skip any question that you choose not to answer.

Mechanism for distribution and return / Web backend

The student researcher will contact to administrator of the nursing college and invite to participate in this study. The email will be sent out to instructors by the nursing college administration asking them to contact with the student researcher if they are willing to participate in this study. The student researcher will send to all recruited participants an email containing information about the study, an invitation to participate, and the questionnaire. Your responses will return to Griffith University when you reply your responses and data will be stored in a database at the Griffith University.

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Chinese translation of the attitude towards the use of social robots questionnaire

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<td>Email: <a href="mailto:shu-chuan.chen@griffithuni.edu.au">shu-chuan.chen@griffithuni.edu.au</a></td>
<td>Email: <a href="mailto:shu-chuan.chen@griffithuni.edu.au">shu-chuan.chen@griffithuni.edu.au</a></td>
</tr>
</tbody>
</table>

By signing below, I confirm that I have read and understood the information package for this research and in particular:

- I understand that my involvement in an evaluation is to specify which items I have difficulty in understanding or have questions about;
- I have had any questions answered to my satisfaction;
- I understand the risks involved;
- I understand that there will be no direct benefit to me from my participation in this research;
- I understand that my participation in this research is voluntary;
- I understand that if I have any additional questions I can contact the research team;
- I understand that I am free to withdraw at any time, without explanation or penalty;

196
I understand that anonymous data collection will be used and my survey responses will be stored in a computer file with password protection for 5 years and only able to be accessed by members of the research team.

I understand that only group results will be published.

I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on +61 7 3735 4375 (or research-ethics @griffith.edu.au) or Jing-Jy Wang on +886-6-2353535 ext.5845 (or ns127@mail.ncku.edu.tw), if I have any concerns about the ethical conduct of the project; and

☐ I agree to participate in the research. Implied consent will be reflected via my completion and reply of the questionnaire.
Appendix G: Questionnaire translation information sheet: a pilot test

Chinese translation of the attitude towards the use of social robots questionnaire

INFORMATION SHEET

Research Team

<table>
<thead>
<tr>
<th>Principal Investigator</th>
<th>Co-Investigator</th>
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| **Professor Wendy Moyle**  
Program Director  
Menzies Health Institute, Queensland-Optimising Health Outcomes, Griffith University  
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Research Fellow  
Menzies Health Institute, Queensland-Optimising Health Outcomes, Griffith University  
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Email: c.jones@griffith.edu.au | **Professor Jing-Jy Wang**  
Director  
Department of Nursing, College of Medicine, National Cheng Kung University  
No.1, University Road, Tainan City 701, Taiwan  
Phone: +886-6-2353535 ext.5845  
Email: ns127@mail.ncku.edu.tw | **Ms Shu-Chuan Chen**  
PhD candidate  
Menzies Health Institute, Queensland-Optimising Health Outcomes, Griffith University  
School of Nursing and Midwifery  
Nathan Campus, 170 Kessels Road, Nathan, QLD, 4111  
Phone: +61 0488 488 180  
Email: shu-chuan.chen@griffithuni.edu.au |

Why is the research being conducted?

Evidence has shown that healthcare professionals and patients with positive attitudes towards using social robots are most likely to adopt and accept social robots. Therefore, it is essential to understand the attitudes of healthcare professionals toward social robots because their attitudes will determine the success or failure of the implementation of social robots in aged care settings. While Costescu and David (2014) have developed an English scale to examine “the attitude towards using social robots in mental health questionnaire”, there is no scale available in the Chinese language to examine Taiwanese healthcare professionals’ attitudes towards social robots in aged care. The purpose of this research is to translate the questionnaire of attitudes towards social robots into Mandarin and to evaluate the reliability and validity of the questionnaire with health professionals.
in Taiwan. We believe that this questionnaire could be a useful instrument in aged care settings in the future study.

**What you will be asked to do**

If you agree to take part in this research, you will be asked to complete a questionnaire. This questionnaire will ask about your views on using social robots in clinical care settings. The questionnaire will take you approximately 10 minutes to complete.

**The basis by which participants will be selected or screened**

You are selected to participate in this research because you are a registered nurse in a clinical setting in Taiwan. You do not need to have used a social robot to be involved in this research.

**The expected benefits of the research**

You may not directly benefit from this research; however, we hope that your participation in the research may help to establish the reliability of the Chinese questionnaire. This information may improve the positive introduction of technologies and psychological well-being of older adults in long-term care in the future.

**Risks to you**

We believe there are no known risks associated with this research as anonymous data collection will be used in this survey.

**Your confidentiality**

Anonymous data collection will be used in this online survey. Survey responses will be stored in a computer file with password protection for 5 years and will only be
accessible by members of the research team. Only group results will be published. Your anonymous data may be used in future studies similar to this one.

**Your participation is voluntary**

Your participation in this study is completely voluntary and you can withdraw at any time. Although we are interested in all of your answers you are free to skip any question that you choose not to answer.

**Mechanism for distribution and return / Web backend**

The student researcher will contact the organizer of the alumni who will invite all potential participants to participate in this study via an email and ask them to contact the student researcher if they are willing to participate in this study. The student researcher will send to all recruited participants an email containing information about the study, an invitation to participate, and the questionnaire. Your responses will return to Griffith University when you reply your responses and data will be stored in a database at the Griffith University. All data from the survey will be downloaded by the researcher and transferred into statistical software for analysis.

**Questions / further information**

If you have any questions about this study, please do not hesitate to contact Shu-Chuan Chen on 886-6-2110600 ext. 707 (Taiwan) or +61-0488488180 (Australia) or shuchuan.chen@griffithuni.edu.au.

**The ethical conduct of this research**

Alternately, if you have any concerns or complaints about any ethical conduct aspects of the research project, you may also contact the manager of Research Ethics at Griffith University on + 61 7 3735 4375 or research-ethics@griffith.edu.au. If you have any concerns or complaints about any ethical conduct aspects of the research project in
Mandarin, you may also contact the professor Jing-Jy Wang on +886-6-2353535 ext.5845 or ns127@mail.ncku.edu.tw.

**Feedback to you**

A summary report of the overall research findings will be made available to you at the completion of the study. If you are interested in the results of the research, you would welcome to email to the student researcher and make a requirement to receive a summary of the results.

**Dissemination of findings**

Results from this study will be published in a Griffith University PhD dissertation and peer-reviewed publications as well as disseminated at national and international academic conferences.

**Expressing consent – anonymous information**

Your responses will be confidential and we do not collect identifying information such as your name, email address or IP address. If you complete the survey, you will be deemed to have consented to your participation in this study.
Appendix H: Questionnaire translation consent form: a pilot test

Chinese translation of the attitude towards the use of social robots questionnaire

CONSENT FORM

Research Team

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<td>College of Medicine, National Cheng Kung University No.1, University Road, Tainan City 701, Taiwan Phone: +886-6-2353535 ext.5845 Email: <a href="mailto:ns127@mail.ncku.edu.tw">ns127@mail.ncku.edu.tw</a></td>
<td>School of Nursing and Midwifery, Nathan Campus, 170 Kessels Road, Nathan, QLD, 4111 Phone: +61 0488 488 180 Email: <a href="mailto:shn-chuan.chen@griffithuni.edu.au">shn-chuan.chen@griffithuni.edu.au</a></td>
</tr>
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</table>

By signing below, I confirm that I have read and understood the information package for this research and in particular:

- I understand that my involvement in an survey is to investigate my views about the use of social robots in long-term care facility;
- I have had any questions answered to my satisfaction;
- I understand the risks involved;
- I understand that there will be no direct benefit to me from my participation in this research;
- I understand that my participation in this research is voluntary;
- I understand that if I have any additional questions I can contact the research team;
- I understand that I am free to withdraw at any time, without explanation or penalty.
• I understand that anonymous data collection will be used and my survey responses will be stored in a computer file with password protection for 5 years and only able to be accessed by members of the research team.

• I understand that only group results will be published.

• I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on +61 7 3735 4375 (or research-ethics@griffith.edu.au) or Jing-Jy Wang on +886-6-2353535 ext.5845 (or ns127@mail.ncku.edu.tw). If I have any concerns about the ethical conduct of the project; and

☐ I agree to participate in the project. Implied consent will be reflected via my completion and reply of the survey.
Appendix I: Ethics approval_questionnaire of translation

RIMS Griffith
Fri 20/10/2017 10:22 AM

To: Szu-Chuan CHEN <shu-chuan.chen@griffithuni.edu.au>, Cindy Jones <C.Jones@griffith.edu.au>, Wendy Moyle <w.moyle@griffith.edu.au>;
cc: research-ethics <research-ethics@griffith.edu.au>;

Importance: High

GRiffth University Human Research Ethics Review

Dear Prof Wendy Moyle,

I write further to the additional information provided in relation to the provisional approval granted to your application for ethical clearance for your project “Chinese translation of the attitude towards the use of social robots questionnaire” (GU Ref No: 2017/819).

This is to confirm that this response has addressed the comments and concerns of the HREC. The ethics reviewers resolved to grant your application a clearance status of “Fully Approved”.

Consequently, you are authorised to immediately commence this research on this basis.

Regards

Kim Madison | Human Research Ethics

Office for Research
Griffith University | Nathan | QLD 4111 | Level 0, Bray Centre (N54)
T +61 7 373 58043 | email k.madison@griffith.edu.au
Health professionals’ and care workers’ views about social robots and their implementation in long-term care in Taiwan

Online Survey Information Sheet

<table>
<thead>
<tr>
<th>Principal Investigator</th>
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<tr>
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<td></td>
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</tr>
<tr>
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<td>Griffith University School of Nursing and Midwifery</td>
<td></td>
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</tr>
<tr>
<td>Nathan Campus, 170 Kessels Road, Nathan, QLD, 4111</td>
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</tr>
</tbody>
</table>

Why is the research being conducted?

The purpose of this research is to understand your views about the use of social robots in older adult care in Taiwan. We believe that this information may help in the provision of technology within aged care in the future.

What you will be asked to do

If you agree to take part in this research, you will be asked to complete an online survey. This survey will ask about your views on using social robots in long-term care settings. The questionnaire will take you approximately 10 minutes to complete.
The basis by which participants will be selected or screened

You were selected to participate in this research because you are working within a long-term care system in Taiwan and your current position is one of the following: registered nurse, occupational therapist, physiological therapist, social worker, psychologist, physician, psychiatrist, administrator, or a nursing aide. You do not need to have used a social robot to be involved in this research.

The expected benefits of the research

You may not directly benefit from this research; however, we hope that your participation in the research may help to improve the positive introduction of technologies and psychological well-being of older adults in long-term care.

Risks to you

We believe there are no known risks associated with this research as anonymous data collection will be used in this online survey.

Your confidentiality

Anonymous data collection will be used in this online survey. Survey responses will be stored in a computer file with password protection for 5 years and will only be accessible by members of the research team. Only group results will be published. Your anonymous data may be used in future studies similar to this one.

Your participation is voluntary

Your participation in this study is completely voluntary and you can withdraw at any time. Although we are interested in all of your answers you are free to skip any question that you choose not to answer.
Mechanism for distribution and return / Web backend

Nurses will be initially invited to participate in the online survey via an email from the Taiwan Council of Nursing and Aged Care. For all other participants, the researcher will contact managers of long-term care facilities who are either introduced by the Dean of the Council of Nursing and Aged Care or listed on Taiwanese long-term care websites. The managers will send an invitation and information email to care workers to contact the researcher. All potential participants will receive an email containing information about the study with a URL link to access the online survey three times during the data collection period. Your responses will return to Griffith University when you submit your responses and data will be stored in a database at the Griffith University survey centre. All data from the online survey will be downloaded by the researcher and transferred into statistical software for analysis.

Questions / further information

If you have any questions about this study, please do not hesitate to contact Shu-Chuan Chen on +886-6-2110600 ext. 707 (Taiwan) or +61-0488488180 (Australia) or shu-chuan.chen@griffithuni.edu.au.

The ethical conduct of this research

Alternately, if you have any concerns or complaints about any ethical conduct aspects of the research project, you may also contact the manager of Research Ethics at Griffith University on + 61 7 3735 4375 or research-ethics@griffith.edu.au. If you have any concerns or complaints about any ethical conduct aspects of the research project in Mandarin, you may also contact the professor Jing-Jy Wang on +886-6-2353535 ext.5845 or ns127@mail.ncku.edu.tw.

Feedback to you

A summary report of the overall research findings will be made available to you at the completion of the study. If you are interested in the results of the research, you would
welcome to email to the student researcher and make a requirement to receive a summary of the results.

**Dissemination of findings**

Results from this study will be published in a Griffith University PhD dissertation and peer-reviewed publications as well as disseminated at national and international academic conferences.

**Expressing consent – anonymous information**

Your responses will be confidential and we do not collect identifying information such as your name, email address or IP address. If you complete the survey, you will be deemed to have consented to your participation in this study.

**Privacy Statement - de-identified information**

The conduct of this research involves the collection, access and/or use of your identified personal information. The information collected is confidential and will not be disclosed to third parties without your consent, except to meet government, legal or other regulatory authority requirements. A de-identified copy of this data may be used for other research purposes including publishing openly (e.g. in an open access repository). However, your anonymity will at all times be safeguarded. For further information consult the University’s Privacy Plan at [http://www.griffith.edu.au/about-griffith/plans-publications/griffith-university-privacy-plan](http://www.griffith.edu.au/about-griffith/plans-publications/griffith-university-privacy-plan) or telephone +61 7 3735 4375.
Appendix K: Online survey consent form

Health professionals’ and care workers’ views about social robots and their implementation in long-term care in Taiwan

CONSENT FORM

Research Team

<table>
<thead>
<tr>
<th>Principal Investigator</th>
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Health Outcomes, Griffith University  
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Research Fellow  
Menzies Health Institute, Queensland-Optimising  
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Phone: +886-6-2353535 ext.5845  
Email: ns127@mail.ncku.edu.tw |

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Department of Nursing, College of Medicine, National Cheng Kung University  
No.1, University Road, Tainan City 701, Taiwan  
Phone: +886-6-2353535 ext.5845  
Email: ns127@mail.ncku.edu.tw | **Ms Shu-Chuan Chen**  
PhD candidate  
Menzies Health Institute, Queensland-Optimising Health Outcomes  
Griffith University  
School of Nursing and Midwifery  
Nathan Campus, 170 Kessels Road, Nathan, QLD, 4111  
Phone: +61 0488 488 180  
Email: shu-chuan.chen@griffithuni.edu.au |

GU ref no: 2017/824

By signing below, I confirm that I have read and understood the information package for this research and in particular:

- I understand that my involvement in an online survey is to investigate my views about the use of social robots in long-term care facility;
- I have had any questions answered to my satisfaction;
- I understand the risks involved;
- I understand that there will be no direct benefit to me from my participation in this research;
- I understand that my participation in this research is voluntary;
- I understand that if I have any additional questions I can contact the research team;
• I understand that I am free to withdraw at any time, without explanation or penalty;
• I understand that anonymous data collection will be used and my survey responses will be stored in a computer file with password protection for 5 years and only able to be accessed by members of the research team.
• I understand that only group results will be published.
• I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on 3735 4375 (or research-ethics@griffith.edu.au) or Jing-Jy Wang on +886-6-2353535 ext.5845 (or ns127@mail.ncku.edu.tw), if I have any concerns about the ethical conduct of the project; and

☐ I agree to participate in the project. Implied consent will be reflected via my completion and submission of the survey online.
Appendix L: Ethics approval_online survey

Full Research Ethics Clearance 2017/824

RIMS Griffith
Fri 20/10/2017 9:49 AM

to Shu-Chuan CHEN <shu-chuan.chen@griffithuni.edu.au>; Cindy Jones <C.Jones@griffith.edu.au>; Wendy Moyle <w.moyle@griffith.edu.au>; research-ethics <research-ethics@griffith.edu.au>

Importance: High

GRiffith University Human Research Ethics Review

Dear Prof Wendy Moyle

I write further to the additional information provided in relation to the provisional approval granted to you application for ethical clearance for your project "Health professionals’ and care workers’ views about social robots and their implementation in long-term care in Taiwan" (GU Ref No: 2017/824).

This is to confirm that this response has addressed the comments and concerns of the HREC.

The ethics reviewers resolved to grant your application a clearance status of "Fully Approved".

Consequently, you are authorised to immediately commence this research on this basis.

Regards

Kim Madison | Human Research Ethics

Office for Research
Griffith University | Nathan | QLD 4111 | Level 0, Bray Centre (N54)
T +61 7 373 58043 | email k.madison@griffith.edu.au
Appendix M: PARO intervention information sheet

Griffith University

The impact of a PARO intervention on depression and well-being in older adults in long-term care in Taiwan – A pilot study

INFORMATION SHEET
GU Ref No: 2017/911

Research Team

<table>
<thead>
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</tr>
</tbody>
</table>

Study Background

Studies have found that social robots have similar beneficial effects to live animals and these robots can elicit the same degree of attachment as a live animal. Many studies using a social robot such as PARO have shown that interaction with PARO improved residents’ mood and depression, encouraged their communication, and decreased their stress level. This study will provide relevant evidence and knowledge of the effectiveness of Paro in a Chinese cultural context. The aim of this study is to explore the effect of a social robot (PARO) intervention on depression and well-being in older adults living in long-term care.
(LTC) facilities. This research is being undertaken by Shu-Chuan Chen a PhD candidate from Griffith University in Queensland, Australia.

What participation will involve?

If you agree to participate in this study, you will be asked to sign a consent form. Your demographics and health information will be sought from your nursing home nursing/medical records. You will need to complete questionnaires to assess your depression, loneliness and quality of life four times: before you are given a PARO (week 0), week 8, week 12, and week 16. The questionnaire will take approximately 40–50 minutes to complete each time and the student researcher will assist you to complete the questionnaire. From week 9 to week 16, you will be given a social robot called PARO and PARO will stay with you 24-hours a day for 8 weeks. At the end of the 8 weeks of having the PARO, you will be interviewed by the student researcher about your experiences and perceptions of PARO.

Who are eligible to participant?

You will be eligible for inclusion in the study if you (1) are aged 65 years or over; (2) have a score higher than 6 on a depression scale; (3) have no impairment as determined by a cognitive examination score; (4) have an ability to communicate in Mandarin or Taiwanese; and (5) have been living in the LTC facility at least 3 months. You will be excluded from the study if you (1) have severe difficulty in communication; (2) are totally dependent on carers for daily activity; (3) have a diagnosed infectious disease; (4) have a diagnosis of dementia; and/or (5) have a diagnosis of a severe mental illness such as schizophrenia or delusional disorder.

What are the benefits of the research?

The outcomes of the research will provide new knowledge on the impact of PARO in older adults for alleviating depression. You may benefit from the social robot intervention through a reduction in depression and feelings of loneliness and as well as an improvement in quality of life.
Risks

You may have some emotional arousal during the social robot (PARO) interaction. However, a recent large study undertaken by the Chief Investigator, Prof Moyle, found no risk or burden to participants in using a social robot (PARO). It is possible that you may have mild distress upon withdrawal of the PARO. You will be encouraged to contact the researchers, or your care staff, and if warranted, referred for psychosocial support as detailed in the study protocol.

Voluntary participation

Participation in this study is entirely voluntary and there is no obligation to participate. If you agree to take part in this study, you or your family or guardian are free to withdraw consent without explanation or penalty. Under no circumstances will you be prejudiced as a result of your actions, participation or withdrawal of consent in terms of present or future involvement with Griffith University or the organisation in which you live. You may refuse to participate in any part of the study such as the use of the PARO or allow the collection of data.

Confidentiality

All information collected in this project will be kept confidential. Only the investigators named above will have access to the data collected. No participants will be named and identified in the reporting of the results of this study. All data will be securely stored at all times during data collection, analysis and upon completion of the study. Data will be returned to Griffith University, School of Nursing and Midwifery, and stored for the required time period of 5 years before being destroyed. A report of the general findings from the study will be made available to you, family and nursing home.

Questions about the study

If you have any questions about this study, please do not hesitate to contact Shu-Chuan Chen on +886-6-2110600 ext. 707 (Taiwan) or +61-0488488180 (Australia) or shu-
chuan.chen@griffithuni.edu.au. Or if you prefer to speak with a local contact please contact Professor Wang on +886-6-2353535 ext.5845 (Taiwan) or ns127@mail.ncku.edu.tw.

**Ethical conduct of the study**

If you have any concerns or complaints about the ethical conduct of the research project, please contact the Manager, Research Ethics on +61 (0)7 3735 4375 or research-ethics@griffith.edu.au. If you have any concerns or complaints about any ethical conduct aspects of the research project in Mandarin, you may also contact the professor Jing-Jy Wang on +886-6-2353535 ext.5845 or ns127@mail.ncku.edu.tw.

**Feedback to you**

A lay summary of the results will be made available to you and the participating facilities.

**Dissemination of findings**

Results from this study will be published in a Griffith University PhD dissertation and peer-reviewed publications as well as disseminated at national and international academic conferences.

**Privacy Statement**

The conduct of this research will involve data collection, access to your medical record and use of your identified personal information. The information is confidential and will not be exposed to a third party without your consent, except to meet government, legal or other regulatory authority requirements. A de-identified copy of this data may be used for research purposes, but your anonymity will be safeguarded at all times. For further information consult the Griffith University’s Privacy Plan at https://www.griffith.edu.au/about-griffith/governance/plans-publications/griffith-university-privacy-plan or telephone +61 (0)7 3735 4375.
If you agree to partake in this aspect of the study please read, sign and return the attached consent form. Please keep a copy of this information sheet.

Griffith University thanks you for consideration of participation in this research. Your participation will be greatly appreciated.
Appendix N: PARO intervention consent form

Griffith University

The impact of a PARO intervention on depression and well-being in older adults in long-term care in Taiwan – A pilot study

CONSENT FORM
GU Ref No: 2017/911

Research Team

<table>
<thead>
<tr>
<th>Principal Investigator</th>
<th>Co-Investigator</th>
<th>Co-Investigator</th>
<th>Student Investigator</th>
</tr>
</thead>
</table>
| **Professor Wendy Moyle**  
Program Director  
Menzies Health Institute, Queensland-Optimising 
Health Outcomes, Griffith University  
School of Nursing and Midwifery  
Nathan Campus, 170 Kessels Road, Nathan, QLD, 4111  
Phone: +61 07 3735 5526  
Email: w.moyle@griffith.edu.au | **Dr Cindy Jones**  
Research Fellow  
Menzies Health Institute, Queensland-Optimising 
Health Outcomes, Griffith University  
School of Nursing and Midwifery  
Nathan Campus, 170 Kessels Road, Nathan, QLD, 4111  
Phone: +61 07 3735 8440  
Email: c.jones@griffith.edu.au | **Professor Jing-Jy Wang**  
Director  
Department of Nursing, College of Medicine, National Cheng Kung University  
No.1, University Road, Tainan City 701, Taiwan  
Phone: +886-6-2353535 ext.5845  
Email: ns127@mail.ncku.edu.tw | **Ms Shu-Chuan Chen**  
PhD candidate  
Menzies Health Institute, Queensland-Optimising Health Outcomes, Griffith University  
School of Nursing and Midwifery  
Nathan Campus, 170 Kessels Road, Nathan, QLD, 4111  
Phone: +61 0488 488 180  
Email: shu-chuan.chen@griffithuni.edu.au |

By signing below, I confirm that I have read and understood the information sheet and in particular:

- This research is to explore the impact of a Paro intervention on depression and well-being in older adults living in long-term care facilities.
- I agree for my demographics and health information to be sought from my nursing home medical/nursing records.
- I agree to be given a PARO for 8 weeks and PARO will stay with me every day during the intervention.

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• I agree to participate in a face-to-face interview about my experiences of the social robot PARO. This interview will be digitally recorded and the recordings retained as part of the research data collection.

• I understand that my participation is voluntary and I can discontinue this participation at any time without penalty or providing an explanation.

• I understand that care will not be compromised if I decline to participate or withdraw consent.

• Any reports or publications resulting from this study will be reported in general terms and will not involve any identifying features.

• The data will be kept confidential at all times and in a locked filing cabinet in the School of Nursing and Midwifery for a period of 5 years before being destroyed.

• A lay summary report of the research findings will be made available to me on completion of the study.

• I understand that I can contact the investigators on the contact details given on the information package, or I may contact the Manager, Research Ethics at Griffith University Human Research Ethics Committee on +61 07 3735 4375 or researchethics@griffith.edu.au if I have any concerns about the ethical conduct of the project.

I have read the Information Sheet and the Consent Form. I agree to participate in this research and give my consent freely. I understand that the study will be carried out as described in the Information Sheet, a copy of which I have retained. I also realise that I can withdraw from the study at any time and that I do not have to give any reason for withdrawing. I have had all questions answered to my satisfaction.

☐ I agree to participate in the project.

☐ I consent to the inclusion of my personal information (demographics/health information) in publications or presentations resulting from this research.
☐ I consent to the inclusion of my images in publications or presentations resulting from this research.

<table>
<thead>
<tr>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signature</td>
</tr>
<tr>
<td>Date</td>
</tr>
</tbody>
</table>

Or

☐ Verbal consent
Appendix O: Protocol for individual use of PARO

Protocol for individual use of PARO - For researcher

| Setting | • Naturalistic.  
|         | • Intervention will be provided on day 1 to participants wherever they are at the time – bedroom, living room, garden etc., but not bathroom.  
|         | • Participants can choose a suitable time to interact with PARO depending on their preferences.  
|         | • PARO can be held in the arms of the participants, or be placed on their lap, desk or bed.  

| Background to PARO intervention | • Intervention is individual, i.e. PARO is given to one individual and left with that individual for 24/7.  
|                                 | • The intervention is not facilitated, except for giving the PARO and removing the PARO.  
|                                 | • Each PARO is named.  
|                                 | • A fully charged PARO will last between 4 and 5 hours (depending on version).  

| Prepare PARO | • Collect PARO from the area where PARO is being charged. Remove from charger and cover with a towel or something similar for the first time.  

| Introduce PARO to participant | • During the first visit, the PARO will be introduced to the participants.  
|                                | • The researcher will encourage participants to make contact and interact with the PARO both verbally and by touching it.  
|                                | • The researcher will introduce the PARO to each participant using a short script. For example: “Look Mrs/Mr X, this is a PARO (or PARO’s name). You can stroke, cuddle, or talk to PARO if you like. PARO can move and produce sounds when you stroke or touch him/her. PARO can recognise your voice when you speak to him/her. It also makes a response when you have eye contact with PARO. PARO will stay with you for 8 weeks”.  
|                                | • Participants will be encouraged to touch PARO and to talk about how the fur feels and how to switch PARO on/off during the introduction.  
|                                | • If another participant, or participants, or family or staff come during the intervention, do nothing. Allow the participant to continue with the PARO.  

| Training staff | • Two staff members from each facility will be trained how to use PARO and solve problems created by using PARO before the intervention.  
|                | • Staff members will be supervised during first week by the researcher, aiming to make the all interventions as similar as possible for the sake of comparison.  

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### During the intervention period

- Treatment fidelity will be monitored through weekly checks of the intervention at each participating LTC facility by the researcher.
- For safety and infection control, PARO will be cleaned and checked randomly every week by the researcher.

### Post intervention

#### Say goodbye to PARO

- In order to prevent separation anxiety occurring after withdrawal of PARO, at the last week of intervention (Monday or Tuesday), the researcher will inform participants that PARO will leave on the coming Friday to prepare participants’ expectation of PARO leaving and prevent any adverse events occurring during the week.
- A 10-minute session is ended smoothly by each participant saying goodbye to PARO on the last day.
- Instruction scripts will be worded as follows: “PARO will leave after 10 minutes. PARO looks like she/he enjoyed being with you. Did you enjoy being with her/him?” (Wait for response). “Would you also like to say something to PARO, Mrs/Mr X?” PARO will then be stored at a predefined location.

Take PARO, cover with towel.

---

### Protocol for individual use of PARO - For staff

#### Training staff

- Two staff members from each facility will be trained how to use PARO and solve problems created by using PARO before one week of the intervention.
- Staff members will be supervised during the first week of intervention by the researcher, aiming to make the all interventions as similar as possible for the sake of comparison.

#### Preparing setting for PARO interaction

- Naturalistic.
- Intervention will be provided to participants wherever they are at the time – bedroom, living room, garden etc. but not bathroom.
- Participants can choose a suitable time to interact with PARO depending on their preferences.
- The PARO can be held in the arms of the participants, or be placed in their lap, desk or bed.
| Background to PARO intervention | • Intervention is individual, i.e. PARO is given to one individual and left with that individual for 24/7.  
• The intervention is not facilitated apart from a researcher, except giving the PARO and removing the PARO.  
• Each PARO is named. |
| Charging and cleaning | • A fully charged PARO will last between 4 and 5 hours (V9) or 2-3 hours (V8).  
• Staff need to charge PARO’s battery every day. Charge time: lunch time or afternoon nap (11:00-14:00), dinner time (17:00-19:00), and overnight.  
• Collect PARO from the area where PARO is being charged. Remove from charger every day.  
• Daily cleaning routine is as follows:  
1. Spray PARO’s fur with Dapple cleanser  
2. Gently wipe clean PARO’s fur with towel, avoid area around eyes and nose  
3. Wipe down PARO’s fur with Germicidal Disposable Wipes.  
4. Let PARO's fur dry as much as possible  
5. Brush the entirety of PARO’s fur (brush in the direction of the fur)  
6. Clean the brush |
| Introduce PARO to participant’s family | • When family visits participants, staff need to introduce PARO to the family.  
• Staff can encourage both family members and participants to make contact and interact with the PARO both verbally and by touching it.  
• Staff can introduce the PARO to each family member using a short script. For example: “Look Mrs/Mr X, this is a PARO (or PARO’s name). You can stroke, cuddle, or talk to PARO if you like. PARO can move and produce sounds when you stroke or touch him/her. PARO can recognise your voice when you speak to him/her. It also makes a response when you have eye contact with PARO.” |
| Problem solving for using PARO during the intervention period | 1. Encouraging participants to interact with PARO  
• The trained staff members will sit and demonstrate again how to interact with PARO and check PARO is working well.  
• PARO is introduced by the care givers similar to the following text: “Look Mrs/Mr X, this is the seal PARO (or PARO’s name). You can stroke, cuddle, or talk to him if you like. PARO can move and produce sounds when you stroke or touch him/her. PARO can recognise your voice when you speak to him/her. It also makes a response when you have eye contact with PARO.” |
2. PARO being taken away from participant
   • If PARO is being taken away from participants by other residents, PARO will be sent back to a trained staff member and then he/she will give PARO back to the participant to prevent arguing between two residents.
   • If another resident attempts to take the PARO go over to the resident and inform them that the PARO is being used at this time.
   • If another resident asks to have a PARO, staff can talk to resident using the following text: “There are some criteria for participating this project; therefore, PARO needs to stay with X at the moment. If you are interested in PARO, the researcher will provide a 15-minute session for interested residents after this project.”

3. Misuse PARO
   • Participant seems to be misusing PARO or abusing another person with PARO, i.e. hitting with PARO or throwing PARO. If this occurs, tell the participant that PARO needs to have a rest. Take PARO, cover PARO and return to the area where PARO is kept. Contact the researcher.

<table>
<thead>
<tr>
<th>Post intervention</th>
<th>Say goodbye to PARO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In order to prevent separation anxiety occurring after withdrawal of PARO, at the last week of intervention (Monday or Tuesday), the staff will inform participants that PARO will leave on the coming Friday to prepare participants’ expectation of PARO leaving and prevent any adverse events occurring during the week.</td>
</tr>
</tbody>
</table>
PARO Infection Control Measures

EQUIPMENT:
- Dapple toy cleaner (or comparable product)
- Wire brush
- Hand towels
- Germicidal Disposable Wipes (or comparable product)
- Purell alcohol-based hand sanitizer gel (or comparable product)

Daily cleaning routine is as follows:
1. Spray PARO's fur with Dapple cleanser
2. Gently wipe clean PARO's fur with towel, avoid area around eyes and nose
3. Wipe down PARO’s fur with Germicidal Disposable Wipes.
4. Let PARO's fur dry as much as possible
5. Brush the entirety of PARO’s fur (brush in the direction of the fur)
6. Clean the brush

Important additional information:
- Residents with contact precautions / open wounds should NOT use PARO!
- Hand hygiene with disposable alcohol wipes must be done before using PARO
- Storage container to be wiped once a week with disinfectant wipe(s)
- Participants are not to drink or eat food or fluid while handling PARO
Appendix P: Interview protocol_ PARO intervention

**Preamble:**
As you are aware, the researcher Shu-Chuan Chen from Griffith University in Australia has been running research investigating the effect of the social robot Paro on depression and wellbeing for older adults living in long-term care. As you have engaged with the Paro and you may have gained experiences and insight into the impact of the Paro, the purpose of this discussion today is to explore and understand these experiences and to get your personal view on the possible impact that the social robot Paro program has had.

I would like to use a digital recorder to record the interview if that is ok with you?

You should be aware that all information collected in this project will be kept confidential. Only the investigators will have access to the data collected. Once the discussions are complete and have been transcribed and the transcriptions checked for accuracy, all data including recorded digital recording will be securely stored at all times during data collection, analysis and upon completion of the study. Any aspects of the discussion that identify you will be removed and no participants will be named and identified in the reporting of the results of this study.

The discussion is expected to take about an hour but you are free to leave at any point. Do you have any questions before we begin?

**Questions**

1. For the purposes of the recording, please can you state your name and role in the research?

2. What did you think of or feel about Paro initially?
3. Do you still think of or feel about Paro in the same way? If no, how do you think of or feel about Paro now?
   Probe: Ask for examples

4. How much time did you spend with Paro each day? How did you interact with Paro?
   Probe: if less than 10 minutes, does anything impede your interaction with Paro?
   If more than 10 minutes per day. What motivates or triggers you to interact with Paro?

5. How did Paro make you feel?
   Probe: happy, excited, tearful, sad, anxious, relaxed
   Ask for examples:

6. What were your most memorable moments with Paro?
   Probe:
   Ask for example:

7. What did you get out of your interaction with Paro?
   Probe: is this a positive or negative impact and why do you think this is the case?

8. What did you like or dislike about Paro?
   Probe:
   Ask for example:
   Can you explain more?

9. Is there anything that you would change about how you interact with Paro?
Finally.
Is there anything else you would like to tell us regarding your experience in being with Paro?

Thank you for your time.
Appendix Q: Ethics approval_PARO intervention

Human Research Ethics Approval

"The impact of a PARO intervention on depression and well-being in older adults in long-term care in Taiwan - A pilot study"

[RIMS: 2017/911]

I am pleased to confirm that this research had full approval from the Griffith University Human Research Ethics Committee, a committee established and operating in accordance with the standards and principles of the Australian National Statement on Ethical Conduct in Human Research (2007) and Griffith University policy and registered with the Australian National Health and Medical Research Council.

The decision to approve is dated 07 November 2018 and covers the period 01 December 2017 to 30 December 2018.

For any queries regarding this ethical approval please contact the Committee Secretary on (07) 3735 4375 or research-ethics@griffith.edu.au.

Yours sincerely,

Dr Amanda Fernie
A/Secretary to the Griffith University
Human Research Ethics Committee and
A/Manager Research Ethics and Integrity
Office for Research
Griffith University
Nathan QLD 4111 Australia

29 November 2017
Appendix R: Questionnaire for online survey

Introduction

This questionnaire contains two parts: demographic information and a questionnaire about your views on using social robots, also called socially assistive robots.

A social robot refers to a device to enhance health and mental well-being for users by providing companionship and social interaction. Social robots focus on health and psychological well-being-related effects in aged care and have different features and functions.

A service type robot is used to assist and support activities of daily living (eating, bathing, toileting and getting dressed) and mobility (including navigation), providing household maintenance, monitoring and maintaining safety. Examples of these types of robots include ‘nursebot’ Pearl, and the German Care-o-bot.

The second type is a pet-like companion robot such as the baby harp seal-shaped robot ‘Paro’ and a dog-shaped ‘AIBO’. Their main functions are to enhance health and mental well-being for users by providing companionship. Studies have shown that companion social robots can increase positive mood in older adults living in long term care facilities.

Take Paro for example:

Paro has the appearance of a baby harp seal, weighs 2.5 kg (version 9), and is approximately the size of a new-born baby. Paro is equipped with an array of tactile sensors that monitor sound, light, temperature and touch by artificial intelligence software. Stroking Paro can trigger it to move its tail and flippers and open its eyes, respond to sound, recognize its name and learn to respond to frequent words used by its owner, and it produces sounds like a real harp seal. Paro can show human-like emotional reactions when it feels surprise, happiness, anger, or cries when it is neglected or does not receive sufficient attention. It is designed to have a diurnal rhythm, so that it is active during the day and asleep at night.
### Part 1: Demographic information of online survey

1. Age in years:  □ under 20  □ 20-25  □ 26-30  □ 31-35  □ 36-40  □ 41-45  □ 46-50  
   □ 51-55  □ 56-60  □ 61-65  □ 66 and over

2. Gender:  □ Female  □ Male

3. Highest educational level?  □ associate diploma  □ Bachelor  □ Masters  □ PhD

4. Your speciality?  □ Head nurse  □ Registered Nurse  □ Nursing aid  □ Occupational Therapist/Physiological Therapist  □ Social Worker  □ Psychologist  □ Administrator  □ physician  □ Psychiatrist  □ other, please indicate: ____________________________

5. What type of healthcare department do you work in?  □ Nursing Home  □ Residential Aged care  □ Day care centre  □ Home care  □ Rehabilitation Wards

6. How long is your clinical experience in long-term care systems? ______ years _______ months

7. Have you ever heard of the use of social robots in clinical practice? □ yes □ no

8. Do you use social robots in your work in the facility now? □ yes □ no
Part 2 online survey Questionnaire

For each statement below, choose from the following answers the one that best describes your view about social robots.

<table>
<thead>
<tr>
<th>Items</th>
<th>strongly disagree</th>
<th>partially disagree</th>
<th>neutral</th>
<th>partially agree</th>
<th>strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Social robots could help with treatment of older people with mental illness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. Social robots could help the health professional to reach his/her objectives in care with support for daily activities.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. Social robots could be useful for society because they help both health professionals and older people living in long-term care facilities.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. Social robots could help both health professionals and older people in aged care for support.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. Social robots could represent companions for older adults living in long-term care facilities.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. Social robots could be useful in mental health services for older adults.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. Using social robots could in the health/nursing care process lead to resolving of difficulties in less time.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. Using social robots could in the health/nursing care process increase treatment efficiency.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. Using social robots could reduce health/nursing treatment costs.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. Using social robots in the health/nursing care process could make the care work more interesting.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>11. I think that older adults would be comfortable if health professionals</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
would use a social robot in the care process.

12. I consider that social robots could be a threat for aged care services.  
   0 1 2 3 4

13. Social robots could help with the process of diagnosis of people with mental illness.  
   0 1 2 3 4

14. I think that older adults would be comfortable if they participate at a therapeutic activity where the health professional used a social robot.  
   0 1 2 3 4

15. I consider that robots would not pose a threat for mental health services designed for older adults.  
   0 1 2 3 4
Appendix S: Questionnaire for PARO intervention

1. Residents’ demographic data and health-related information

Part 1: Personal information

1. Gender: □ male □ female
2. Age: □ 65-74 □ 75-84 □ 85 over
3. Religion: □ Buddhism □ Daoism □ Christian □ Catholic □ Others indicate:
4. Highest level of education: □ no education □ 6 years □ 9 years □ 12 years
   □ College/ University □ Master degree □ PhD
5. Current Marriage status? □ Single □ Married □ Divorced □ Widowed
6. Do you have Children? □ No □ Yes
7. How often do your families, relatives, and friends visit you? □ twice / week
   □ Once/week □ once /two weeks □ once /three weeks □ once /month
8. Did you keep a pet before you moved into the long-term care facility?
   □ No □ Yes; What type of pet? □ dog □ cat □ bird □ fish
   □ other__________

Part 2 Health information from chart

1. Date of moving in long term care facilities:
2. Type of depressive disorder (ICD-9 code):
3. Other diagnosed diseases: □ diabetes □ hypertension □ heart disease □
   bronchitis disease □ arthritis □ cancer □ other ____________
4. Medications
   4-1 Antidepressants: □ No □ Yes: ________________
   4-2 Psychotropic medication: □ No □ Yes: ________________
   4-3 Other medications:
   4-4 Other therapy: □ CBT □ ECT □ RT □ other therapy, ____________
5. Level of ADL:
6. Movement: □ walk □ walker assisted □ wheelchair □ bedrest
7. MMSE score:
8. GDS score:
Scale 1

Choose the best answer for how you have felt over the past week:

<table>
<thead>
<tr>
<th>No.</th>
<th>Questions:</th>
<th>Answer:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Are you basically satisfied with your life?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>2.</td>
<td>Have you dropped many of your activities or interests?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>3.</td>
<td>Do you feel that your life is empty?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>4.</td>
<td>Do you often get bored?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>5.</td>
<td>Are you in good spirits most of the time?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>6.</td>
<td>Are you afraid that something bad is going to happen to you?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>7.</td>
<td>Do you feel happy most of the time?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>8.</td>
<td>Do you feel helpless?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>9.</td>
<td>Do you prefer to stay at home, rather than go out and do things?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>10.</td>
<td>Do you feel that you have more problems with memory than most?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>11.</td>
<td>Do you think it is wonderful to be alive now?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>12.</td>
<td>Do you feel pretty worthless the way you are now?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>13.</td>
<td>Do you feel full of energy?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>14.</td>
<td>Do you feel that your situation is hopeless?</td>
<td>Yes / No</td>
</tr>
<tr>
<td>15.</td>
<td>Do you think that most people are better off then you are?</td>
<td>Yes / No</td>
</tr>
</tbody>
</table>

Total score
Scale 2
Directions: Indicate how often you feel the way described in each of the following statements.
Circle one number for each.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I feel in tune with the people around me</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. I lack companionship</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. There is no one I can turn to</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. I do not feel alone</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. I feel part of a group of friends</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. I am no longer close to anyone</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. My interests and ideas are not shared by those around me</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. I am an outgoing person</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. There are people I feel close to</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>11. I feel left out</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<tr>
<td>12. My social relationships are superficial</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<tr>
<td>13. No one really knows me well</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>14. I feel isolated from others</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>15. I can find companionship when I want it</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>16. There are people who really understand me</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>17. I am unhappy being so withdrawn</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>18. People are around me but not with me</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>19. There are people I can talk to</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>20. There are people I can turn to</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Scale 3

This questionnaire asks for your thoughts and feelings about certain aspects of your quality of life and addresses issues that may be important to you as an older member of society.

Please answer all the questions. If you are unsure about which response to give to a question, please choose the one that appears most appropriate. This can often be your first response.

Please keep in mind your standards, hopes, pleasures and concerns. We ask that you think about your life in the last two weeks.

You should circle the number that best fits how much you have worried about the future over the last two weeks. Please read each question, assess your feelings, and circle the number on the scale for each question that gives the best answer for you.

1. To what extent do impairments to your senses (e.g. hearing, vision, taste, smell, touch) affect your daily life?
   (1) Not at all  (2) A little  (3) A moderate amount  (4) Very much  (5) An extreme amount

2. To what extent does loss of for example, hearing, vision, taste, smell or touch affect your ability to participate in activities?
   (1) Not at all  (2) A little  (3) A moderate amount  (4) Very much  (5) An extreme amount

3. How much freedom do you have to make your own decisions?
   (1) Not at all  (2) A little  (3) A moderate amount  (4) Very much  (5) An extreme amount

4. To what extent do you feel in control of your future?
   (1) Not at all  (2) Slightly  (3) Moderate  (4) Very  (5) Extremely

5. How much do you feel that the people around you are respectful of your freedom?
   (1) Not at all  (2) Slightly  (3) Moderate  (4) Very  (5) Extremely

6. How concerned are you about the way in which you will die?
   (1) Not at all  (2) Slightly  (3) Moderate  (4) Very  (5) Extremely

7. How much are you afraid of not being able to control your death?
   (1) Not at all  (2) Slightly  (3) Moderate  (4) Very  (5) Extremely

8. How scared are you of dying?
   (1) Not at all  (2) Slightly  (3) Moderate  (4) Very  (5) Extremely

9. How much do you fear being in pain before you die?
   (1) Not at all  (2) A little  (3) A moderate amount  (4) Very much  (5) An extreme amount

10. To what extent do problems with your sensory functioning (e.g. hearing, vision, taste, smell, touch) affect your ability to interact with others?
    (1) Not at all  (2) A little  (3) Moderately  (4) Mostly  (5) Completely

11. To what extent are you able to do the things you’d like to do?
    (1) Not at all  (2) A little  (3) Moderately  (4) Mostly  (5) Completely
12. To what extent are you satisfied with your opportunities to continue achieving in life?
   (1) Not at all (2) A little (3) Moderately (4) Mostly (5) Completely

13. How much do you feel that you have received the recognition you deserve in life?
   (1) Not at all (2) A little (3) Moderately (4) Mostly (5) Completely

14. To what extent do you feel that you have enough to do each day?
   (1) Not at all (2) A little (3) Moderately (4) Mostly (5) Completely

15. How satisfied are you with what you have achieved in life?
   (1) Very dissatisfied (2) Dissatisfied (3) Neither satisfied nor dissatisfied (4) Satisfied (5) Very satisfied

16. How satisfied are you with the way you use your time?
   (1) Very dissatisfied (2) Dissatisfied (3) Neither satisfied nor dissatisfied (4) Satisfied (5) Very satisfied

17. How satisfied are you with your level of activity?
   (1) Very dissatisfied (2) Dissatisfied (3) Neither satisfied nor dissatisfied (4) Satisfied (5) Very satisfied

18. How satisfied are you with your opportunity to participate in community activities?
   (1) Very dissatisfied (2) Dissatisfied (3) Neither satisfied nor dissatisfied (4) Satisfied (5) Very satisfied

19. How happy are you with the things you are able to look forward?
   (1) Very unhappy (2) Unhappy (3) Neither happy nor unhappy (4) Happy (5) Very happy

20. How would you rate your sensory functioning (e.g. hearing, vision, taste, smell, touch)?
   (1) Very poor (2) Poor (3) Neither poor nor good (4) Good (5) Very good

21. To what extent do you feel a sense of companionship in your life?
   (1) Not at all (2) A little (3) A moderate amount (4) Very much (5) An extreme amount

22. To what extent do you experience love in your life?
   (1) Not at all (2) A little (3) A moderate amount (4) Very much (5) An extreme amount

23. To what extent do you have opportunities to love?
   (1) Not at all (2) A little (3) Moderately (4) Mostly (5) Completely

24. To what extent do you have opportunities to be loved?
   (1) Not at all (2) A little (3) Moderately (4) Mostly (5) Completely
Scale 4

<table>
<thead>
<tr>
<th>Maximum Score</th>
<th>Score</th>
<th>ORIENTATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>(     )</td>
<td>What is the (year), (season), (date), (day), (month)</td>
</tr>
<tr>
<td>5</td>
<td>(     )</td>
<td>Where are we (state), (county), (town or city), (hospital), (floor)</td>
</tr>
</tbody>
</table>

REGISTRATION

| 3       | (     ) | Name 3 common objects, (e.g. ‘apple’, ‘table’, ‘penny’). |
|         |        | Take 1 second to say each. Then ask the patient to repeat all 3 after you have said them. Give 1 point for each correct answer. Then repeat them until he/she learns all 3. Count trials and record. |
|         |        | Trials: |

ATTENTION AND CALCULATION

| 5       | (     ) | Spell ‘world’ backwards. The score is the number of letters in the correct order ( D__ L__ R__ O__ W__ ) |

RECALL

| 3       | (     ) | Ask for the 3 objects repeated above. Give 1 point for each correct answer. [Note: recall cannot be tested if all 3 objects were not remembered during registration.] |

LANGUAGE

| 2       | (     ) | Name a ‘pencil’ and ‘watch’ (2 points) |
| 1       | (     ) | Repeat the following “No, ifs, ands, or buts” (1 point) |
| 3       | (     ) | Follow a 3-stage command: |
|         |        | ‘Take a paper in your right hand, |
|         |        | Fold it in half, and |
|         |        | Put it on the floor’ (3 points) |
|         |        | Read and obey the following: |
| 1       |       | Close your eyes (1 point) |
| 1       |       | Write a sentence (1 point) |
| 1       |       | Copy the following design (1 point) |

Total Score________

238
Appendix T: Paper Three

Title page

Title: A social robot intervention on depression, loneliness and quality of life for Taiwanese older adults in long-term care

Running title: Social robot for older adults with depression

1. Shu-Chuan Chen, MSN, RN [Corresponding author]
   PhD candidate, School of Nursing and Midwifery, and Menzies Health Institute Queensland, Griffith University, Queensland, Australia
   Lecturer, Department of Nursing, National Tainan Junior College of Nursing, Tainan, Taiwan R.O.C.
   Postal Address: 170 Kessels Road, Nathan, Queensland 4111, Australia
   Email: shu-chuan.chen@griffithuni.edu.au
   Tel: + 61 7 3735 7682
   ORCID: 0000-0002-3787-2959

2. Wendy Moyle, PhD, RN
   Program Director, Griffith University, Menzies Health Institute Queensland, Queensland, Australia
   Professor, School of Nursing and Midwifery, Griffith University, Queensland, Australia
   Postal Address: 170 Kessels Road, Nathan, Queensland 4111, Australia
   Email: w.moyle@griffith.edu.au
   ORCID: 0000-0003-3004-9019

3. Cindy Jones, PhD
   Associate Professor, Bond University, Faculty of Health Sciences & Medicine, Queensland, Australia
   Adjunct Research Fellow, Griffith University, Menzies Health Institute Queensland, Queensland, Australia
   Postal Address: 14 University Drive, Robina, Queensland 4226, Australia
   Email: cjones@bond.edu.au
   ORCID: 0000-0002-7249-2580
4. Helen Petsky, PhD, RN
   Senior Lecturer, School of Nursing and Midwifery, and Menzies Health Institute
   Queensland, Griffith University, Queensland, Australia
   Postal Address: 170 Kessels Road, Nathan, Queensland 4111, Australia
   Email: h.petsky@griffith.edu.au
   ORCID: 0000-0002-5315-9002
Abstract

Objectives: To investigate the effect of a social robot intervention on depression, loneliness, and quality of life of older adults in long-term care (LTC), and to explore participants’ experiences and perceptions after the intervention.

Design: A mixed methods approach consisting of a single group, before and after, quasi-experimental design and individual interview.

Participants: Twenty older adults with depression from four LTC facilities in Taiwan were recruited.

Intervention: Each participant participated in 8 weeks of observation and 8 weeks of intervention. In the observation stage, participants received usual care or activities without any research intervention. In the intervention stage, each participant was given a Paro robot to keep for 24-hours 7 days a week.

Measurements: The Geriatric Depression Scale, the UCLA loneliness scale-3, and the World Health Organization Quality of Life Questionnaire for older adults were administered at four time points. Individual qualitative interviews with thematic analysis followed.

Results: A repeated multivariate analysis of variance and Friedman’s test showed no significant changes during the observation stage between T1 & T2 for depression and quality of life (p >.5). For the intervention stage, statistically significant changes in decreasing depression and loneliness, and improving quality of life over time were identified. Three themes emerged from the interviews: [i] humanizing Paro through referring to personal experiences and engagement; [ii] increased social interaction with other people; and [iii] companionship resulting in improved mental well-being.

Conclusions: There were significant improvements in mental well-being in using Paro. Further research may help us to understand the advantages of using a Paro intervention as depression therapy.

Keywords: social robot, Paro, older adults, depression, loneliness, well-being, psychosocial intervention
1. Introduction

The World Health Organization estimated that the overall prevalence of depressive disorders among older populations generally varies between 10%-20% (Barua et al., 2011). According to a worldwide estimate, approximately 5 million older adults experience late-onset depression, but this number may be conservative as it remains under-recognized and inadequately treated (Viscogliosi et al., 2013). Research shows that people who live in long-term care (LTC) facilities have higher rates of depression than those living in the community (Chau et al., 2019b; Seitz et al., 2010). Reasons for higher rates include physical pain, poor person-environment fit, sleep disturbance and limited social support (Chau et al., 2019a; Seitz et al., 2010). Symptoms of depressive disorders include: depressed mood, diminished interest, loss of energy, and feelings of worthlessness (American Psychiatric Association, 2013). Furthermore, depression is strongly associated with many negative health outcomes for older adults (Novick et al., 2015) and presents as somatic symptoms, such as insomnia, loss of appetite, fatigue, headaches and lethargy (Luppa et al., 2012), as well as increased risk of suicide (Yang et al., 2015). Studies have identified a positive correlation between depression and loneliness where older adults who perceive feelings of loneliness tend to experience a higher level of depression and more negative emotions (Liu et al., 2016; Nyqvist et al., 2013). Thus, psychological and social vulnerability might be exacerbated in older adults in LTC and may eventually impact their quality of life. However, there is limited research on effective psychosocial interventions for depression and loneliness among older adults in LTC (Simning and Simons, 2017). Therefore, these issues merit more attention to develop effective strategies to manage depression.

Advances in technology have created a vast potential for the provision of new forms of healthcare. Recently, there has been increasing interest in the use of social robots to alleviate psychological distress and encourage social interaction for older adults with dementia (Moyle, 2019). The use of social robots in LTC has led to a proliferation of studies which explore the physical and psychological outcomes of older adults with dementia (Moyle et al., 2017; Petersen et al., 2017).

A range of social robots have been developed for use in LTC. The most common animal companion robot, Paro (Personal Assistive RobOt), was developed in Japan and designed
to engender psychological or enrichment effects as a mental commitment robot, that makes people feel an emotional attachment to the robot through interaction with the robot (Shibata et al., 2012). It has been recognized as a potential psychosocial intervention for improving mental well-being in older adults (Chen et al., 2018; Pu et al., 2018). Paro has the appearance of a baby harp seal and is equipped with an array of tactile sensors that monitor sound, light, and touch. Paro can show human-like emotional reactions such as happiness and anger.

Paro interventions are based on human-animal interactions aimed at providing physiological, psychological, and social benefits. Physiological effects are triggered through sensory stimulation with Paro such as stroking and can result in a reduction in blood pressure (Robinson et al., 2015). Psychological effects are experienced through the comfort derived during close interaction and social benefits are provided through engagement in activity with Paro (Shibata and Wada, 2011). Recent studies have shown Paro can decrease depression (Petersen et al., 2017) and loneliness (Robinson et al., 2013) as well as improve mood (Moyle et al., 2013), and quality of life (Jøranson et al., 2016) in people with dementia. Although extensive Paro research has been carried out with people with dementia, no single study exists which focuses on older adults with depression. Therefore, an effective and innovative psychosocial intervention that aims to reduce depression and improve well-being for older adults with depression in LTC is warranted.

2. Method

2.1 Design

A pilot mixed-methods study with a single group, before and after quasi-experimental design and individual interview were used.

2.2 Settings and Participants

This study was conducted at four accredited LTC facilities with more than 100 beds in Southern Taiwan. A purposive sample of depressed older adults living in LTC was recruited. The inclusion criteria of participants were: (1) aged 65 years or older; (2) with
a score higher than 6 out of 15 on the Geriatric Depression Scale-Short Form (GDS-SF) (Friedman et al., 2005); (3) no cognitive impairment as determined by the Mini-Mental State Examination (MMSE) cutoff score of ≥24/25 (Zhang et al., 1990) by educational level; (4) able to communicate in Mandarin or Taiwanese; and (5) had been living in LTC for at least 3 months. This was due to relocation as residents often exhibit a higher prevalence of depression following admission into LTC during the first 3 months (Hoover et al., 2010). Participants who: (1) had severe difficulty in communication; (2) were totally dependent on carers for daily activity; (3) had a diagnosis of infectious disease; (4) had a diagnosis of dementia and severe mental illness such as schizophrenia and delusional disorder, were excluded.

Using the PASS version 14 (NCSS, Kaysville, Utah), a target sample of 44 participants was recruited based on a prior study that examined the effect of a Paro intervention on depression (Moyle et al., 2013) and the number of time points at which data were collected. To allow for a 10% attrition rate, this study sought to recruit 22 participants, and as each participant served as his or her own control, this doubled the sample size to 44.

2.3 Recruitment

An expression of interest to be involved in the study was sent to directors of LTC facilities via email or telephone. The research contacted the directors of four LTC who had expressed an interest in being involved. Initially, the directors identified and provided a list of potential residents who met the study criteria and introduced the researcher to these potential participants. The researcher subsequently contacted them in person and explained the aims and details of the study, and written consent was sought from each participant before the start of the study. The researcher screened all participants to determine their levels of depression and cognition, and only those who met the inclusion criteria were recruited into the study.

2.4 Intervention

There were two stages in the study, observation and intervention stages. In the observation stage, participants received usual care or activities in the LTC facility without any research intervention for 8 weeks to ascertain their habitual mood and behavior. In the
intervention stage, each participant was given a Paro to keep for 24-hours, 7 days a week, for 8 weeks. Participants could choose a suitable time to interact with the Paro according to their preferences. When they did not wish to interact with Paro, they had the choice to put the Paro aside or to take the Paro with them. During the first visit, the researcher introduced the Paro to participants, who were encouraged to make contact and interact with it both verbally and by touching it.

Two staff members from each participating LTC facility were trained by the researcher in (a) how to operate the Paro; (b) introduce it to the participant’s family; and (c) solve potential problems that may arise during its use. For hygiene and safety reasons, guidelines for infection control measures when using a Paro were also introduced to staff to oversee.

During the last week of the intervention, the trained staff informed participants that the Paro would be leaving them on the following Friday. On the last day, the researcher gave each participant 10-minutes to say his/her farewell to the Paro.

2.4 Treatment fidelity

Treatment fidelity was monitored through weekly checks of the intervention by the researcher. These procedures included three steps. First, the Paro’s condition was checked to ensure it was charged and operating correctly. Second, each visit took 10-15 minutes. Participants’ interactions with the Paro in the activity room or bedroom were observed. If participants were in the bedroom while the researcher was visiting, the researcher greeted participants, had a chat and observed the intervention. This step included how often, and when, participants used the Paro, how they interacted with Paro, their non-verbal expressions, and whether they had any questions when they used Paro. These notes were used to help the researcher to understand the participants’ experiences and to interpret the results, but they were not used as part of the data analysis. Third, any issues raised by participants to the staff were discussed with the researcher to ensure that staff could resolve these issues.

2.6 Data collection
Demographic data and health-related information were collected at baseline. Outcome measurements included the GDS-SF (Liu et al., 1998), the UCLA Loneliness Scale Version 3 (UCLA-3) (Chang and Yang, 1999) and the World Health Organization Quality of Life Questionnaire for older adults (WHO-QOL-OLD) (Liu et al., 2013). The researcher at four time points administered these: a week before the start of the 8-week observation (T1), immediately at the end of the 8-week observation (T2), at the mid-point of the Paro intervention (T3), and immediately at the end of the 8-week Paro intervention (T4). After the Paro intervention, an interview was conducted to understand participants’ experiences of using the Paro. There was no follow-up assessment after the end of the Paro intervention as previous two systematic reviews (Chen et al., 2018; Pu et al., 2018) had found no significant effect of a social robot intervention on depression at follow-up.

2.6.1 Demographic data and health-related information

Demographics such as age, gender, education level, the length of stay in LTC and previous pet ownership were collected. Health-related information collected included the type of depressive disorder, any other chronic disease, a medication audit including anxiolytics, antidepressants and other medications as well as the Barthel score (Wade and Collin, 1988) for self-care and mobility.

2.6.2 MMSE

The MMSE (Folstein et al., 1975), is a widely used tool that screens the level of cognitive impairment, using the concepts of orientation, registration, attention and calculation, recall and language. The MMSE has good internal consistency with a Cronbach alpha of .91 in older populations (Marioni et al., 2011) and .83 to .84 in older Taiwanese populations (Lou et al., 2007). The MMSE score ranges from 0 to 30. In this study, the cut-off point was based on the study of Zhang et al. (1990) in which the level of cognitive impairment varies according to educational level: 17/18 for older people without formal education, 20/21 for those with 1–6 years of education, and 24/25 for participants with more than 6 years of education in Chinese older adults.

2.6.3 GDS-SF
The GDS-SF (Yesavage and Sheikh, 1986) consists of 15 items with 10 positive items and 5 negative items. The Chinese version of GDS-SF was translated by Yeh et al. (1995). GDS-SF is a useful tool to detect depressive symptoms in older populations (Greenberg, 2007). Each item has a ‘yes’ or ‘no’ answer response. The scores range from 0–15 and a cutoff of 6 or more indicates the presence of depression as it is conventionally used for differentiating depressed from nondepressed older adults (Friedman et al., 2005). This scale has good reliability with Cronbach’s alpha of internal consistency reported at .89 in the original version and .90 in the Chinese version (Lee et al., 1993).

6.6.4 UCLA-3

The UCLA-3 is a 20-item scale that was developed by Russell (1996). Chang and Yang (1999) translated the Chinese version of UCLA-3. It is used to measure a person’s subjective feelings of loneliness. Each item on the scale is rated from 1 (Never) to 4 (Often) with a total score ranging from 20 to 80. The higher the score, the more severe the person’s feelings of loneliness. This scale has good reliability with Cronbach’s alpha of internal consistency ranging from .89 to .94 in the original scale (Russell, 1996) and .85 to .90 in the Chinese version (Chang and Yang, 1999).

6.6.5 WHO-QOL-OLD

The WHO-QOL-OLD (Power et al., 2005) is derived from the World Health Organization Quality of Life Questionnaire-BREF (THE WHOQOL GROUP, 1998). The Chinese version of WHO-QOL-OLD was translated by Liu et al. (2013). This questionnaire consists of 24 items with 6 domains: sensory abilities; autonomy; past, present and future activities; social participation; death and dying; and intimacy. Responses are rated on a 5-point Likert scale with a higher score indicating a better quality of life. Internal consistency as measured by Cronbach’s alphas of all subscales ranged from .72 to .91 in the original study (Power et al., 2005) and .72 to .95 in the Chinese version (Yao and Chien, 2013).

6.7 Individual Interviews

An individual semi-structured interview was conducted with participants following the Paro intervention. The interview explored participants’ experience and perceptions of
participating in the Paro intervention to gain a better understanding of the use of Paro in bringing about a change in mental well-being. Each interview took approximately 30-40 minutes and was recorded digitally and transcribed verbatim.

6.8 Ethical considerations

Ethics approval for the study was obtained from a University Human Research Ethics Committee (Reference Number: 2017/911) before the commencement of the study. Written consent for participation was obtained before the start of the study from all participants.

6.9 Data analysis

Quantitative data were analysed using SPSS 25.0 (IBM, Armonk, NY). An intention-to-treat approach (Gupta, 2011), in which all participants’ data were analysed according to their enrolment, was used. Descriptive statistics were used to demonstrate demographic characteristics. A repeated analysis of variance (ANOVA) was used to examine changes in depression and loneliness before and after the Paro intervention. Due to abnormal distribution of data, the Friedman test was employed to examine changes in quality of life. Further post-hoc analysis using the paired sample t-test and Wilcoxon Signed Ranks test were conducted where appropriate. Cohen's d of 0.20, 0.50, and 0.80 were used to represent small, moderate and large effects, respectively. The significance level was set at $p < .05$.

All interview data were audio-recorded digitally and transcribed verbatim in Chinese for data analysis by a research assistant. The researcher checked the quality of transcription by selecting a transcript and re-listening to the digital recording while reading the transcribed text. Qualitative data analysis was guided by the six steps of thematic analysis outlined by Braun and Clarke (2006): (i) familiarization with data; (ii) generation of initial codes; (iii) identification of themes; (iv) reviewing themes; (v) defining and naming themes; and (vi) producing the report. The researcher read through the qualitative data to obtain a sense of overall views and wrote memos about initial perceptions of the data. An initial coding framework was developed by the researcher based on an initial analysis of the first three participant transcripts, using inductive coding and a constant comparative approach. Another researcher checked the accuracy of the language translation of the
manuscript and assisted the researcher to recognize important phrases or experiences mentioned by participants, following a reading of the transcripts. The researcher coded each transcript once a comprehensive coding framework was agreed upon. Differences in coding were discussed, resolved, and used in the further development of the coding framework. Themes and sub-themes were compiled together with verbatim quotations.

3. RESULTS

3.1 Participants

Thirty-two eligible older adults with depression were approached before the commencement of the study. Of these, 12 older adults declined to participate due to a lack of interest (n = 6), did not return the consent form (n = 2), felt stressed (n = 3), or did not provide a reason (n = 1). Finally, 20 participants consented to participate in this study, all of whom completed the study, and there was no missing data.

3.2 Demographic characteristics and health information of participants

The demographic characteristics and health information of the participants are summarized in Table 1. The participants were aged between 65 and 93 years, mean 81.1 ± 8.2. The majority of participants were female (65%) and were widowed (65%). Seventy per cent of participants reported that they did not have a pet before they moved into LTC, and on average, they had lived in LTC for 3.4 years (SD = 2.3). The mean baseline Barthel score was 54.5 ± 31.4 indicating moderate dependency in self-care and activities of daily living in participants.

All participants had experienced at least one chronic disease or illness. Seventy-five per cent of participants had a diagnosis of mild depression, but only a few of them (5%) took antidepressants, and none received other forms of treatment for depression such as cognitive or electroconvulsive therapy. However, some participants took medications such as anxiolytics (15%), hypnotics (40%), and medications for acute anxiety and psychotic conditions (85%).

3.3 Effects of 24-hour PARO intervention on depression, loneliness, and quality of life
Changes in scores of depression, loneliness, and quality of life at each time point are presented in Figure 1. In the observation stage (from T1 to T2), there were no significant changes in these three variables. However, in the 8-week 24-hour Paro intervention (from T2 to T4), the results revealed significant positive changes in these three variables. Mauchly's Test of Sphericity indicated that sphericity was established in both depression ($\chi^2 = 4.09, p = 0.54$) and loneliness ($\chi^2 = 5.92, p = 0.32$). Repeated ANOVA revealed a statistically significant difference for both depression, $F(3, 57 = 87.26, p < 0.001, \text{partial eta squared} = 0.821)$ and loneliness, $F(3, 57 = 61.7, p < 0.001, \text{partial eta squared} = 0.765)$. Also, we provided Cohen's d effect size in Table 2. Post-hoc examination using paired sample $t$-tests was undertaken to determine the differences for depression and loneliness in each pair of comparison (Table 2). After the 8-week 24-hour Paro intervention (from T2 to T4), there were significant differences in every time point comparison ($p < 0.05$).

The Friedman test was used to examine changes in quality of life due to an abnormality of data distribution. The results demonstrate that there was a significant difference in the quality of life for participants over time ($\chi^2 = 30.28, p < 0.001$). Consequently, post-hoc analysis using the Wilcoxon Signed-Rank test was conducted to examine the differences in quality of life in each pair of comparison (Table 3). There was no significant difference in the observation stage (T1 and T2). After the 8-week Paro intervention, there were significant differences in T2 versus T3 and T2 versus T4, but no significant difference in comparison of T3 versus T4.

Since taking antidepressants might affect the outcome of the study, 5% (n=1) of the participants who had taken antidepressants were excluded. This exclusion did not impact on depression, loneliness, and quality of life results.

3.4 Qualitative results

Three themes emerged from the interviews: [i] humanizing Paro through referring to personal experiences and engagement; [ii] increased social interaction with other people through using Paro; and [iii] companionship resulting in improved mental well-being. Participants are referenced by their number followed by gender (F = Female; M = Male) and age (e.g. Case 1, F84).
3.4.1 Theme 1: Humanizing Paro through referring to personal experiences and engagement

Humanizing Paro is defined as attributing human-like qualities to a robot. The naming of Paro was an important first step for this intervention as it determined how participants perceived Paro and affected how they interacted with it. Humanizing Paro by giving it a name through referring to personal experience and engaging with it in a meaningful way emerged as important factors for all participants as they regarded Paro as a valuable object, automatically stimulating them to interact with it. These names were positive identities, related to a close family member, a pet, a nickname, or a memorable object from past experiences. One participant stated: “I called him Brown Sugar Cake, because that was the only dog I had. It reminded me of him. I miss my dog very much [Case 5, M65]”. Another participant said: “I called it ‘Xiao-Ying’, because that was the nickname my husband had for me [Case13, F75]”. Assignment of a meaningful name appeared to affect the role assigned to Paro by participants and influenced how participants interacted with it and their attitudes toward it. Hence, humanizing Paro helped participants feel closer to Paro and engage with it.

3.4.2 Theme 2: Increased social interaction with other people through using Paro

This theme involves how Paro provides an opportunity to help participants improve social interactions, such as increasing verbal responses among older adults in LTC. Several participants exhibited increased verbal and non-verbal communication while holding and talking with Paro. They liked to talk with Paro, made eye contact, and paid attention to it. An example follows: “I loved to chat with Da-Xiong in Japanese, Mandarin, and Taiwanese [Case 18, M88]”. One participant articulated that Paro provided opportunities to encourage conversations with others since other residents would come to interact with her when she was with Paro. This would not occur when she did not have Paro. She said:” I think I have more conversations with other people because of Xiao-Jin [Case 1, F81]”. Another participant stated “When I took it outside, some residents came to play with Du-Du and staff took pictures with it. I have more interactions with other people [Case 4, F86]”. Most participants highlighted that Paro provided opportunities to help them
improve their social interaction as they experienced the benefits of using Paro as a means of connection to other people.

3.4.3 Theme 3: Companionship resulted in improved mental well-being

This theme refers to Paro providing companionship for older adults with depression and looks at how Paro helped participants to improve their mood and well-being. Companionship is defined as participants feeling a sense of closeness with Paro. This involved Paro being there, wanting Paro to be there, enjoying its company and then developing a relationship that came naturally. Participants had Paro as a companion during the Paro intervention, which provided sufficient time for interaction with it according to their preferences. Participants said that “I had a lot of affection for Xiao-Ying, it felt like an emotional attachment, like someone was waiting for me and needed me [Case 13, F75]”. Most participants thought that Paro could comfort them through companionship, and participants reported experiencing a more meaningful life in LTC as Paro blended into their daily routines. A participant stated: “When it stayed with me, I don’t feel like a silly old person living here. When it lived here, it made sounds. I felt that time flew faster, life was more meaningful and there was companionship [Case 6, M89]”. Some participants saw Paro as a meaningful presence instead of one of the scheduled activities in LTC. One participant said: “Steven helped me to kill time and to forget about things. It should be said that it gave us some level of comfort, like my loved ones, ~ I regard it as a companion, and it is comforting [Case 3, M65]”.

Additionally, most participants indicated that Paro could reduce the feeling of loneliness through direct interaction such as stroking, petting, and conversation or indirect interactions such as putting Paro next to them. A participant said: “I don’t feel as bored because I could talk to Little-Cute. I was able to overcome the feeling of loneliness because I felt that there was someone accompanying me [Case 7, F74]”. Most participants indicated that Paro engendered positive psychological effects and provided warmth and companionship to boost their mood and to lift their spirits. One participant said: “I felt that there was an improvement in my mood, and this has continued. There are many good things about Xiao-Qiu, it will be helpful to us living here [Case 16, F76]”.

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However, difficulty with disengagement from Paro indicated the existence of a rewarding relationship between the participants and Paro after the termination of the intervention. Although participants enjoyed the opportunity to engage with Paro, some of the participants reported that they encountered difficulties with disengagement when the social robot was removed. For example, “After Chubby left, I felt lonely and disappointed. The care staff teased me and said: ‘Since Chubby went back, I cannot fall asleep’. I used to get up at 5:30 in the morning, but now I get up at 4:30. I haven’t sleep well in the last few days. It’s affected my sleep a little. I feel like I have lost a companion (Case 8, F84)”. However, these symptoms presented for only one to two days, and then they returned to their usual activities prior to their time with Paro.

4. DISCUSSION

Advances in technology have created a potential for the provision of a new form of health and social care. Recently, there has been increasing interest in the use of social robots to alleviate psychological distress and encourage social interaction for older adults. However, very little is known about Paro as an intervention for depressed older adults living in LTC. This study is distinctive because it is the first study using a 24-hour Paro intervention to examine the effects of Paro on depression and well-being for older adults and to explore participants’ experience of Paro. As significant improvements in mental well-being were noted in this study, there may be advantages in using Paro alone or in combination with a suite of other psychological interventions. Older adults indicated positive experiences with Paro and mood improvement during the intervention. Consequently, these findings provide a number of important implications for meaningful future research. Quantitative results demonstrated that Paro can potentially alleviate depression and loneliness and improve quality of life. Qualitative findings identified key factors, which improved mental well-being, including humanizing Paro through referring to personal experiences, increased social interaction, and companionship resulting in mood improvement.

The findings of this study are consistent with previous studies, which have demonstrated that participation in Paro interventions could decrease depressive symptoms (Petersen et al., 2017; Thodberg et al., 2016), anxiety (Petersen et al., 2017), loneliness (Robinson et al., 2013), improve mood (Lane et al., 2016), and quality of life
However, these positive outcomes in depression contrasts with those of other previous studies (Jøranson et al., 2015; Robinson et al., 2013), which indicated that there were no significant changes in levels of depression after a Paro intervention. This discrepancy could be attributed to the low baseline depression scores recorded where different instruments were used. The Cornell Scale for Depression in Dementia (CSDD) and the Geriatric Depression Scale (GDS) were used in the study of Jøranson et al. (2015) and Robinson et al. (2013) respectively. Low scores of depression at baseline were recorded in both studies where the flooring effect may have confined the potential for an improvement in depression in both studies.

Uncertainty remains as to whether Paro has sustained effects on depression and loneliness. Findings of a cluster RCT (Jøranson et al., 2015) demonstrated no immediate effect of a Paro intervention in decreasing depression but interestingly found a significant sustained effect on depression three months after the Paro intervention. In contrast, studies by both Moyle et al. (2017) and Liang et al. (2017) found no evidence of longer-term sustained effects of Paro on mood improvements post-intervention. Furthermore, while Paro interactions can positively reduce loneliness (Robinson et al., 2013), there was a lack of studies to assess the longer-term sustained effects of Paro on loneliness. Further research is thus needed to determine the sustained effects of Paro intervention on depression, mood, and loneliness.

Humanizing a robot does not necessarily imply an anthropomorphic appearance and robots do not need to emulate all possible human activities or simulate human emotions (Sciutti et al., 2018). Humanization impacts people’s expectations of how to interact with a robot and their views of what it is or what it is not. Furthermore, appropriate use of robots varies according to the extent to which they are perceived as having human qualities (Robert, 2017). The qualitative findings illuminated that participants humanized Paro by giving it a name by referring to personal experiences and engaging with the robot in a meaningful way. This was an initial and crucial step to facilitate interaction and engagement with Paro since this process could help older adults to recall prior positive experiences related to an important event, object, or person in their early life. Older adults had the opportunity to name the Paro to facilitate rapport building, which could motivate interaction and engagement with Paro. This experience affected their connection and
interaction with Paro, which influenced the manner and the frequency of interactions with Paro in the weeks that followed.

Studies have reported that Paro can improve social dynamics, by increasing opportunities for interaction among older adults, care staff, and their relatives and this can lead to an increase in social exchange (Hung et al., 2019; Shibata and Wada, 2011). The qualitative results of the study revealed that older adults increased communication and social interaction with other people through Paro. These results are in line with those of previous studies, which revealed that Paro functions as an icebreaker or a stimulus to start conversations in a group activity (Robinson et al., 2015; Takayanagi et al., 2014). In this study, we found that Paro can play the role of a promotor or intermediator to connect participants with other people. Thus, it can help older adults with depression to expand their interpersonal interactions.

Prieto-Flores et al. (2011) indicated that a lack of companionship is the most common factor related to depression and loneliness in LTC. The clinical environment of residential settings and lack of alternative approaches to care have been identified as depression risk factors (Dow et al., 2011). Since a LTC often has limited funding and staff resources, these may impede the introduction of individual and innovative interventions for older adults. The qualitative results indicated that Paro could comfort participants through companionship and help them experience a more meaningful life in LTC as Paro blended into their daily routines. These findings were consistent with previous studies (Moyle et al., 2018) which revealed that Paro may be an appropriate strategy for treating depression among older adults in LTC, as it is useful in encouraging people to interact with each other, has a calming effect and provides companionship, motivation, and enjoyment. Although Paro presented a positive impact on depression, and well-being in older adults with depression at the end of the intervention, there was a lack of evidence regarding sustainability and long-term effect.

4.1 Strengths and limitations

These findings provided valuable information for designing and specifying the 24-hour Paro intervention for deployment with older adults with depression in LTC to aid in improving their mental well-being. Additionally, the study helped in understanding the
benefits of Paro for reducing depression. However, this study also had some limitations. First, this study did not compare changes in participants’ psychological responses against a comparison or control condition. Therefore, a randomized controlled trial is needed to determine the psychological effect of the intervention. Second, the Paro intervention lasted for 8 weeks, but participants used the Paro for varying amounts of time. It was challenging to record the amount of time participants spent interacting with Paro within a 24-hour time period, due to a lack of human resources and the reliable recording means such as an inbuilt function in Paro to record interaction time. Therefore, it is conceivable that the amount of time interacting with a PARO might be a mediator that impacts the outcome of the intervention. Third, although qualitative interviews were performed by the principal investigator, analyses were conducted by two researchers. Therefore, there was no investigator bias. However, investigator bias may occur in this study due to the lack of blinding. Therefore, these might limit the interpretations of the study. Last, due to the purposive sampling of depressed older adults living in LTC, there was a limitation for generalizability of the study findings.

5. CONCLUSION

As significant improvements in mental well-being were noted in this study, there may be advantages in using Paro alone or in combination with a suite of other psychological interventions. Older adults indicated positive experiences with Paro and mood improvement during the intervention. Consequently, these findings provide a sound foundation for meaningful future research.

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