

Bridging Culture and Technology: Developing a Culturally Sensitive intervention to
Alleviate Loneliness and Social Isolation among Older Chinese Immigrants

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ABSTRACT

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Background: Older adults are often considered particularly vulnerable to loneliness and social isolation, primarily due to functional declines associated with aging, an increased risk of facing multiple losses, and diminished resilience during their later years. Loneliness is the subjective feeling of lacking support and companionship, while social isolation is its objective counterpart, indicating a genuine lack of social connections. Despite having apparent definitional differences, loneliness and social isolation often co-occur, exacerbating their negative impacts on older adults. A recent report by the U.S. federal government highlights that loneliness is a critical public health issue, severely affecting the health and well-being of older adults. Addressing this issue and ensuring the mental health of the aging population have become urgent health challenges in a rapidly aging global population. With the advancement of technology and the push from the pandemic, Information and

Communication Technology (ICT) is a potential strategy to promote social connections and reduce feelings of loneliness. However, there remains a lack of solid evidence supporting the effectiveness of existing interventions, including those involving ICT. The failure of these interventions can be attributed to the complexity of loneliness experience and the diversity of subjects' backgrounds, including racial and cultural differences. International migration is considered a significant risk factor for loneliness and social isolation, especially in older adults. The population of older Chinese immigrants is rapidly expanding and has become one of the largest groups in Western societies. Despite their numbers, older Chinese immigrants have received limited attention in the research literature, even though they exhibit a higher prevalence of loneliness compared to other age and ethnic groups. This not only troubles older adults and their families but also negatively affects the healthcare system and even the stability of society.

Objectives: This dissertation attempts to develop an effective strategy to address this critical issue more precisely, bridging the gap in knowledge and application. The objective of this research is to gain a comprehensive understanding of the experiences of loneliness and social isolation among older Chinese immigrants and to design, develop, and evaluate a culturally sensitive ICT intervention aimed at mitigating these conditions. Specifically, the study aims to: 1) explore the lived experiences and challenges related to loneliness, social isolation, and technology use among older Chinese immigrants; 2) assess the effectiveness of existing ICT

interventions in addressing loneliness and social isolation, with a focus on culturally sensitive approaches; 3) design and preliminarily test a web-based discussion platform, Virtual Online Communities for Aging Life Experience–Older Chinese Immigrants (VOCALE-OCI), tailored to the specific needs and preferences of older Chinese immigrants.

Methods: This dissertation is divided into three parts. The first study includes results from in-depth interviews with older Chinese immigrants in the United States to explore their experiences of loneliness and social isolation and engagement with ICT. Thematic analysis reveals vital themes related to the multifaceted nature of loneliness, the impact of cultural and social factors, and the challenges and motivations behind ICT use. The second study includes a review of the literature on ICT interventions for loneliness and social isolation among older adults, focusing on culturally sensitive approaches. The third study involves designing, developing, and preliminary evaluating VOCALE-OCI through participants' feedback and usability testing by the think-aloud method, applying Human-Centered Design principles, and emphasizing cultural sensitivity.

Main findings: The qualitative study identified four core themes related to the subjective experiences of loneliness and social isolation among 18 older Chinese immigrants (mean age: 72.09 years; standard deviation: ± 10.27 years; age range: 60-89 years old), highlighting the importance of cultural influences, life transitions, and overcoming technological barriers. The review included 13 reviews comprising various types of review articles published within the

last five years. This research emphasized the potential of ICT interventions in reducing loneliness among older adults but also pointed out the limited research on minority racial/ethnic groups and the necessity for culturally sensitive designs. Building on the first two, the third study combined Bronfenbrenner's Ecological Systems Theory to develop a prototype of VOCALE-OCI. This study involved 8 older Chinese immigrants, with a mean age of 65.88 years (SD = 5.94) and an age range from 60 to 78 years. Preliminary usability showed positive participant feedback, indicating its potential to foster a sense of belonging and community. Participants noted that the online community platform was culturally resonant, accessible, and inclusive, aligning with their cultural values and preferences.

Conclusions: The findings from this dissertation contributes to a deeper understanding of loneliness and social isolation among older Chinese immigrants and demonstrates the potential of a culturally sensitive ICT solution, VOCALE-OCI, to address these challenges.

The research underscores the critical role of cultural sensitivity in designing effective interventions and the importance of involving users in the design process. The findings highlight the value of advocating for the expansion of research to include diverse older immigrant populations and the exploration of long-term effects and broader applicability of such interventions. Future work should focus on refining ICT solutions based on continuous feedback, integrating advanced technologies like AI for personalization, and developing scalable interventions that can be adapted to other vulnerable groups.

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CHAPTER 1.

Introduction

Background and Significance

Older adults are particularly vulnerable to loneliness and social isolation, primarily due to age-related functional declines, an increased risk of experiencing multiple losses, and diminished resilience during later life transitions (Golden et al., 2009; Simon et al., 2014). Loneliness is the subjective sensation of feeling unsupported and without companionship, while social isolation represents its objective counterpart, indicating a real lack of societal connection (Tomaka et al., 2006; Wu, 2020). Despite their distinct definitions, loneliness and social isolation often occur simultaneously, exacerbating their negative impacts on older adults (Balki et al., 2022). A recent report by the United States (U.S.) federal government underscores the significance of loneliness as a critical public health concern, severely affecting the health and well-being of older adults (National Academies of Sciences, Engineering, and Medicine, 2020). Addressing this issue and ensuring the mental health of the older adult population has emerged as a pressing health challenge as the global population ages rapidly. However, there remains a lack of strong evidence supporting the effectiveness of existing interventions (Akhter-Khan & Au, 2020; Shah et al., 2021). The failure of these interventions can be attributed to a neglect of the complex nature of loneliness and the

diversity of the subjects' backgrounds, including racial and cultural differences (Akhter-Khan & Au, 2020; Jin et al., 2021).

Immigration has been identified as a significant risk factor for loneliness and social isolation, particularly in older adults (Wu & Penning, 2015). The population of older Chinese immigrants is rapidly expanding and has become one of the largest groups in Western societies (Lin et al., 2015). Despite their considerable numbers, older Chinese immigrants have received limited attention in the research literature even though they exhibit a higher prevalence of loneliness compared to other groups (Simon et al., 2014). This dissertation attempts to develop an effective strategy to more personalized improve this significant issue, which not only troubles older adults and their families but also negatively affects the health care system and even the stability of society.

The **significance** of this research can be articulated as follows:

1. **Loneliness and social isolation constitute a severe threat to the well-being and health of older adults.** Several studies have shown that loneliness is related to negative health consequences such as depression, high blood pressure, heart disease, stroke, and diminished longevity (Cacioppo, Capitanio, & Cacioppo, 2014; Coyle & Dugan, 2012; Gale, Westbury, & Cooper, 2018). Social isolation also increases health concerns, and is associated with dementia, increased risk of falls, and increased risk for re-hospitalization (Kuiper et al., 2015; Shah et al., 2023). Research indicated one-third of older adults feel

a lack of companionship, and 27% often isolated from others (Abedini et al., 2019). The COVID-19 pandemic has aggravated loneliness and social isolation in older adults. As the population rapidly ages, the importance of paying attention to the mental health of older adults has become increasingly prominent (Brooke & Clark, 2020). Loneliness comes from the gap between reality and expectations in interpersonal relationships (Malani et al., 2019; Perlman & Peplau, 1981). Loneliness and social isolation are both linked to inadequate social support (Peerenboom et al., 2015). Social support buffers loneliness and social isolation, positively correlates with the quality of life of older adults, and helps reduce stress and depressive symptoms (Unsar et al., 2016; Krause & Liang, 1986). Giving and receiving support are both beneficial to older adults' well-being (Thomas, 2010). Accordingly, it is essential to understand the root causes of personal loneliness to formulate appropriate methods

2. **Information and Communication Technology (ICT) is considered a promising**

strategy to help alleviate loneliness among older adults, as it can facilitate social connection, provide convenience and connection, and create opportunities for diverse interactions (Barbosa Neves et al., 2019). ICT refers to the interconnection of information technology equipment (personal computers) and communication technologies (telephones and telecommunications networks). ICT use is especially pronounced after COVID-induced social distancing (Guner et al., 2021). According to

studies that investigated the impact of loneliness on death anxiety, the fear or worry that arises from the awareness of death (Menziés & Menziés, 2020), among older adults during the COVID-19 pandemic, the researchers found a positive, high, and significant relationship between general loneliness, social-emotional loneliness, and death anxiety among older adults (Guner et al., 2021; Aisenberg-Shafran et al., 2021). Research also shows that participants in our research studies who do not use social media or mobile phones to communicate with their relatives have higher levels of loneliness (Guner et al., 2021). When ICT interventions are designed with an age-centered approach, participants are more inclined to use these interventions frequently and maintain a positive attitude towards technology (Czaja et al., 2018; Rochat et al., 2018; Arlati et al., 2019; Vercelli & Rainero, 2019). The researchers suggested enhancing older adults' ability to operate technology, emphasizing the expansion of their communication networks, and advocating that the use of technology is critical in preventing loneliness among older adults (Hajek & König, 2021). Therefore, it is necessary to consider the needs of older adults and the digital divide, and design interventions according to their interests and preferences.

- 3. Chinese older adults in the United States are minorities who receive little attention, and there is limited research on this population.** The Chinese represent the oldest and largest Asian demographic in the United States, numbering million, with approximately

20% aged 65 or over (Budiman & Ruiz, 2021; Rosenbloom & Batalova, 2023). This population is experiencing rapid growth (Dhingra et al., 2020; Budiman & Ruiz, 2021). Despite their significant presence, the health needs of older Chinese Americans have not been adequately addressed, and research on this demographic remains sparse (Dong et al., 2014; Liang et al., 2024). This oversight is particularly pronounced for older adults who immigrate to the U.S. later in life to live with their adult children. These individuals often face challenges such as lower levels of education, limited English proficiency, and a higher likelihood of poverty (Tran, 2017). Furthermore, older Asian Americans exhibit the lowest rates of English proficiency and homeownership among their age group, underscoring the barriers they face in accessing quality healthcare and integrating into new social networks (Kim et al., 2020; Young et al., 2022).

The vulnerability of older Chinese immigrants to loneliness is exacerbated by the loss of their original social networks, cultural and linguistic barriers, limited physical activity, and challenges in adopting technology, making it difficult for them to integrate into new social environments (Li et al., 2018). A population-based study in the Chicago area revealed that the prevalence of loneliness among older Chinese Americans is notably higher (26%) compared to older Chinese immigrants in Britain (20%), the overall aging U.S. population (16.9%), and older adults in mainland China (Theeke, 2010; Victor et al., 2012; Simon et al., 2014). This indicates that older Chinese

immigrants constitute a high-risk group for loneliness and should be a priority for intervention.

Moreover, many older Chinese immigrants struggle with English proficiency, have lower health literacy levels, and have limited access to high-quality healthcare services. They often feel isolated and lack social support due to cultural and linguistic barriers, transportation issues, and unfamiliarity with the U.S. healthcare and living systems (Dong et al., 2014; Simon et al., 2014). While loneliness is a common issue affecting this group, the specificity of their experiences and the subjective nature of loneliness mean that not all interventions are equally effective across this diverse population. There is a clear need for adaptive interventions that address personal demands and are culturally and linguistically appropriate for older Chinese immigrants, taking into account their cultural backgrounds and experiences in interventions (Dong et al., 2014; Simon et al., 2014). Synthesizing existing literature indicates a need for further understanding of the complexities and variations in loneliness experienced by older adults from diverse backgrounds. This understanding is essential to precisely develop interventions tailored to the needs of older Chinese immigrants. This calls for focused research and development of interventions that prioritize the mental health and well-being of older Chinese immigrants, a demographic that, despite its significant size and growing presence, receives little attention in both academic research and healthcare

planning.

Statement of the Study Purpose

The dissertation aims to address this significant gap in mental health care for older Chinese immigrants by developing a culturally sensitive, online community specifically designed to alleviate social isolation and loneliness among this demographic. The specific objectives of this dissertation include:

1. To conduct a qualitative study to explore the subjective experiences of loneliness and social isolation and the factors influencing the acceptability of technologies, including challenges in adopting technology, motivations, and strategies for overcoming technological barriers.
2. To perform an umbrella review to assess the updated evidence of the effectiveness of ICT interventions in mitigating loneliness and social isolation among older adults.
3. To design, develop, and evaluate a culturally sensitive online community prototype, VOCALE OCI, aimed at reducing loneliness and social isolation among older Chinese immigrants.

Content of the Dissertation

This dissertation is organized into three primary sections. It was essential to first understand the unique experiences and challenges faced by older Chinese immigrants to build a foundation for the exploration of the solution to address the issues. Therefore, Chapter 2 begins with a qualitative study conducted through in-depth interviews with 18 older Chinese

immigrants in the United States. This study probes into their experiences with loneliness, social isolation, and the engagement with ICT while residing in a foreign nation. It specifically examines the interplay between cultural influences, immigration, societal factors, and technological aspects, highlighting the significant elements that encourage their ICT adoption. The analysis provides insights into the obstacles encountered by this group in adopting technology, their motivations for utilizing ICT, and the strategies developed in response to technological challenges. This study contributes to deepening the understanding of how to enhance the accessibility and effectiveness of ICT interventions for this demographic.

Next, to understand the current state of ICT interventions in alleviating loneliness and social isolation among older adults, the second part (Chapter 3) presents the results of an umbrella review. This integrative analysis is dedicated to exploring the design and implementation of ICT strategies aimed at reducing feelings of loneliness and social isolation among this demographic. Chapter 3 focuses on gathering and reviewing evidence from review articles, synthesizing the latest findings. By summarizing a wide range of reviews, it sheds light on the nature, effectiveness, theoretical underpinnings, limitations and recommendations for ICT interventions aimed at eliminating loneliness and social isolation among older adults. Furthermore, it delves into the challenges faced by these interventions, particularly highlighting the significance of cultural considerations.

The third section (Chapter 4) presents the outcomes of the design, development, and evaluation process of the VOCALE OCI prototype. It includes insights from participant feedback, highlighting their perspectives and the prototype's effectiveness in addressing their needs. Anchored in Human-Centered Design (HCD+), this initiative focuses on creating an online community tailored to alleviate loneliness and social isolation specifically among older Chinese immigrants.

In the final chapter, Chapter Five, I provide a comprehensive summary of all the research conducted, offering a cohesive overview of the findings. This chapter concludes with an extensive discussion, not only presenting potential solutions to the challenges encountered in developing ICT measures for minority immigrant populations but also highlighting the potential opportunities presented by using the VOCALE-OCI online community. The focus of this discussion is on its effectiveness in alleviating feelings of loneliness and social isolation among older Chinese immigrants in the United States.

Additionally, this chapter further explores future research directions and potential applications of the VOCALE-OCI online community, including how ongoing feedback and iterative design improvements can enhance platform usability and engagement. The discussion also speculates on the integration of advanced technologies, such as AI-driven personalization and language translation features, to make the platform more accessible and customizable according to user needs. It also explores the potential for expanding and

adapting the VOCALE-OCI platform to other immigrant communities and demographic groups facing similar challenges, to increase its broader applicability and impact. This chapter emphasizes the importance of user involvement in the design process to ensure the platform remains relevant and effective in meeting the nuanced needs of different groups. Through these discussions, Chapter Five lays the foundation for future exploration and application, offering examples and directions for innovative solutions to combat loneliness and social isolation in aging immigrant communities.

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CHAPTER 2.

Navigating Loneliness and Social Isolation in a Digital Age: Cultural, Social, and Technological Influences Among Older Chinese Immigrants in the U.S.

Abstract

Background

Loneliness and social isolation significantly impact the well-being of older adults, particularly immigrants from minority groups. Despite the various interventions developed to address these issues, their effectiveness remains unclear, possibly due to neglecting the subjective nature of loneliness and the diverse backgrounds of participants, including racial and cultural differences.

Research Purpose

This study aims to understand the experiences of loneliness, social isolation, and information and communication technology (ICT) usage among older Chinese immigrants in the U.S, focusing on cultural, social, and technological factors influencing their experiences.

Methods

The qualitative study utilized in-depth interviews conducted in Mandarin Chinese with 18 older Chinese immigrants in Seattle (mean age: 71.11 ± 9.5 years, range: 60-89 years).

The data were analyzed using thematic analysis.

Results

Four main themes emerged: Four main themes emerged: 1. Theme 1 explores the multifaceted nature of loneliness and social isolation, emphasizing the personal, psychological, and spiritual dimensions influenced by individual and cultural factors. 2. Theme 2 discusses the experiences and challenges of loneliness and social isolation, including life transitions, homesickness, limited English proficiency, and mobility restrictions. 3. Theme 3 explores technology adoption, identifying motivations and barriers such as reliance on others, privacy concerns, and strategies to overcome these challenges. 4. Theme 4 focuses on the cultural influences on the use of information and communication technology, loneliness, and social integration.

Conclusion

Older Chinese immigrants face unique challenges in combating loneliness and social isolation, significantly influenced by cultural, social, and technological factors. Their experiences highlight the need for culturally sensitive approaches in designing intervention measures and support mechanisms.

Keywords: Loneliness, Social Isolation, Older Chinese Immigrants, ICT Use, Cultural Impact, Qualitative Study.

Introduction

There is abundant evidence to suggest that loneliness and social isolation have detrimental effects on the health and well-being of older adults, posing a significant public health issue. These conditions are not only linked to various adverse health outcomes, including depression, stroke, cognitive decline, dementia, and an increased mortality rate (Fratiglioni et al., 2004; Gale et al., 2018; Mann et al., 2017; Van As et al., 2022; World Health Organization, 2024), but they also place a considerable burden on socioeconomic and healthcare systems. The issue has received increased attention due to the rapid aging of populations globally, leading researchers and policymakers to prioritize reducing loneliness among older adults in public health policies (Akhter-Khan & Au, 2020; World Health Organization, 2024). Despite the development of numerous interventions to combat loneliness and social isolation, the evidence of their effectiveness remains inconclusive (Akhter-Khan & Au, 2020; Shah et al., 2021). The failure to fully consider the subjective nature of loneliness and the varied backgrounds of research participants, including differences in race and culture, may contribute to the ineffectiveness of these interventions (Akhter-Khan & Au, 2020; Jin et al., 2021).

Moreover, immigration has been identified as a significant risk factor for loneliness, especially among older adults (de Jong Gierveld et al., 2015; Wu & Penning, 2015). This is particularly concerning in the United States, where the aging population is increasingly

diverse, highlighting the need for health interventions that are culturally sensitive and tailored to the needs of older adults from minority backgrounds. Among these groups, Chinese Americans constitute the largest Asian-origin group in the U.S. and one of its fastest-growing ethnic demographics (Budiman & Ruiz, 2021).

As the third-largest immigrant group in the United States, Chinese immigrants make up about 5% of the U.S. immigrant population as of 2021, with their numbers continuing to rise. Notably, among this population, older adults account for a significant 20%, a proportion that surpasses both the U.S.-born (17%) and the overall immigrant population's elderly proportion (17%) (Rosenbloom & Batalova, 2023). With the trend of aging intensifying, the needs and well-being of older Chinese immigrants have emerged as major concerns, particularly given the significant health risks posed by loneliness and social isolation. Older Chinese immigrants may encounter unique challenges related to loneliness and social isolation due to factors such as language barriers, cultural differences, family structure, social networks, and health issues (Li et al., 2018). A population-based study found that the prevalence of loneliness among older Chinese immigrants in the U.S. is 26%, significantly higher than that observed in older Chinese immigrants in Britain and the broader aging population in the U.S. (Simone et al., 2014). Despite this, older Chinese immigrants have received limited attention in research and intervention efforts (Lai et al., 2020; Hawkins et al., 2022).

While previous studies have explored the benefits and barriers of ICT use among older

adults, such as facilitating interpersonal interactions and connections, expanding social circles, and establishing support systems (Fotteler et al., 2023; Jøranson et al., 2023), older Chinese immigrants face unique cultural and linguistic challenges that may influence their adoption and use of ICT differently compared to other older adult populations. Therefore, more literature is needed concerning the experiences and needs of older Chinese immigrants in this regard. This knowledge gap suggests insufficient research targeting this specific group, leaving us without a comprehensive understanding of their unique challenges with technology adoption and the potential cultural influences they may encounter in adopting ICT solutions. Furthermore, existing studies often overlook the impact of personal backgrounds and experiences on technology acceptance, particularly within cross-cultural older adults (Akhter-Khan & Au, 2020). Cultural factors are essential for understanding the acceptance and usage of ICT among older Chinese immigrants. The cultural backgrounds, values, and beliefs of this group may profoundly affect how they perceive and utilize technology, thus significantly influencing the effectiveness and acceptability of ICT solutions. Therefore, considering this point is vital for designing technology interventions that meet the specific needs of this population.

Building upon this, the present study addressed three key questions to delve deeper into these issues:

1. How do Chinese older adults experience and perceive loneliness and social

isolation? This question aims to understand better the subjective experiences and perceptions of loneliness and social isolation among older Chinese immigrants. It explores how they experience loneliness and social isolation in their daily lives in American society and the impact of these experiences on their psychological well-being and social welfare.

2. What role does Information and Communication Technology play in alleviating loneliness and social isolation among older Chinese immigrants? This question explores how ICT is utilized by older Chinese immigrants to address issues of loneliness and social isolation. It investigates how they use these technologies to maintain existing social connections and establish new ones and the impact of these technologies on improving their social interactions and quality of life.
3. How do cultural factors influence ICT usage and perceptions of loneliness and social isolation among older Chinese immigrants in the United States? This question aims to examine how cultural backgrounds shape the acceptance and usage of ICT among older Chinese immigrants and how cultural factors influence their perceptions of loneliness and social isolation. This includes studying how factors such as cultural values, language proficiency, and technological habits influence their ability and willingness to engage in social interactions using ICT.

These questions comprehensively address the unique challenges related to loneliness

older Chinese immigrants face in the United States, aiming to provide a basis for developing targeted social support and technological interventions through qualitative research methods. They cover multiple facets, ranging from individual experiences to cultural influences to technology usage, thereby offering insights into the design of tailored interventions.

Research Purpose

The overall objective of this study is to gain an in-depth understanding of the experiences of loneliness, social isolation, and the use of information and communication technologies (ICT) among older Chinese immigrants. Specifically, it aims to understand their subjective experiences and perceptions of loneliness and social isolation, explore their use of ICT to alleviate these feelings, and examine how cultural factors influence their ICT usage and perceptions of loneliness and social isolation.

Methods

Study Design

This study employed qualitative research methods, conducting one-on-one in-depth interviews with older Chinese immigrants in Seattle, Washington, to gain a deeper understanding of the life experiences of loneliness and social isolation within the cultural framework, as well as their experiences and perspectives on using ICT. To ensure the quality of the research, the consolidated criteria for reporting qualitative research (COREQ) checklist was employed (please see Appendix 2.1). The research protocol (IRB number 00018094) was

approved by the Human Subjects Division of the University of Washington in Seattle.

Participant Recruitment and Data Collection

The interviewer (S.Y.C.; first author), a female, held a Master of Science Degree in Nursing and was a doctoral candidate during the interview period. She had completed coursework related to qualitative research and had experience as a research assistant interviewing older adults. Furthermore, she practiced interviewing prior to the actual interview sessions to refine the interview guidelines and procedures.

A total of 18 participants were interviewed for this research. The selection criteria for older Chinese immigrants required: (1) being 60 years of age or older, (2) self-identification as Chinese with Mandarin Chinese as the primary non-English language, (3) having immigrated to the United States for at least two years, and (4) residing in King County, Washington. Exclusion criteria included (1) a current diagnosis of severe mental disorder, or (2) cognitive impairment that could influence the ability to respond. Participant recruitment was carried out through various methods. Participant recruitment was carried out primarily using Convenience Sampling and Snowball Sampling methods. Printed and electronic flyers were posted at Asian community centers such as the Asian Counseling and Referral Service (ACRS), Chinese Information and Service Center (CISC), and Kin On. Additionally, flyers and emails detailing the study were sent to potential participants (older Chinese immigrants) by community centers and nursing home, inviting their participation. The first author (S.Y.C.)

also gave presentations at the community centers to introduce the study and recruit participants. Snowball sampling was employed by asking initial participants to refer other older Chinese immigrants who might be interested in the study. The research team then contacted interested individuals, conducting telephone screenings to ascertain their eligibility. All potential participants underwent pre-interview screening to evaluate their eligibility for the study (please see Figure 2.1). Recruiting continued until data saturation was reached, ensuring no new themes were identified from further interviews. Data collection occurred between September 2023 and March 2024. Open-ended, semi-structured interviews were conducted in Mandarin Chinese. According to the preferences of the participants, the interviews were distributed across different modalities: 10 participants were interviewed face-to-face, 6 via Zoom, and 2 by telephone. The face-to-face interviews were conducted either at their homes (9 interviews) or in a reserved discussion room at a library (1 interview). These interviews were one-on-one, with no one else present besides the participant and the researcher. Each interview lasted approximately one hour and utilized an open-ended, semi-structured protocol. Field notes were made during and interviews. Every interview was recorded and transcribed verbatim in Mandarin Chinese. Every interview was recorded and transcribed verbatim in Mandarin Chinese. Analysis of the transcripts was conducted in the original Mandarin to preserve the nuances of the participants' responses. Only the quotes used in the manuscript were translated into English, and these translations were verified by a

bilingual scholar proficient in both Mandarin Chinese and English to ensure accuracy and fidelity. As the study aimed to obtain firsthand experiences from the participants, they were informed that no special preparation was required. However, participants were briefed on the interviewer's background and the goals of the study, as well as the reasons for conducting the interviews.

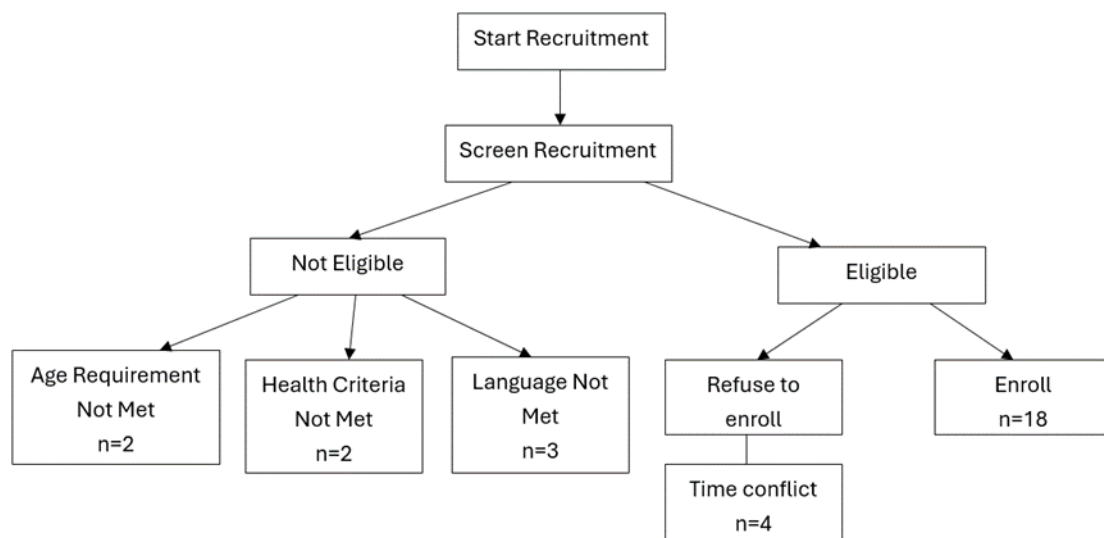


Figure 2.1 The flow chart detailing the recruitment process

Data Analysis

Following the approach outlined by Braun & Clarke (2006), thematic analysis was used to identify major themes. The analysis of the Chinese transcripts, facilitated by MAXQDA software, began with repeated readings of the interview records to familiarize with the data and identify preliminary thoughts and impressions. Employing an inductive method, two coders independently utilized descriptive codes to identify and annotate meaningful segments within the entire dataset, capturing the essence of the articulated content. To ensure inter-rater

reliability during the coding process, we conducted a pilot coding session. Two coders independently coded the transcript of the first interview, compared and discussed discrepancies, and confirmed the coding approach and direction. Throughout the subsequent coding process, the coders engaged in regular discussions to maintain consistency and address any emerging issues. Both coders then collaboratively reviewed the initial codes to find patterns and relationships among them, thereby determining overarching themes. Discrepancies were resolved through consensus meetings, and in cases where consensus could not be reached, a third party, a professor who is an expert in geriatric nursing, was consulted to achieve agreement. Subsequently, themes were searched for by reviewing the initial codes to find patterns and relationships among them, thereby determining overarching themes. The coherence and contextual consistency of themes were reviewed, ensuring they accurately reflected the data. The established themes were collectively refined and confirmed by both coders to enhance interpretive validity. Themes were clearly defined and assigned appropriate names that accurately captured their essence. Themes were presented through illustrative quotes from the data and the significance of the themes relative to the research objectives was explained.

Results

Demographics

In this study, a total of 18 older Chinese immigrants over the age of 60 participated in

individual interviews, comprising 11 female and 7 male participants. The mean age of the female subgroup was 72.09 years, with a standard deviation of 10.27 years. In contrast, the mean age for the male subgroup was 69.57 years, with a standard deviation of 8.70 years. The participants' aggregate mean age was 71.11 years, with a standard deviation of 9.5 years. The age distribution indicates that 61.1% of the participants fell within the 60-69 age bracket, 16.7% within the 70-79 age bracket, and 22.2% within the 80-89 age bracket.

Examining marital status, 66.7% of the participants are married, 5.5% were single, and 27.8% are widowed, with all widowed individuals being female. The classification of educational achievement was: 11.1% have not completed high school education, 11.1% are high school graduates, 50% hold a bachelor's degree, and 27.8% possess a Graduate or Professional degree, with a notably higher proportion of advanced degrees among males (42.9%) compared to females (18.1%).

Regarding residential status, 22.2% of the participants lived alone, 61.1% cohabited with a spouse or partner, and 16.7% lived with children, with all individuals living alone being female. The participants exhibited a wide range of residency durations in the United States, ranging from newcomers who have resided in the US for as little as two years to long-term residents who have lived there for up to 55 years. The data is categorized into decadal intervals, with the largest group consisting of participants who have lived in the US for 21-30 years, accounting for 33.3%, followed by those residing for 31-40 years, constituting 27.8%.

The distribution across other year brackets includes at least one participant each, underscoring the broad diversity among the study participants. **Table 2.1** summarizes the demographic characteristics of study participants.

Table 2.1 Demographic description of study participants (n = 18)

	Female (n = 11)	Male (n = 7)	Total (n = 18)
Age (years), M (SD)	72.09 (10.27)	69.57 (8.70)	71.11 (9.5)
60-69	7 (63.7%)	4 (57.1%)	11(61.1%)
70-79	1 (9%)	2 (28.6%)	3 (16.7%)
80-89	3 (27.3%)	1 (14.3%)	4 (22.2%)
Marital status			
Married	6 (54.5%)	6 (85.7%)	12 (66.7%)
Single	0	1 (14.3%)	1 (5.5%)
Widowed	5 (45.5%)	0	5 (27.8%)
Highest education completed			
< High school	2 (18.1%)	0	2 (11.1%)
High school graduate	1 (9%)	1 (14.2%)	2 (11.1%)
Bachelor's Degree	6 (54.5%)	3 (42.9%)	9 (50%)
Graduate or Professional Degree	2 (18.1%)	3 (42.9%)	5 (27.8%)
Living Situation			
Living Alone	3 (27.3%)	1 (14.3%)	4 (22.2%)
Living with Spouse/Partner	5 (45.4%)	6 (85.7%)	11 (61.1%)
Living with Children	3 (27.3%)	0	3 (16.7%)
Years In US			
0-5 years	0	1(14.3%)	1 (5.5%)
5-10 years	0	1(14.3%)	1(5.5%)
11-20 years	1 (9%)	2 (28.6%)	3 (16.7%)
21-30 years	5 (45.5%)	1(14.3%)	6 (33.3%)
31-40 years	4 (36.5%)	1(14.3%)	5 (27.8%)
41-50 years	0	1(14.3%)	1 (5.5%)

50-60 years

1 (9%)

0

1 (5.5%)

Major Themes Emerging from the Study

In this study, four primary themes were identified, with each theme encompassing various subthemes. The findings reveal the perspectives of older Chinese immigrants on loneliness through Theme 1: Multifaceted Nature: Unveiling Personal, Psychological, and Spiritual Layers. Furthermore, Theme 2: Experiences and Challenges of Feelings of Loneliness and Social Isolation provides an in-depth examination of their experiences and challenges related to loneliness and social isolation. Theme 3: Exploring Technological Engagement: Driving Forces, Obstacles, and Solutions discusses the motivations behind and obstacles to older Chinese immigrants' use of technological products. Finally, Theme 4: Cultural Implications on ICT Use, Loneliness, and Social Integration elucidates the impact of culture on the use of ICT, loneliness, and social integration. Each theme is further explained through specific subthemes, totaling fifteen, as detailed in Table 2.2 and a mind map (Figure 2.2). Visualizing themes can be beneficial for recognizing connections between them (Pokorny et al., 2018).

Table 2.2 Themes and Sub-themes

Theme	Sub-theme	Aspects
1. Multifaceted Nature: Unveiling Personal, Psychological, and Spiritual Layers	1-1. Subjectivity and Diversity	
	1-2. Internal States and Personal Circumstances	
	1-3. The Spiritual	

	Dimension of Loneliness		
2. Experiences and Challenges of Feelings of Loneliness and Social Isolation	2-1. Life Transitions and Homesickness		
	2-2. Disruption and Difficult Reconstruction of Social Networks Amid and Beyond the COVID-19 Pandemic		
	2-3. Limited in English		
	2-4. Health, Aging, and Social Barriers		
	2-5. Mobility Limitations		
	2-6. Desire for Independence		
3. Exploring Technological Engagement: Driving Forces, Obstacles, and Solutions	3-1. Motivations for Adopting Technology	3-1-1. Daily Management	
		3-1-2. Accessing Health Information or Transitioning to Telemedicine	
		3-1-3. Fostering Social Connection	
		3-1-4. Seeking Personal Entertainment	
		3-1-5. Engaging in Personal Growth	
	3-2. Barrier to Adoption	3-2-1. Depending on Others for Help	
		3-2-2. Privacy and Fraud Concerns	
		3-2-3. Physiological Limitations Related to Aging	
		3-2-4. Impact of English-Centric ICT Products on Technology	

	Adoption	
	3-3. Overcoming Technological Barriers: Strategies Used by Older Chinese Immigrants	3-3-1. Seeking Assistance 3-3-2. Online Tutorials and Self-Learning
4. Cultural Influences on Loneliness, Social Networks, and ICT Use Among Older Chinese Immigrants	4-1. Influenced by Confucian Thought 4-2. The Traditional Culture of Avoiding Uncertainty	

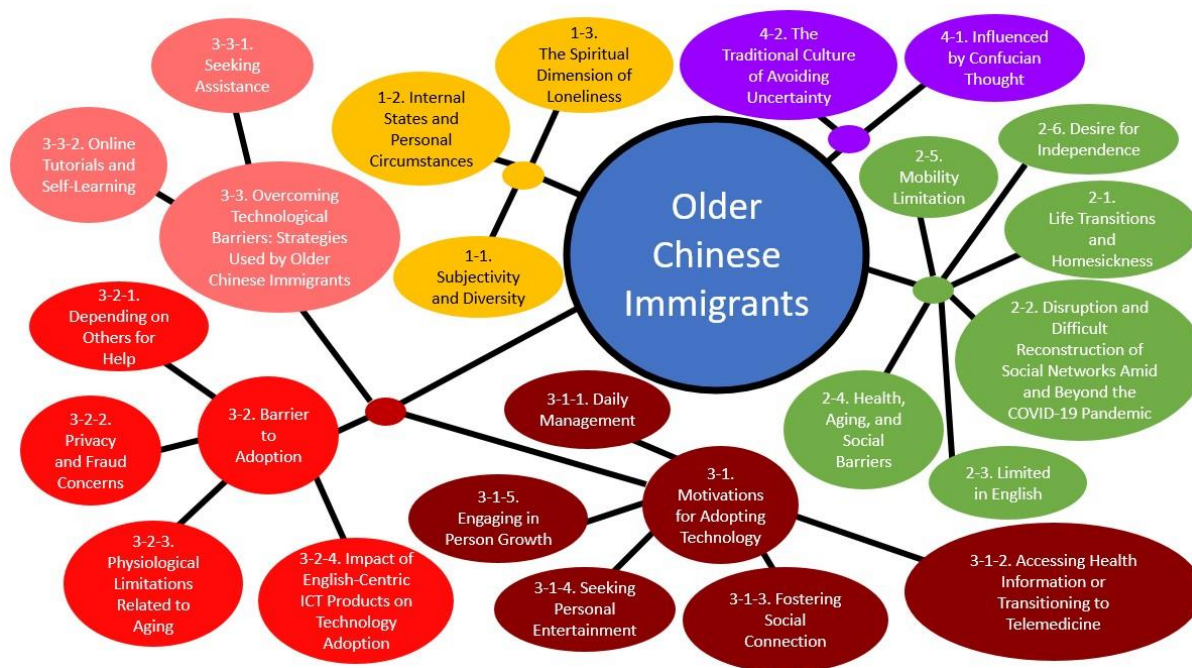


Figure 2.2 The Mind Map of the Themes

Theme 1. Multifaceted Nature: Unveiling Personal, Psychological, and Spiritual Layers

Sub-theme 1-1. Subjectivity and Diversity

Participants' descriptions of loneliness highlighted its close connection to personal

mental health and emphasized the diversity and subjectivity of the feeling of loneliness.

Participants often described loneliness as a negative psychological state, indicating that it could be triggered by external environmental or internal psychological factors. As Participant 16 (P16) stated:

The word loneliness just feels rather negative... The feeling of loneliness is a psychological state. It can be caused by external or internal factors. (P16, Male, 65yrs)

In addition, the participants described the perception of loneliness varies between individuals and the outside world, underscoring the importance of deep conversations, which involve two individuals sharing private and personal details about their lives (Kardas et al., 2022), to understand the true sense of loneliness. For instance, Participant 15's statement exemplifies this variation in perception:

Whether or not one is lonely, there are two aspects: one is whether he himself believes he is lonely, and the second is how other people view him, whether they think he is lonely. These two are different, and this is my view." (P15, Male, 75yrs)

These insights not only show the complexity of loneliness but also point to loneliness as a profound inner experience, the authenticity of which may only be known by the individual.

Sub-theme 1-2. Internal States and Personal Circumstances

The feeling of loneliness is closely related to an individual's social interactions,

personality traits, interests, hobbies, and lifestyle. The sense of helplessness when lacking social companionship and resources is seen as an important source of loneliness. The participants mentioned:

I feel it might be when I feel a lack of companionship. (P02, Female, 60yrs)

Without anyone to accompany, without resources, one feels very lonely when helpless. (P05, Female, 69yrs)

These observations emphasize that loneliness is not merely the absence of external social interaction but pertains to an individual's internal psychological and emotional state.

For example:

If a person has no interest, in anything at all, they won't want to learn anything new, and that might lead to loneliness. (P15, Male, 75yrs)

Feeling very bored can make you feel lonelier. (P06, Female, 89yrs)

Sub-theme 1-3. The Spiritual Dimension of Loneliness

One participant highlighted the connection between the feeling of loneliness and the spiritual dimension, suggesting that achieving a state of spiritual fulfillment can dispel feelings of loneliness, even in the absence of social connections or material wealth. This unique perspective on loneliness introduced a layered approach to understanding life:

My definition of loneliness might be different from what most people you ask would say. Life is divided into three levels: the first level is physical, the second level is

mental, encompassing a sense of achievement and the feeling of reaching goals; and the highest third level is the soul, which transcends the mental, you know, the soul is metaphysical. So, if you can reach this level, you absolutely won't be unhappy. (P03, Male, 61yrs)

The participant's experience emphasizes that loneliness is not merely physical isolation but a deep psychological and emotional state, including a longing to be understood and cared for, as well as a disparity with reality. However, this experience also reveals that for some people, loneliness can lead to self-discovery and spiritual growth, suggesting that it is not absolutely negative.

In conclusion, loneliness is a multifaceted, profound feeling that can originate from both internal and external factors, primarily manifesting as a psychological state. It may be caused by a lack of activities, companionship, social relationships, or regrets about not achieving certain levels in life, leading to a sense of emptiness. Loneliness is not just a lack of material or mental aspects but a craving for fulfillment on a physical, emotional, and even spiritual level. It may be due to a lack of interaction and resonance, as well as differences between personal inner feelings and external perceptions. For some, loneliness represents a lack of deep connections in an extroverted life; for others, it means finding a path to satisfaction and self-actualization, even in isolation. Through in-depth interviews and understanding, we have discovered that loneliness is an extremely personalized and complex experience, closely

linked to each person's life journey, values, and inner world.

Theme 2. Experiences and Challenges of Feelings of Loneliness and Social Isolation

The phenomenon of loneliness and social isolation among older Chinese immigrants encompasses a wide array of experiences and underlying causes, making it a multifaceted and complex issue. These experiences and contributing factors are deeply interwoven, collectively influencing individuals and resulting in different levels of loneliness.

This complexity is further elucidated through insights gleaned from interviews with the participants.

Sub-theme 2-1. Life Transitions and Homesickness

Participants shared how they face challenges brought about by significant life changes such as retirement, declining health, and migration, while simultaneously dealing with the dual pressures of deep longing for their homeland and nostalgia. This profound sense of homesickness is especially highlighted against the backdrop of being far from aging parents and their homeland, thereby intensifying feelings of loneliness and disconnection. As

Participant 1 stated:

Sometimes, I just feel like saying, 'Ah, when family is far away... you really miss home... especially during major festivals, like the New Year or the Mid-Autumn Festival... If you don't spend it with your family, it feels lonely, just like that... Like for the Lunar New Year, there's hardly any festive atmosphere here. It's just about

school and work, and then... there are fewer relatives, and it's also a matter of time.

It's just that other people are not celebrating either, so compared to the atmosphere

back in my hometown, it really lacks a lot. (P01, Female, 60yrs)

The change in pace of life, from one filled with social activities to a static life constrained by physical limitations and reduced social interactions, brought unease to the participants.

There are different challenges for those in their fifties, sixties, seventies, eighties—

physical condition, available resources. We might still be working, possibly

interacting with clients to some extent, but if retire, that's all gone. (P05, Female,

69yrs)

It feels like life is very boring without work. (P04, Male, 60yrs)

At the same time, a deep longing for the familiarity and comfort of their hometown deepened their sense of alienation from their current living environment and homesickness, further intensifying the feeling of loneliness. This experience highlights the need for special attention to the adaptation process to life transitions of older Chinese immigrants and their nostalgia for past lives and cultures.

When I first arrived, I really didn't like it because in my hometown, you see, we work,

and after work, I want to have places to go to, after work, that's our real time. Because

when we were young, when we were single, we could go anywhere to play. But after

coming here (to the United States) and getting married, there were no places to go.

Then as soon as I got married, I lived on this island, and at the beginning of living here, every day after I sent my husband to work, I was alone, locked in that house, and then just waited for him to finish work. So, it was really lonely. (P07, Female, 63yrs)

The friends from when I was young now all have their own lives, so I can't be as close to them as before, because everyone has their own life, and the relationship isn't as close... (P02, Female, 60yrs)

Sub-theme 2-2. Disruption and Difficult Reconstruction of Social Networks Amid and Beyond the COVID-19 Pandemic

Moving to a new country often means leaving behind existing social networks, including friends, extended family, and community ties. For older adults, rebuilding these networks is not only time-consuming but also mentally and emotionally exhausting, especially with the recent impact of COVID-19. Many older Chinese immigrants come to the United States to live with their descendants. Although this arrangement can provide economic and material support, they find that due to their family members being busy with work or studies, they cannot offer enough companionship and attention. Participant 15 expressed:

I have also encountered some of the older generation from Mainland China. Young people can easily integrate into this society, but their parents and our generation face many difficulties in adapting to life here because they can't drive, don't speak the

language, and their children are out working, leaving them feeling very lonely and isolated. (P15, Male, 75yrs)

The pandemic has significantly changed interpersonal interactions. Participants spoke about how COVID-19 has impacted their social activities, noting,

The main change is in the way people interact; there's less contact, and feelings have faded." (P05, Female, 69yrs)

Before the pandemic, I used to take him (my husband) to the senior center every week, and he would be so happy, getting dressed up in his suit and tie, ready to go.

But then, when we couldn't go to the senior center anymore (due to the pandemic), he became very depressed, unbearably so. He said he was too bored, and that you guys (referring to his wife and children) didn't have time to talk to me. (P13, Female, 86yrs).

Even though the social distancing policies implemented during the COVID-19 pandemic have been lifted, its effects continue to profoundly impact older immigrants. The participants said that this public health crisis has limited their social activities and reduced their contact with the outside world, especially as they face the loss of familiar faces, health deterioration, and other changes, further exacerbating their feelings of loneliness. This shows that even after the easing of pandemic control measures, the loneliness challenges faced by older immigrants remain severe. Continuous attention and support are needed to help them rebuild social

connections and resume normal social interactions.

I used to go to the community center every Sunday, but it was closed due to the coronavirus pandemic. It reopened this year, but my wife and I haven't gone back because we're worried about infection. Her doctor advised her to avoid crowded places. (P08, Male, 82yrs)

After the pandemic, I went back to check and found that many people were no longer there. It feels like facing new people, which I find hard to adapt to, so I stopped going. Sometimes, it's easier when you're in an environment with familiar people you're comfortable with. But now, at my age, starting over, especially with people who speak English, it feels like the relationships I built there have disappeared. So, forget it, I won't go anymore. (P07, Female, 63yrs)

Sub-theme 2-3. Limited in English Proficiency

For participants with limited English proficiency, linguistic barriers significantly impair their ability to understand communications and public information around them, greatly limiting their social interactions and access to information. Language obstacles not only hinder their effective communication with others but also further increase their feelings of isolation and alienation from their surroundings, including intergenerational interactions. For instance:

The reason is threefold: I can't understand English, I can't comprehend what people

are saying outside, and I can't drive, making me feel as if I have no eyes, no ears, no legs." (P11, Female, 79yrs)

My English is very poor. Even now, when I go to McDonald's to buy something, I still can't understand, so normally, I encounter some language problems. (P12, Female, 69yrs)

These barriers restrict the ability of older Chinese immigrants to communicate effectively in English-speaking settings, limit their interaction with the broader community beyond their cultural group, and make daily life more complex by turning simple tasks into daunting challenges. This impacts their access to services, participation in community events, and opportunities to seek necessary assistance.

Language can also affect family member interactions and deepen feelings of loneliness, such as:

I can't communicate with my grandchildren, ah, they all speak English, and we end up using gestures, which probably makes us less close. (P13, Female, 86yrs)

Sub-theme 2-4. Health, Aging, and Social Barriers

As they age, older Chinese immigrants encounter a variety of health and aging-related challenges, such as chronic diseases and physical decline, including hearing impairment, that restrict their engagement in social and community activities. These conditions often result in lessened outdoor activities, which in turn reduce social opportunities and exacerbate feelings

of loneliness. This paragraph underscores the significant influence of health and aging concerns on the social involvement of older Chinese immigrants and their increased susceptibility to loneliness. In participants' statements:

My mother, of course, feels very lonely, and her only hope is me. Since she had a stroke, she has stopped interacting with others... She lives in a nursing home where both residents and staff speak English, and they can't communicate with her... Due to the stroke and her age, she now speaks unclearly, so everything has to depend on me... Therefore, there must be some connection between physical health and mental health, such as affecting feelings of loneliness. (P03, Male, 61yrs)

When everyone is chatting, I can't hear, so they just don't talk to me... Because I can't hear clearly, even ordering a meal feels very difficult for me... (P04, Male, 60yrs)

As they age, older adults may encounter mobility issues, chronic pain, or other physical declines, limiting their ability to engage in social activities and community participation. Therefore, they may go out less due to their physical condition, leading to reduced social opportunities and increased feelings of loneliness. In accordance with the participant's statement:

I used to travel often... but for the past five years, I've only traveled within the United States, like visiting my sister, and stopped going abroad. I don't go to the mainland anymore... (The main reason is) I'm afraid of flying, and my health isn't very good.

Yeah, I can't handle long-distance travel. I had cancer over a decade ago and underwent surgery. Then, two years ago, I got a disease that made it impossible for me to walk. Suddenly, my legs wouldn't move, and I couldn't walk. Parkinson's disease. But now the medicine is very effective; after taking it, I got better.... (P13, Female, 86ys).

Sub-theme 2-5 Mobility Limitations

Mobility challenges faced by older Chinese immigrants are a significant risk factor for loneliness. The ability to move is fundamental to participating in social activities. Older adults who cannot drive, find it difficult to go out, or are unwilling to go out significantly reduce their chances of engaging in social activities. This means they may miss opportunities to interact with family, friends, and community members, leading to a reduction in their social network and an increase in feelings of loneliness. For example:

Later on, my husband fell ill and could no longer drive, so we stopped going to the senior center, they offer some activities for the Asian community....., because of my poor driving skill, I dare not drive on highways, I could only drive locally, so I (myself) never went to the senior center. (P12, Female, 69yrs)

I stopped driving around June or July, because I had a car accident in December last year, and then the police thought I was a bit old, there might be some problems with driving, so I didn't drive after that. (P10, Female, 82yrs)

Additionally, mobility challenges limit not only the physical range of activities for older adults but also their independence, increasing their dependency.

Transportation. I can't drive. My husband would drive me, and then my son would...

My family would take me to the bus stop, but I couldn't understand the sign... I didn't need to go anywhere, so I hardly ever went out. (P06, Female, 89yrs)

I think the main issue is that it's inconvenient to go out, so I rarely go to crowded places, try to avoid them, and my interactions with friends have also been cut off, face-to-face interactions are gone, so I mostly rely on phone calls. (But) this (phone communication) tends to make people feel more distant in relationships. (P08, Male, 82yrs)

This dependency can create a sense of burden among them and potentially impact their mental health, resulting in diminished self-esteem and self-efficacy. A participant shared her experience:

I can't drive, I feel so useless. My daughter told me, 'Mom, don't do this, it's too dangerous. Wherever you need to go, I'll take you.' My daughter is very good, extremely filial. (P13, Female, 86yrs)

Sub-theme 2-6. Desire for Independence

In the process of adapting to a new sociocultural context, older Chinese immigrants encounter various challenges, including linguistic barriers, mobility restrictions, and cultural

differences. Despite these challenges necessitating reliance on others, narratives from this population underscore a pervasive desire for autonomy and self-sufficiency. This aspiration is not merely a reflection of physical capability for self-care but extends to a psychological dimension, encompassing a drive to maintain self-esteem and self-worth. Importantly, these individuals express a conscientious wish not to become a burden on their offspring, signifying a strong preference for independence even in the absence of companionship from spouses or family members. This preference for autonomy is further exemplified through their engagement in daily tasks, thereby fostering a sense of personal fulfillment.

For instance,

My daughter is busy with work, doesn't have spare time, so I try not to bother them. I help with picking up the grandchildren from school. The rest of the time, I cook at home. (P05, Female, 69yrs)

I initially considered moving into a nursing home, but after seeing many, the rooms were too small, and entertainment and activities were fixed. I want to do what I enjoy, to have control... As elderly, we need to find our own enjoyment. When I used to be able to drive, I would help transport other elderly newcomers to the elderly center, but I would also advise them to go on their own in the future. (P13, Female, 86yrs)

It's best to be able to live independently... One must be financially independent and then maintain health so no one else has to take care of you when you're sick, whether

it's cleaning or going shopping.....I walk every day, aiming for 10,000 steps a day to maintain my physical strength and health. I don't want to age prematurely and become a burden to my children. (P15, Male, 75yrs)

The desire of older Chinese immigrants to maintain an independent lifestyle deeply impacts their daily life choices and mindset, showcasing their positive attitude and sense of self-efficacy in facing the challenges of aging.

Theme 3. Exploring Technological Engagement: Driving Forces, Obstacles, and

Solutions

This section delves into the dynamics of how older Chinese immigrants engage with technology, examining the reasons behind their adoption, the barriers they encounter, and the methods they employ to surmount these challenges. It reveals that their pursuit of technology is not just about staying connected or informed but also encompasses a desire for personal enrichment and overcoming the silence of isolation. The journey, however, is fraught with difficulties such as dependence on others for guidance, concerns over privacy breaches, and the physical limitations that come with aging. Despite these hurdles, the resilience of this demographic shines through as they adopt various strategies, including seeking external help, leveraging online resources for learning, and embracing self-directed exploration to navigate the digital world. These actions reflect a determined effort to bridge the technological gap, underscoring a broader narrative of adaptation and perseverance.

Sub-theme 3-1. Motivations for Adopting Technology

Older Chinese immigrants adopt technology to significantly enhance their daily lives and social interactions. Their motivations and goals for integrating technology into their routines are diverse, serving both practical and enriching purposes. These varied motivations highlight the multifaceted role technology plays in meeting their needs, facilitating not just a means to an end but enriching their lives in multiple dimensions. Participants' motivations for using technology are summarized as follows.

Sub-theme 3-1-1. Daily Management

Technology plays a pivotal role in organizing daily life through reminders, accessing calendars, searching for information, managing emails, translation functions, and browsing news and social media platforms. This usage is particularly prevalent among those still working with busy schedules, including family responsibilities. As the participants stated:

I'm still working, not yet retired... There are chores at home, and I have to take care of my grandchildren... So, I use the calendar, Google, all the emails, and social media.

Including browsing this online information including news... just daily life reminders, and then there's searching. (P16, Male, 65yrs)

I use the most basic functions, like checking the weather, stocks, calendar, oh, and the usual stuff... I watch YouTube. There are videos about sarcopenia, cholesterol, high blood pressure, how to eat to reduce the 'three highs'. Whatever I want to know, I

search online. (P13, Female, 86yrs)

I think it's information related to life, like you can look up information about stores, or... when you want to have more understanding or knowledge about something that happened recently. (P02, Female, 60yrs)

Sub-theme 3-1-2. Accessing Health Information or Transitioning to Telemedicine

The internet has also become a vital source of information for individuals seeking to improve their health and wellness. This trend is evident in the experience shared by one of the participants, highlighting how digital resources can empower individuals to take control of their health. For instance:

I tend to watch health-related programs more often... I watch YouTube. There are videos about sarcopenia, cholesterol, high blood pressure, and how to eat to reduce these three high conditions. Whatever I want to know, I search for it online. (P13, Female, 86yrs)

Some have replaced hospital outpatient visits with computer video conferencing, saving the trouble of travel. As Participant 09 described:

Hospital, now sometimes it is changed to having a computer video chat with the doctor at home, that is, telemedicine. Now I go to the hospital clinic once a year, and I have video calls with the doctor every three or two months, so I mostly stay at home (very convenient, no need to go to the hospital). (P08, Male, 82yrs)

Sub-theme 3-1-3. Fostering Social Connections

Social media platforms such as Facebook, Line, and WeChat are used to maintain contact with friends and family, especially those from their country of origin. This social engagement extends to finding old classmates and staying in touch.

Like Facebook, Line, WeChat. That's roughly the social media... At first, when I got in touch, I found it useful, gradually searching for old classmates or friends... Friends from the past now rely on these platforms for contact. (P16, Male, 65yrs)

I manage an online community on Facebook with about four to five thousand people. If they have questions, they ask in the community, like who is responsible for which document, how to sign, I help answer because I'm experienced (in this field). (P04, Male, 60yrs)

Sub-theme 3-1-4. Seeking Personal Entertainment

Seeking personal entertainment, such as watching videos, news, engaging in photography, and cooking, is a significant reason for older Chinese immigrants to use technology. Online platforms like YouTube are often used to access a wide array of content, including music, cultural information, and educational videos.

I almost eat dinner around six or seven, then I go upstairs to relax, watch the iPad. As you get older, you can't sleep, so I watch until about eleven or twelve before I sleep again... When I wake up at four or five o'clock, what do I do? I watch videos, I watch

whatever I find, there are so many videos on this tablet. When there's nothing to watch, I watch TV series. (P13, Female, 86yrs)

My computer is also used for watching TV series, checking my emails, playing Sudoku, watching popular YouTube videos. For example, when I want to cook something, I look it up on the computer, the TV also has YouTube." (P10, Female, 82yrs)

Sub-theme 3-1-5. Engaging in Personal Growth

Many older Chinese immigrants engage in online learning to acquire new skills, including how to use technology itself. They attend courses offered by community centers or online platforms, learning about video editing, language learning, and other topics of interest. This not only provides them with valuable skills but also keeps them mentally active and engaged.

I just started learning... in our senior center, there was a teacher who started a course, he taught video editing... with music... Now our teacher teaches cartoon making.

We're still learning, setting up tables, chairs, making a person, and then making clothes and pants for them. It's actually a lot of fun, really fun. (P12, Female, 69yrs)

Overall, the use of technology products by older Chinese immigrants is diverse, covering practical needs and personal interests.

Sub-theme 3-2. Barrier to Adoption

When learning or using technology, the participants noted several obstacles, including:

Sub-theme 3-2-1. Depending on Others for Help

Older Chinese immigrants face numerous challenges such as language barriers, mobility limitations, and cultural differences, which necessitate their reliance on others for help with technology, particularly among women. This dependency is not only for practical daily support like transportation and shopping but also for emotional support and assistance in communication. The role of family members is especially critical as they provide both practical help and emotional comfort, aiding older adults in alleviating loneliness and adapting to stress. As the participants indicated:

I can't drive. My husband drove me, and then my sons. (P06, Female, 89yrs)

I don't use (technology products) much. But it's okay, my husband can handle it; he works in IT. I just seek help from him. (P07, Female, 63yrs)

I don't use the computer, so when I need information or have to do something, I just ask my son or daughter-in-law to check. (P06, Female, 89yrs)

The need to depend on others also affects the participants' use of technology. The participants mentioned lacking confidence in their technical skills and often rely on family members or friends to assist with navigating new devices and applications. This dependency can limit their engagement and frequency of technology use, as they may hesitate to use

technology unless support is readily available. For example,

I can't (use the internet), and I haven't thought about learning it. I don't want to learn because there's someone (who knows how), so every time I tell him (my husband), 'If you pass away before me, my situation will be very bad... Need someone to teach (technology), now my memory is not good, I forget as soon as I'm taught. (P18, Female, 67yrs) ... if it's step by step, then it's probably still OK. So, there's this thing about teaching someone how to set things up from scratch, which I don't know how to do, haha. This might be a common issue among us older women, because I've asked many and they all seem to have this problem. (P18, Female, 67yrs)

Sub-theme 3-2-2. Privacy and Fraud Concerns

Participants expressed worries about their information being stolen or misused. The complexity of discerning credible sources and misinformation can lead to a fear of online platforms, thus avoiding the use of technology to prevent personal security breaches.

I don't trust any social media. Do you think social media has privacy? Who is your information passed to? Do you know? (P03, Male, 61yrs)

Misinformation makes it complicated to trust what can be believed in this society.

There's already so much to discern, and it creates even more that needs to be distinguished... Some elderly are afraid their information will be stolen through social platforms, so they simply choose not to use them. (P16, Male, 65yrs)

However, not all participants shared these concerns. Some individuals were more comfortable engaging with online platforms and saw them as beneficial for social interaction and information gathering. For example:

"I think there is a lot of information available online that can be searched and learned from, for example, watching YouTube videos, which is quite convenient... I don't think all the information online is accurate... I will filter the information, ask others, and use my own experience and knowledge to make judgments." (P02, Female, 60yrs)

This highlights that although participants view the dissemination of online information as a tool for acquiring new knowledge, they simultaneously emphasize the importance of critical thinking and filtering of online information. The need for discernment skills reflects a balanced attitude in the digital age, where individuals rely on online resources while maintaining a skeptical and cautious mindset.

In addition, although participants are aware of online privacy and fraud risks, they feel more secure and comfortable using social platforms primarily for interactions with familiar contacts. This sense of security encourages their willingness to use these platforms.

"I have used some online forums for discussing topics of interest, which is a good way to pass the time... I also use LINE. These technological and social platforms help maintain social relationships, making it easier to contact others... I feel more at ease because it's mostly family and friends on these platforms, so I'm less worried (about

fraud and privacy issues)." (P09, Female, 69yrs)

"I use LINE frequently to keep in touch with friends; they just sent me a message yesterday. I use LINE because I don't want too many complicated social interactions...

These social platforms are helpful because I can stay in touch with family and friends at any time." (P13, Female, 86yrs)

Although participants generally expressed concerns about privacy and fraud, their attitudes towards online engagement varied. Some individuals remained cautious and avoided using online platforms due to these risks. In contrast, other participants were willing to balance the risks of online privacy and fraud with the benefits of accessing interesting information and engaging in online social interactions. Furthermore, these participants felt safe and comfortable interacting with familiar contacts on social platforms, as the familiar and controlled social environment alleviated their concerns about privacy and fraud.

Sub-theme 3-2-3. Physiological Limitations Related to Aging

Moreover, due to aging, older Chinese immigrants report facing multiple difficulties when using technological products and services, such as reduced finger dexterity and poor vision, hinder their interaction with digital devices.

I used to type fast, but now with age, my fingers are not as nimble, so I resort to writing or using voice commands. (P13, Female, 86yrs)

When encountering difficulties like small text, I adjust my phone's settings to enlarge

the font. I found this feature after some tinkering and later taught it to other elders.

(P11, Female, 79yrs)

The text on computers seems too small, so I adjust it according to my needs. (P10,

Female, 82yrs)

Sub-theme 3-2-4. Impact of English-Centric ICT Products on Technology Adoption

In the United States, ICT products primarily designed for English speakers may alienate individuals who do not speak the language, including our participants, making it challenging for them to effectively utilize the internet. This language barrier not only limits their access to information and services but also intensifies their feelings of isolation. For example:

Generally, (Chinese)older people don't use the internet because they cannot (read and) speak English. (P13, Female, 86yrs)

These challenges not only limit the ability of older Chinese immigrants to benefit from technology but also exacerbate their loneliness by restricting their opportunities to participate in social activities.

Sub-theme 3-3. Overcoming Technological Barriers: Strategies Used by Older Chinese Immigrants

Sub-theme 3-3-1. Seeking Assistance

Many older immigrants rely on family, friends, or community resources when facing difficulties with technology. Participants mentioned community centers offering courses and

individual assistance to help them become familiar with new software and devices they had not used before. For example,

Actually, the reason I started learning about technology was because there was a teacher at our senior center who offered a course called 'Film Production (P12, Female, 69yrs).

Family plays a crucial role in this aspect, with many participants stating that their children and spouses often provide teaching or solve tech-related issues. Due to the close relationship between elders and their children, they tend to seek help from them when encountering problems. As family members, children are usually willing to offer support and assistance. Moreover, compared to older adults, the younger generation is generally more familiar and knowledgeable about technological products. They may have already acquired relevant technical knowledge and operational experience through school or work, allowing them to provide effective guidance and solutions. The operating interfaces or instruction manuals of some tech products may be primarily in English, posing a significant barrier for elderly immigrants with limited language skills. Their children might better understand these languages and cultural contexts, thereby offering better explanations and instructions.

Those software, I don't know how to use, it's my son who teaches me... After my son bought me a phone, he asked me what I wanted to do with it. I told him what I wanted, and he helped me set it up. (P10, Female, 82yrs)

My daughter taught me how to use these (smartphones), and how to look up this information was taught by my daughter. (P13, Female, 86yrs)

How to operate the smartphone in detail, I don't know. If there's a problem, I just call my son. (P15, Male, 75yrs)

Sub-theme 3-3-2. Online Tutorials and Self-Learning

When faced with challenges, some elderly immigrants prefer to learn through online tutorials or by exploring on their own. They adopt a self-directed learning approach until they encounter an insurmountable obstacle, at which point they turn to the internet for solutions. This method demonstrates their willingness to engage with technology at their own pace and underscores the importance of user-friendly software design. Typically, individuals with a basic understanding and technical skills with tech products tend to resolve issues on their own first.

I usually prefer to teach myself, until I hit a snag, then I turn to the internet to search.

For the same question, there's bound to be someone who has asked it and answered it.

(P16, Male, 65yrs)

Nowadays, software designs are more user-friendly, meaning you don't need to learn some of the more special functions; the basics are usually enough. If there's an issue, just looking it up online usually brings up the solution. (P04, Male, 60yrs)

Theme 4. Cultural Influences on Loneliness, Social Networks, and ICT Use Among Older Chinese Immigrants

Sub-theme 4-1. Influenced by Confucian Thought

This sub-theme summarizes how Confucian values deeply influence the ICT adoption, loneliness, and social isolation experiences among older Chinese immigrants in the US. It highlights the pivotal role of family and cultural traditions in their social support networks, emphasizing filial piety, respect for elders, and familial loyalty. Elderly immigrants prioritize family over external social relationships, often depending on family members for support in challenges. Additionally, traditional gender roles and the preference for socializing within the Chinese community, due to language and cultural similarities, are noted. The concept of "face" also shapes their social interactions, further impacting their psychosocial health and can serve as a guide for designing technological products for them.

The descriptions by participants 15 and 6 reflect the central role of family and kinship relations in Chinese culture, and how these relations shape the social circles and support systems of older Chinese immigrants in the United States.

My main focus is on my existing social circle, which is my family and relatives.

Fundamentally, I'm not very keen on, nor do I place much importance on maintaining (external) social relationships, because of my personality. I tend to focus on my own domain...I mainly want to spend more time with my family. (P15, Male, 75yrs)

I hardly have friends, only relatives. I have three sisters and a brother. They also have their own families, their children are married, with wives and children, and I have my own. All are relatives, we all look out for each other. (P06, Female, 89yrs)

Gender roles in traditional Chinese family also appear in their experiences, such as the dependence of older women with spouses on their husbands and children. Participant 18 described her reliance on her husband's experience and feelings:

My trouble is just this, without my husband, it's like I've lost an arm or a leg, just like that. My husband is only worried about having no one to cook for him. He's not afraid of anything else, because to him, things like the iPhone, iPad, and computers are a piece of cake. He doesn't see any problem with them. (P18, Female, 67yrs).

Apart from family, in choosing friends, there's also a tendency towards Chinese people with similar language abilities and life backgrounds. Several participants expressed similar experiences:

The main thing is not being good at English, or being older, just like that. It might start with getting to know one friend, then through a chain reaction, one friend introduces another friend, creating a community where everyone helps each other out, people from the same hometown know best what's needed, and having similar backgrounds makes it easier to talk. (P05, Female, 69yrs)

Of course, I have more Chinese friends. My wife's English ability is slightly weaker,

so we mainly make friends with Chinese people. (P15, Male, 75yrs)

People may not be relatives, but the land is familiar (人不親，土親)(P11, Female, 79yrs)

Participants also mentioned the concept of "face" in Chinese culture, as Participant 12 said:

Compared to others, indeed, many Asians live solely for others, which Westerners do not do. ... It's all about face, but Westerners really don't have (such concerns). (P12, Female, 69yrs)

These experiences, besides illustrating the link between language, culture, and the psychosocial health of older Chinese immigrants, also provide direction for the design of their technological products.

Sub-theme 4-2. The Traditional Culture of Avoiding Uncertainty

Due to the emphasis on stability and tradition in Chinese culture, which tends to avoid uncertainties such as technology (Hofstede et al., 2010), older Chinese immigrants' attitudes and behaviors are influenced by traditional education and values, leading them to adopt a reserved attitude towards change and new things. For instance, their unfamiliarity with advanced technological products leads to their hesitation in using them:

I feel it's (technology) rather difficult, so I haven't learned it, the new stuff, oh, I'm not familiar with it..... If I need to look up some information or am unsure about

something, I would ask my husband for help, because I am worried that if I do it myself, I will mess things up. (P05, Female, 69yrs)

Most people (Chinese older adults) think that (learning to use technological products) is not worth it. Why? Because everyone likes to stay in their comfort zone, (maintaining) that familiar feeling. (P16, Male, 65yrs)

In addition to cultural factors, older adults are generally more risk-averse than younger individuals, meaning they are more fearful and resistant to situations that might result in loss or negative outcomes (Albert & Duffy, 2012). This aversion to risk makes them less willing to try new and unfamiliar things, leading to greater avoidance of uncertainty and more conservative and cautious attitudes towards new technologies. Participants expressed confusion and hesitation due to their age and the belief that they could not learn new skills:

"I am too old; I can't do it (use computers and smartphones). My father also said: 'We are not young anymore, we can't learn.'" (P03, Male, 61yrs).

..... ..or it could be the uncertainty, so they (the elderly) would rather not use (technology). (P17, Male, 78yrs)

Discussion

This study sheds light on the common experiences of loneliness and social isolation among older Chinese immigrants in the United States, particularly during the COVID-19 pandemic, and underscores the significant role of traditional Chinese culture in their

experiences of loneliness, social isolation, and technology use, highlighting their unique needs in these aspects.

Based on the themes mentioned above, a model (Figure 2.3) can be developed to present the cultural and technological dynamics of loneliness and social isolation among older Chinese immigrants. This model visually represents the experiences of loneliness and social isolation among older Chinese immigrants in the United States. It highlights the significant role of culture (including traditional Chinese culture and American culture) and technology use in these experiences, underscoring their influence. The model is structured around four primary themes: "Loneliness," focusing on the personal, psychological, and spiritual layers influenced by cultural context; the theme of "Social Isolation" indicates the experiences and challenges associated with social isolation, which are shaped by cultural context, necessitating an understanding of these dynamics to effectively address social isolation; "ICT Adoption," illustrating how technology adoption can either mitigate or exacerbate feelings of loneliness and isolation, depending on the barriers and strategies employed; and "Cultural Influences," illustrating the profound impact of Chinese culture and attitudes towards uncertainty on these experiences. The interconnections between these themes highlight the interplay of individual, societal, and cultural factors, necessitating personalized and culturally sensitive interventions.

Previous research has somewhat explored the loneliness and social isolation experienced

by older Chinese immigrants (Dong et al., 2012; Dong & Chen, 2017), yet there remains a substantial gap in fully understanding their subjective experiences and the challenges they face concerning loneliness, social isolation, and the adoption of technology. This gap has become more pronounced in the wake of the COVID-19 pandemic. To address this lack of understanding, this study engaged participants from diverse backgrounds, including variations in age, living situations, educational levels, and years of residence in the U.S. revealing these individuals' rich, subjective experiences and perceptions as they contend with the intricate challenges posed by loneliness, social isolation, and the integration of technology into their lives.

The study found that the complexity of loneliness and social isolation among older Chinese immigrants in the U.S. is profoundly influenced by a multifaceted interplay of personal, psychological, spiritual, and cultural factors. This complexity is captured by identifying three primary themes, each with specific subthemes, that collectively provide a nuanced understanding of the experiences under in-depth interviews. The first theme, "Multifaceted Nature: Unveiling Personal, Psychological, and Spiritual Layers," emphasizes loneliness's deeply subjective and diverse nature, highlighting how an intricate blend of personal circumstances and cultural influences uniquely shapes individual narratives. This suggests that interventions aimed at mitigating loneliness must be highly personalized and culturally sensitive. Further, the study delves into the "Nuanced Experiences and Challenges"

associated with loneliness and social isolation, shedding light on the significant role of life transitions, health and aging issues, and the disruptive impact of the COVID-19 pandemic on social networks. This theme underscores the critical interconnection between individual experiences and broader societal factors, suggesting that addressing loneliness must consider the complex socio-cultural dynamics.

The exploration of "Technology Adoption" among this demographic reveals a dual narrative: while there is a strong inclination towards using technology for various purposes, including social connection and access to health information, significant barriers such as privacy concerns, dependency on others for assistance, and challenges related to aging hinder its adoption. The study points out the creative strategies employed by individuals to overcome these barriers, indicating a resilience and adaptability that could be leveraged in designing supportive interventions. Lastly, the impact of "Cultural Influences" on technology use, loneliness, and social integration, particularly the influence of Confucian thought and attitudes towards uncertainty, illustrates the profound effect of cultural values and attitudes on the experiences of older Chinese immigrants. These insights highlight the importance of acknowledging the unique sociocultural contexts of Chinese American immigrant seniors to tailor effective support and intervention strategies, aligning with the views of Akhter-Khan & Au (2020) on the significance of understanding the subjective aspects of loneliness and the diversity of participant backgrounds for enhancing intervention outcomes.

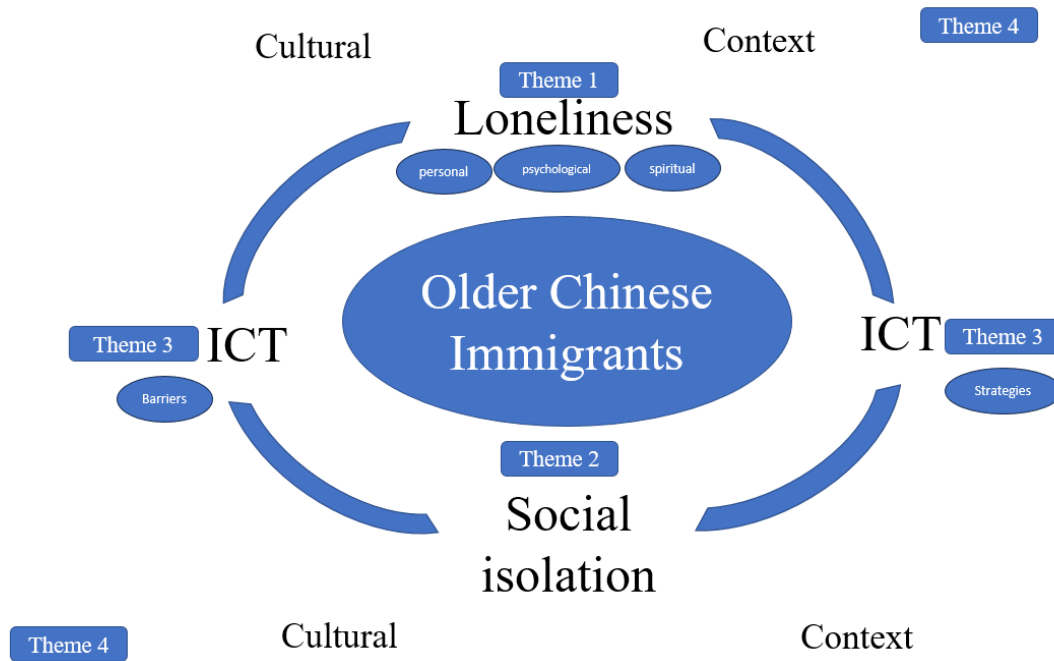


Figure 2.3 Cultural and Technological Dynamics of Loneliness and Social Isolation Among Older Chinese Immigrants

Loneliness Variability by Ethnicity, Age and Gender Among Older Chinese Immigrants

The exploration of loneliness among older adult immigrants reveals the intricate interplay between cultural values, emotional regulation, and societal expectations. This complexity is further nuanced by ethnicity, age, and gender, underscoring the necessity to understand loneliness within a cultural context. Cultural influences on emotional expression and experience are pivotal, with individuals modifying their emotional displays to align with their cultural heritage, enabling adaptation to varied social scenarios and challenges (Matsumoto et al., 2008). Collectivist cultures, in particular, emphasize the communal over the individual, with emotional expressions and experiences being tethered to community

expectations. This contrasts with Western cultures, where a greater emphasis is placed on the autonomy of emotional expression.

In collectivist societies, such as many Asian cultures, there is a marked tendency towards the internalization and control of emotions to preserve communal harmony and uphold social image (Guffey et al., 2015). China stands out as a high-context culture, relying heavily on non-verbal cues and contextual nuances for communication, wherein the overt expression of negative emotions is often deemed inappropriate or disrespectful (Hofstede et al., 2010). Observations indicate that loneliness among these individuals may manifest through subtler expressions, such as articulations of regret or helplessness in the absence of companionship. This nuanced expression of loneliness is deeply entwined with the concept of 'face' in Chinese culture, which highly prizes social interaction and group belonging. The stigma associated with loneliness, perceived as an inability to integrate into societal norms, pressures individuals to resort to less direct means of expressing their feelings, avoiding the explicit articulation of loneliness to prevent the loss of face and the implication of dependency or inadequate self-regulation.

Wright-St Clair et al. (2017) reviewed the empirical studies of loneliness amongst older adults in New Zealand and showed that the risk of loneliness varied by age group and ethnicity. Our interview results also found that for the younger elderly group aged between 60 and 70 years, some of whom are still working or in semi-retired states, social isolation is less

of a problem due to interactions with clients and colleagues at work. However, being in a transitional phase of life, many require time to adapt and plan. Many also express concerns about future physical changes due to aging, such as deteriorating physical strength and vision, which lead to mobility restrictions. Nevertheless, due to work training or earlier exposure to electronic devices, their acceptance and attitude towards technology products is more positive, which could serve as a tool for them to connect with society in the future. It is noteworthy that older respondents or those with lower educational levels show lower usage and acceptance of technology, signifying the necessity for more personalized intervention measures.

This study also found that gender plays a significant role in the loneliness experiences of older Chinese immigrants, although research on gender differences in loneliness levels has yielded varying results (Beal, 2006; Maes et al., 2019). A study on a population of Chinese American adults aged 60 and above indicated that older Chinese women experience significantly higher levels of loneliness compared to their male counterparts. Compared to men, women are more likely to sometimes or often feel a lack of companionship and have poorer health conditions (Dong & Chen, 2017). Nicolaisen et al. explored loneliness in men and women aged 40 to 80 years at baseline over a 15-year period using panel data from three waves of the Norwegian Life Course, finding that women were lonelier than men (Nicolaisen et al., 2024). However, the meta-analysis by Maes et al. (2019)

did not find gender differences in loneliness across various life stages, including old age. They also noted that their analysis was limited because over 75% of the studies were conducted in Western countries, more than half of the included studies did not report information on socio-economic or ethnic status, and only 10% of the samples primarily consisted of minority groups. Although this study did not measure and compare loneliness levels between genders, it is indeed necessary to pay special attention to Chinese elderly women. This is due to their higher economic dependence and the increased risk of loneliness and social isolation they face as they age, children leave home, or they become widowed (Beal, 2006). Furthermore, they are less familiar with the use of technology compared to men.

Previous studies have paid little attention to the impact of ethnicity, age, and gender on loneliness and social isolation. Akhter-Khan and Au (2020) emphasized that overlooking the intricate nuances of loneliness and the diverse backgrounds of research participants, including differences in race and culture, may lead to ineffective loneliness interventions. Therefore, future research should emphasize the influence of ethnicity, age, and gender on loneliness and social isolation, and develop more effective intervention measures tailored to the specific needs of different ethnic groups, age groups, and genders.

The Impact of the COVID-19 Pandemic on Technology Use Among Older Chinese

Immigrants

The COVID-19 pandemic has profoundly affected global society, compelling individuals to increasingly rely on technology for socializing, working, learning, shopping, and other daily activities (Nascimento et al., 2023). This study discovered that due to pandemic-induced isolation and social distancing measures, older Chinese immigrants faced challenges maintaining connections with family, friends, and their communities. For example, they struggled to visit relatives in their homeland and temporarily lost access to their usual social circles, such as churches and community centers. Information and Communication Technologies (ICT), especially video calling and social media platforms like Zoom, WeChat, and LINE, became crucial for staying connected, also hastening their learning and adoption of these tools. Compared to the high costs of traditional international calls, free or low-cost communication software emerged as a popular alternative. Moreover, their intuitive and simple design significantly increased their willingness to use technology (Todd et al., 2022).

Furthermore, beyond social needs, limited opportunities to access essential information and services were a key driver in prompting older Chinese immigrants to use technological products. Previously, their sources of information and services were primarily community centers, elderly organizations, and religious groups. However, during the pandemic, many of these institutions either temporarily closed or shifted to online services, prompting these

elderly individuals to learn how to use the internet and related applications to continue receiving information and meeting their basic needs. Study participants also mentioned their experiences with remote health management and online medical consultations. The potential threat COVID-19 posed to the health of older adults spurred the demand for remote health management and online medical consultations, enabling them to monitor their health conditions and receive medical services at home (Lam et al.,2020).

The pandemic has changed societal expectations and perceptions of older adults' use of technology, increasing their acceptance and interest in it. Despite the gradual easing of the pandemic, many elderly individuals continue to use and learn new technologies, recognizing technology's key role in meeting their needs for social interaction, health management, information access, and convenience during the pandemic. Technology use is no longer seen as a privilege of the young but has become integrated into the lives of some elderly individuals. This has enhanced the potential of technology to connect older adults with their social networks and alleviate feelings of loneliness.

The Interweaving of Loneliness, Social Isolation, Technology Use, and Culture Among Older Chinese Immigrants

The experiences of the participants in this study reveal that traditional Chinese culture plays a pivotal role in the loneliness, social isolation, and technological usage among older Chinese immigrants. Although there are varied definitions of loneliness, they all contain

subjective and abstract nature, involve both social and emotional dimensions, and are deeply influenced by culture (Beal, 2006; Victor et al., 2005; Weiss, 1973). By clarifying how loneliness and culture are conceptually connected, Van Staden and Coetzee (2010) conclude, "*Loneliness shares common features across cultures, yet culture shapes it and is shaped by it.*"

The definition of loneliness varies by culture. For example, the Oxford Advanced Learner's Dictionary (9th edition) defined loneliness as "unhappy because you have no friends or people to talk to; of a situation or period of time sad and spent alone (Deuter et al., 2015)." A Chinese Dictionary offers the following definition of loneliness "幼而無父曰孤，老而無子曰獨" (A young man without a father is solitary, an old man without a son is lonely); isolation and helplessness; solitude and lonesome; alone" (Ministry of Education, 2021). Further comparing the similarities and differences in the definition of loneliness between the two cultures, the similarity is the subjective, emotional nature. The difference is that the Western definition shows that loneliness is the lack of "interpersonal communication and interactions," which implies that having no subject to talk to is the source of loneliness. In comparison, the definition of loneliness in the Chinese dictionary is related to family, without family members, or lack of family support. Older Chinese immigrants are affected by both Western and Chinese culture; to deliver culturally appropriate interventions to Older Chinese immigrants, cultural backgrounds and psychological support factors must be

considered. In other words, clarifying the definition of loneliness in Chinese American culture, and understanding the causes of loneliness and related influencing factors are necessary steps before tailoring an appropriate intervention.

Compared with Western society, Chinese culture puts a premium on collectivism. Collectivist cultures underline the requirements and goals of the group as an entirety, hold in high regard relationships with other members of the group, and the connectedness of people take a leading role in each person's identity (Cheung & Leung, 2007; Triandis, 2001). Older adults in countries that hold a strong "collectivist" culture are more family-oriented and may be more likely to become lonely than those where individualism thrives (Lykes & Kimmelmeier, 2014). In Chinese culture, traditional Confucian Family Values emphasize that the individual is an inseparable part of the family, which in turn is a fundamental component of the society. Consequently, the Chinese often place the importance of the family above the individual. Especially filial piety or loyalty towards the family is a key virtue in Chinese culture, to respect and cherish one's parents, and it is necessary to take care of one's parents (Ikels, 2004; Watts, 1989). The Chinese proverb "養兒防老"(raising a child is insurance for old age) vividly reflects the Chinese culture of filial piety. Children need to take care of their late-life parents in return for their kindness in raising them (Teerawichitchainan et al., 2015). Filial piety is usually achieved through intergenerational cohabitation, as well as social and material support (Weng, 2019). Chinese older people are often reluctant to go to nursing

homes, believing that children should take care of them directly; otherwise, they are unfilial (Ma et al., 2019). However, this high level of family solidarity does not necessarily translate into high life satisfaction for older generations (Treas & Mazumdar, 2002). Li et al. (2018) used in-depth interviews to explore the aging experiences and challenges of older Chinese immigrants in Los Angeles, and the study results showed that due to the busy schedules of adult children, they are usually alone most of the time and do not want to interfere with their children, which is also one of the reasons for their loneliness. This finding also echoes the experience of the participants of this study.

Bergren (2017) noted that unmet expectations of filial piety among Chinese older adults are associated with disappointment, depression, stress, and loneliness. Chinese culture emphasizes a family-centered, relationship-oriented life. Without family bonds or interpersonal connections, people experience loneliness. This definition conforms to Chinese culture at the cognitive, self and personality, and social relationship levels. Family-oriented and relationship-centered resilience played an essential role in helping Chinese older adults deal with the high risk of loneliness (Lou & Ng, 2012). Approximately 95% of Chinese American older adults' social networks consist of relatives, impacting their use of preventive medicine, mental health, and cognitive health (Bergren, 2017). Older Chinese immigrants are highly dependent on their children. Dependency on family can lead to a person's hesitance or difficulty extending one's social community exceeding the home environment. They are

convinced that families are responsible for delivering social and psychological support.

However, family companionship may not be sufficient to overcome the feeling of loneliness brings on (Garcia Diaz et al., 2019; Schwartz, 2007). This suggests that the family plays a crucial role in Chinese culture and that the social isolation experience of older Chinese immigrants may be because of a lack of support from social connections outside the family.

It is noteworthy that nearly all participants mentioned language barriers as a primary factor affecting their immigrant life and psychological distress, highlighting language as a crucial consideration in designing technological products for older Chinese immigrants.

Indeed, language is an integral part of culture, serving not only as a primary means of communication within a cultural group but also embodying the values, beliefs, and traditions of that culture (Jiang, 2000). Language plays a pivotal role in preserving historical and cultural heritage, influencing how members of a culture express their thoughts, perform their rituals, and celebrate their history. It is a key element of a cultural group's identity, reflecting its unique characteristics and worldview. The same phrases may carry different meanings in different cultures; therefore, familiarity with both culture and language is necessary for the precise design of technological products. This emphasizes the importance of considering linguistic and cultural nuances to ensure technology is accessible and meaningful to its intended users.

Additionally, according to Hofstede's cultural dimensions theory, key dimensions of

culture include Individualism vs. Collectivism and Uncertainty Avoidance, etc. (Wu, 2006).

Uncertainty Avoidance is the degree to which members of a society tolerate uncertainty and the unknown. Cultures with high Uncertainty Avoidance tend to create rules and norms to reduce uncertainty, while those with low Uncertainty Avoidance are more open to change and innovation. Chinese culture, which tends to adhere to traditional conservative norms, partially explains why some older Chinese immigrants are not very receptive to learning new technologies through high Uncertainty Avoidance. In practical application of this experience, it is advisable to establish clear rules when developing intervention measures to facilitate compliance and thus enhance the motivation of older Chinese immigrants to use technology.

Limitations and Future Recommendations

Through an in-depth exploration of participants' experiences, this study has provided a rich understanding of the challenges older Chinese immigrants face and how these were intertwined with the unique aspects of Chinese culture, such as the importance of family and social reputation (often referred to as 'face' or 'miànzi') within their community background..

The findings not only reveal the difficulties encountered by older adults, such as language barriers and aging issues, but also highlight the importance of considering their cultural backgrounds and specific needs when developing and adapting interventions aimed at alleviating loneliness and social isolation among older adults. However, this study also has some limitations. Firstly, the sample size is small, and the participants are limited to the

Washington area, which may affect the generality and applicability of the results. Second, the research is mainly based on the participants' subjective experiences, which may introduce bias. Despite efforts to increase the representativeness and inclusivity of the study by considering factors such as gender, age, socioeconomic status, and whether they live with family during participant selection, these limitations still need to be recognized and addressed.

This study offers the following recommendations for research and application. First, it is advised to expand the sample size to include more geographical areas and older adult immigrants from different backgrounds to enhance the universality and applicability of the research findings. Second, adopting a mixed-methods research design that combines quantitative data and qualitative insights to enrich the understanding of older adult immigrants' experiences to provide a more comprehensive and in-depth analysis. Lastly, older adults from different cultural backgrounds may experience and cope with loneliness and social isolation differently. Therefore, it is recommended to explore culture-related factors that influence loneliness and social isolation. Additionally, some interventions may be perceived as highly effective and appropriate in certain cultures but may not be accepted or suitable in others, indicating that the acceptance of interventions can vary among older adults from different cultural backgrounds. When designing and implementing interventions, it is crucial to consider cultural sensitivity and incorporate culture-related factors.

Application Aspect

Develop culturally sensitive ICT interventions targeted at older Chinese immigrants, considering their unique cultural values and behavior patterns, such as creating Chinese language versions, incorporating family and friends to boost their motivation to use, designing applications that are easy to use and whose content aligns with Chinese cultural preferences, and detailed training materials to promote their active participation and enhance the effectiveness of the interventions.

Conclusion

The experiences of loneliness and social isolation among older Chinese immigrants are intricately woven through cultural, social, and technological dimensions, showcasing their uniqueness and individual needs. A comprehensive and in-depth understanding of their experiences is essential when designing interventions and support mechanisms. This approach facilitates the development and adaptation of culturally sensitive solutions tailored to their specific needs, significantly reducing the negative impacts of loneliness and social isolation. Such interventions not only enhance their physical and mental health and well-being but also align with the United Nations Sustainable Development Goals (United Nations, 2023), including reducing health inequalities and boosting technological competencies, especially in Information and Communication Technology.

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Appendix 2.1

COREQ (COnsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A.

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 1: Research team and reflexivity			
<i>Personal characteristics</i>			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	P. 23
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	P. 23
Occupation	3	What was their occupation at the time of the study?	P. 23
Gender	4	Was the researcher male or female?	P. 23
Experience and training	5	What experience or training did the researcher have?	P. 23
<i>Relationship with participants</i>			
Relationship established	6	Was a relationship established prior to study commencement?	P. 24
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	P. 24
Interviewer characteristics	8	What characteristics were reported about the interviewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	P. 24
Domain 2: Study design			
<i>Theoretical framework</i>			
Methodological orientation and	9	What methodological orientation was stated to underpin the study? e.g. grounded theory,	P.25

Theory		discourse analysis, ethnography, phenomenology, content analysis	
<i>Participant selection</i>			
Sampling	10	How were participants selected? e.g. purposive, convenience, consecutive, snowball	P.23
Method of approach	11	How were participants approached? e.g. face- to-face, telephone, mail, email	P.24
Sample size	12	How many participants were in the study?	P.23
Non-participation	13	How many people refused to participate or dropped out? Reasons?	P.25
<i>Setting</i>			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	P.24
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	P.27
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	P.27
<i>Data collection</i>			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	P.23
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	N/A
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	P.24
Field notes	20	Were field notes made during and/or after the interview or focus group?	P.24
Duration	21	What was the duration of the interviews or focus group?	P.24
Data saturation	22	Was data saturation discussed?	P.24
Transcripts returned	23	Were transcripts returned to participants for comment and/or correction?	N/A

Topic	Item No.	Guide Questions/Description	Reported on Page No.
Domain 3: analysis and findings			
<i>Data analysis</i>			
Number of data coders	24	How many data coders coded the data?	P.25
Description of the coding tree	25	Did authors provide a description of the coding tree?	P.29
Derivation of themes	26	Were themes identified in advance or derived from the data?	P.25
Software	27	What software, if applicable, was used to manage the data?	P.24
Participant checking	28	Did participants provide feedback on the findings?	N/A
<i>Reporting</i>			
Quotations presented	29	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	P.29
Data and findings consistent	30	Was there consistency between the data presented and the findings?	P.32
Clarity of major themes	31	Were major themes clearly presented in the findings?	P.29
Clarity of minor themes	32	Is there a description of diverse cases or discussion of minor themes?	P.29

Developed from: Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care*. 2007. Volume 19, Number 6: pp. 349 – 357

CHAPTER 3

Culturally Sensitive ICT Interventions for Reducing Loneliness and Social Isolation

Among Older Adults: An Umbrella Review

Abstract

Background

Information and Communication Technology (ICT) has shown promise in mitigating loneliness among older adults by fostering social connections. The rapid technological advancements and the social distancing measures due to COVID-19 have further underscored the potential of ICT interventions. However, there is a significant gap in culturally sensitive approaches that address the unique needs of older adults from diverse racial/ethnic minority communities.

Objective

This umbrella review aims to synthesize updated evidence on the effectiveness, types, and theoretical bases of ICT interventions in addressing loneliness and social isolation among older adults, with an emphasis on culturally sensitive approaches and the inclusion of racial/ethnic minority groups.

Methods

Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol and the Joanne Briggs Institute (JBI) umbrella review methodology, we conducted a comprehensive search in major databases. The search focused on literature

published from January 1st, 2019, to March 1st, 2024, to capture the most recent evidence in the context of the COVID-19 pandemic, which began in December 2019.

Results

Our review highlights the potential of ICT interventions, particularly video conferencing, in reducing loneliness among older adults. Despite positive outcomes, the evidence base remains limited, with most studies lacking methodological rigor. The review also reveals a scarcity of studies targeting racial/ethnic minority groups, indicating a need for more inclusive research. Cultural sensitivity emerges as a crucial factor in designing and implementing effective ICT interventions.

Conclusion

ICT interventions offer a promising avenue to combat loneliness and social isolation among older adults. However, there is a critical need for further research to expand the evidence base with high-quality, methodologically sound studies that are culturally sensitive and inclusive of diverse populations. This will help in developing targeted, human-centered design (HCD) interventions that effectively address the multifaceted nature of loneliness across different cultural contexts.

Implications

The findings underscore the importance of cultural sensitivity in ICT intervention design. Future research should prioritize the development of culturally inclusive interventions

and explore their effectiveness among diverse older adult populations to ensure broad applicability and impact.

Keywords: Information and Communication Technology Interventions, Loneliness, Social Isolation, Older Adults, Culture

Introduction

Information and Communication Technology (ICT) has emerged as a pivotal strategy in mitigating loneliness among older adults by enhancing social connections, providing ease of access, and facilitating diverse interactions (Barbosa et al., 2019). ICT encompasses both information technology equipment, like personal computers, and communication technologies, such as telephones and telecommunications networks. In recent decades, the proliferation of personal computers, laptops, smartphones, tablets, and the internet has played a significant role in connecting individuals and supporting their social lives. Social networking sites, with Facebook being notably popular among older adults (Nef et al., 2013), have become integral to maintaining social connections, a trend that has become even more pronounced in the wake of social distancing measures imposed due to COVID-19. Research conducted by Guner and colleagues (2021) during the pandemic highlighted a strong correlation between loneliness, social-emotional loneliness, and death anxiety among older adults in Turkey, underscoring the importance of utilizing technology to maintain connections and mitigate loneliness.

In this context, Balki et al. (2022a) conducted an umbrella review of 21 studies to address the limitations identified in previous reviews regarding the efficacy of technological interventions for loneliness among older adults. These previous reviews often cited the limitations stemming from unclear evidence, diverse populations, and a broad spectrum of

themes, leading to inconclusive results. Balki and colleagues' findings underscored that ICT and video conferencing, in particular, hold promise in fostering social connections among older adults. Nonetheless, the body of evidence remains scant and calls for further research characterized by higher quality and methodological rigor. This necessity is driven by the understanding that loneliness and social isolation are significant, yet addressable, mental health issues among older adults. ICT interventions, standing out in their effectiveness, not only significantly alleviate loneliness but also positively influence other aspects of social isolation through enhanced social support, communication with family and friends, and access to information. Despite these positive outcomes, the potential of these interventions to foster new connections warrants further exploration. Given the rapid technological advancements and the publication of additional reviews in the years following Balki and colleagues' study, there is a pressing need for updated evidence focused specifically on ICT. Such focused analysis is crucial for identifying current and promising approaches to enhance social networking among older adults, thereby informing the development of targeted strategies to combat loneliness and social isolation.

Emphasizing the profound impact of culture on health and technology, Bonifacio (2021) suggests that social scientists should carefully interpret where their research takes place and question how cultural beliefs related to aging, technology, and geography influence the ability and meaning of using ICTs. After immigrating, older adults must give up their original social

network, coupled with limited language proficiency, physical activity ability, and ability to apply technology. It is challenging to integrate into the new interpersonal social network, making them particularly vulnerable to loneliness (Li et al., 2018). This also means that it is necessary to conduct a more in-depth and comprehensive analysis of the application of ICT to mitigate loneliness of older adults, including existing interventions and culturally related elements, as a solid foundation for the future development of human-centered design (HCD) and culturally sensitive IT-supported interventions. Based on extensive literature searches, it was found that there were no ICT interventional studies targeting racial/ethnic minority, racial/ethnic minority older adults, or older immigrants, especially older Chinese immigrants, to reduce loneliness. Nevertheless, much retrospective literature has examined the effectiveness of ICT interventions to reduce loneliness in older adults more broadly. Therefore, this article selects updated review articles to provide an overview of the latest evidence, summarize the comprehensive reviews to answer questions about the type, effectiveness, theoretical base, and authors' recommendations on ICT interventions for addressing loneliness in older adults, and further discuss the challenges of existing interventions, especially with regard to the cultural aspect.

Method

Search strategy

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)

protocol (Moher et al., 2015) and an adapted version of the Joanne Briggs Institute (JBI) umbrella review methodology (Aromataris et al., 2015) were employed as search strategies. The PICOS (Population, Intervention, Context (or Comparison), Outcomes, and Study design) framework was used to define the research question and focus the search strategy.

Inclusion and Exclusion Criteria

The criteria for inclusion were developed based on the Population, Intervention, Context (or Comparison), Outcomes, and Study design (PICOS) framework. **Table 3.1** outlines the specific criteria used to select studies for inclusion in this review.

Table 3.1 Inclusion and exclusion criteria

PICOS framework	Inclusion criteria	Exclusion criteria
P (Population)	Individuals aged over 60 years residing in community or residential settings	People with significant neurocognitive impairments that could affect their participation in interventions, such as dementia.
I (Intervention)	The interventions involve ICT aimed at alleviating loneliness and/or social isolation among older adults	Interventions not involving ICT or not aimed at reducing loneliness or social isolation
C (Context)	Independent living arrangements, residential care facilities such as sanatoriums and nursing homes, and community settings	Participants in acute care settings or with significant neurocognitive disorders that impede their ability to engage with ICT interventions
O (Outcomes)	Measures related to loneliness	Studies that do not directly

	and/or social isolation	measure outcomes related to loneliness or social isolation
S (Study design)	Studies employing reviews of quantitative studies with or without meta-analyses, utilizing meta-analysis (MA) methodologies, ensure that the evidence synthesized is of high methodological quality and relevance.	Research designs other than systematic reviews or meta-analyses, such as primary studies, reviews of qualitative literature, case studies, and opinion pieces.

This study initially aimed to explore the impact of cultural perspectives on interventions involving ICT for older adults. To this end, our research team consulted and collaborated with a health sciences librarian to conduct a systematic literature search. This process employed a structured search methodology, incorporating keywords, subject headings, and Boolean operators. Searches were conducted in databases such as PubMed, CINAHL, Cochrane Library, PsycINFO and Web of Science, focusing on the most recent review articles published in English from January 2019 to March 2024. The search utilized keywords related to cultural competence, including "Cultural Competence," "culturally sensitive," "culturally competent," "cultural competence," "culturally appropriate," and "Minority Groups." The interventions were focused on keywords related to "technology", with outcomes measured in terms of "loneliness" and "social isolation", and the research designs were limited to "reviews and/or meta-analyses". However, the search results from each database showed only 0 to 2

relevant articles, none of which met the inclusion criteria for this study upon review of their titles and abstracts.

Subsequently, the research team expanded the search scope, re-conducting the search with the same keywords but not limiting it to review articles. This search yielded between 2 to 49 articles per database. However, none of these articles met the inclusion criteria of this study after reviewing their titles and abstracts. Details on the use of keywords in each database and reasons for exclusion are provided in Appendix 3.1.

Given the absence of reviews or intervention studies designed specifically from a cultural perspective or targeting minority groups to alleviate loneliness or social isolation, the research then focused keywords on "elderly," "technology," "social networks," "loneliness," "social isolation," and "reviews." The objective was to gain a more comprehensive understanding of the trends and the latest evidence in ICT interventions for older adults to mitigate feelings of loneliness. For detailed search terms used in each database, refer to Appendix 3.2.

Study Selection Process

The search outcomes were exported using an RIS file and uploaded to Rayyan for screening. After removing duplicate papers, two researchers independently reviewed the titles and abstracts of all potentially relevant articles. The articles that remained were then subjected to full-text screening. The PRISMA flow chart (Figure 3.1) outlined the paper identification and selection phases.

Quality appraisal

The AMSTAR 2 checklist (Appendix 3.3) is a tool designed to assess the quality of systematic reviews and includes 16 items. This checklist is utilized to evaluate the quality of selected reviews based on the question and description of each item, and responses are categorized as "Yes," "Partial Yes," or "No" (Shea et al., 2017).

Data Extraction

After a full-text review, 13 articles were identified that met the requirements of this paper. All these articles were published between 2019 to 2024. We extracted relevant data from these studies using a standardized form. The results are described in tabular form, including pertinent characteristics of the reviews such as objectives, search periods, searching databases, number of articles included, participants (age, gender), ethnicity, geographic location, ICT interventions, main findings, and key recommendations. For detailed tables, please refer to Appendix 3.4.

Results

Among the selected 13 reviews, 5 (38.5%) are literature reviews (Casanova et al., 2021; Noone et al., 2020; Döring et al., 2022; Todd et al., 2022; Gunnes et al., 2024), 6 (46.2%) are systematic reviews (Ibarra et al., 2020; Choi and Lee, 2021; Latikka et al., 2021; Wiwatkunupakarn et al., 2022; Beogo et al., 2023; Lei et al., 2024), and two (15.3%) are systematic reviews and meta-analyses (Jin et al., 2021; Shah et al., 2021). All 13 papers were

published within the last 5 years (2019 to 2024). The first authors are based in several countries, including Ireland (n=1), Russia (n=1), Italy (n=1), Korea (n=1), the United Kingdom (n=1), China (n=1), Australia (n=2), Finland (n=1), Canada (n=1), Germany (n=1), Norway (n=1), and Thailand (n=1). The primary purpose of all selected reviews is to investigate the effectiveness of ICT in reducing loneliness and/or social isolation among older adults.

ICT interventions employed by researchers encompass a wide range of tools, such as animal robots and online social platforms and transitioning from merely providing emotional support to designing multi-level systems that foster social participation, cognitive engagement, physical activity, and nutritional guidance (Choi & Lee, 2021; Casanova et al., 2021). Most studies have utilized existing ICT technologies, while some have developed new ICT solutions tailored for older adults. Most studies utilized existing ICT technologies, while some developed new ICT solutions specifically tailored for older adults (Czaja et al., 2018; Ibarra et al., 2020). The categorization of various ICT interventions as delineated by the different authors follows:

- **Internet-Based Applications and Social Networking:** Todd et al. (2022) and Lei et al. (2024) focused on internet-based applications, including social media and social media apps, video conferencing apps, and customized online social networking platforms. Wiwatkunupakarn et al. (2022) highlighted the use of social network sites and social media.

- **Smart Home and Smartphones:** Latikka et al. (2021) detailed studies employing smart home solutions or combinations of smart homes and smartphones, indicating a move towards ambient assisted living environments.
- **Robotics and Videotelephony:** Beogo et al. (2023) and Gunnes et al. (2024) discussed the use of robots embedded with videotelephony, social robots, conversational agents, and gameplay, suggesting a trend towards more interactive and engaging ICT interventions.
- **Videoconferencing and Support Networks:** Various forms of videoconferencing using platforms like Skype, Zoom, and FaceTime were employed, as mentioned by Todd et al. (2022) and Beogo et al. (2023), alongside telephone support networks and applications for phones and tablets, indicating the importance of visual communication in overcoming isolation.
- **Virtual Reality (VR) and Activity Systems:** Latikka et al. (2021) mentioned research using VR systems and activity systems that include activity sensors, pointing towards incorporating immersive technologies and physical activity monitoring in ICT interventions.
- **Diverse ICT Tools:** Döring et al. (2022) and Gunnes et al. (2024) reported on a wide array of ICT tools, including email, social networking services (SNS), videogame

consoles, smartphones, tablets, chat/messaging apps, and AR/VR systems, showing the versatility of ICT in catering to various needs of older adults.

This comprehensive approach, spanning from traditional support networks to advanced technological interventions, reflects a significant evolution in ICT interventions aimed at enhancing the quality of life for older adults, promoting a holistic view of well-being that incorporates social, cognitive, physical, and nutritional aspects (Shah et al., 2021; Choi & Lee, 2021; Casanova et al., 2021; Czaja et al., 2018; Ibarra et al., 2020).

The overall quality of the studies included in the selected reviews was low to moderate. Despite its positive impact on older adults, there was not enough strong evidence to support the effectiveness of ICT interventions in reducing loneliness among older adults (Ibarra et al., 2020; Jin et al., 2021; Shah et al., 2021; Wiwatkunupakarn et al., 2022; Lei et al., 2024). The principal recommendation common across the thirteen reviews was that they all highlighted design issues within the included studies and underscored the need for more rigorous, well-structured, and long-term follow-up randomized controlled trials. Individual suggestions include providing older people with the necessary training and support for using ICT; especially since their receptiveness to technology may vary when perceiving loneliness. ICT interventions should be co-designed or co-implemented with older adults, and an intuitive and simple interface design can minimize their difficulties in operating new ICT interventions (Ibarra et al., 2020; Latikka et al., 2021; Todd et al., 2022). Jin et al. (2021) and Lei et al., (2024)

noted the high heterogeneity among older adult participants in existing research and emphasized the importance of considering the characteristics of older adults and prioritizing research on high-risk groups. Choi and Lee (2021) suggested that ICT interventions aimed at promoting emotion, health, and safety in older adults should be developed. Future considerations should also include the usability of technology, as well as its affordability and accessibility for older adults. Moreover, Döring et al., (2022) pointed out the significance of incorporating theoretical frameworks into research, as studies seldom use theoretical frameworks, which could affect the prediction and interpretation of results. Due to the lack of comprehensive theories linking the use of communication technologies with the reduction of loneliness or social isolation, it is recommended to further develop comprehensive theories that connect the use of communication technologies with reducing loneliness or social isolation. These theories should guide research to focus on significant variables and potential causal relationships. This paper also analyzes the distribution of existing interventions in the systems of the socio-ecological framework (Bronfenbrenner, 1979), and finds that most of the ICT interventions mainly improve the connection with family and friends, aimed at the microsystem. The second is the mesosystem, expanding the social circle, usually extended by family members or friends. There were fewer studies that directed at the macrosystem, particularly at the cultural level. For example, such studies might evaluate relevant policies and providing suggestions as a basis for future policies to make the overall environment more aligned with

the population's needs.

The review papers included in the study provide valuable insights into the sample and contextual characteristics of the studies examined. The majority of the studies included female participants, reflecting a higher proportion of women in the samples. For instance, Choi and Lee (2021) reported that out of 644 participants, 445 were female (69.1%). Similarly, Noone et al. (2020) reported that out of 209 participants, 126 were female (60.3%). Shah et al. (2021) indicated that out of 646 participants, 427 were female (66.1%). Latikka et al. (2021) noted that 46.15% to 85.37% of participants were female across 17 studies that reported gender ratios. Lei et al. (2024) found female ratios ranging from 40% to 100% across their included studies. Wiwatkunupakarn et al. (2022) reported that the female ratio was between 51% and 82% in their included studies. The remaining included review papers did not identify the gender of the participants.

The living arrangements of participants varied, with many studies involving residents of nursing homes or long-term care facilities. For example, Noone et al. (2020) noted that participants were primarily located in nursing homes in Taiwan. Shah et al. (2021) found that participants were from various settings, including nursing homes, homes, and mixed environments. However, other studies did not specifically state the living arrangements of participants, only mentioning the countries where the studies were conducted (Choi & Lee, 2021; Latikka et al., 2021; Todd et al., 2022; Wiwatkunupakarn et al., 2022; Beogo et al., 2023;

Gunnes et al., 2024).

Regarding comfort with technology, although these studies did not explicitly state the participants' initial familiarity and acceptance of technological products, several studies addressed this issue by providing preliminary training and ongoing technical support to ensure that participants could effectively use information and communication technology (ICT) interventions. Shah et al. (2021) emphasized the importance of user-friendly designs and continuous support to enhance the acceptability and usability of these technologies among older adults. Todd et al. (2022) reported that many older adults initially faced difficulties but were more willing to adopt new technologies during the COVID-19 pandemic when these technologies were designed to be easy to use. Similarly, Latikka et al. (2021) found that despite the initial reluctance, older adults appreciated technology that was intuitive and easy to learn, suggesting that comprehensive training and simple interface designs are crucial for successful adoption. Lei et al. (2024) noted that the inclusion of older adults in the design and selection of technology enhanced their engagement and comfort levels (Lei et al., 2024). Wiwatkunupakarn et al. (2022) also highlighted the need for ongoing technical support and user-friendly interfaces to reduce barriers to technology use among older adults (Wiwatkunupakarn et al., 2022). Moreover, Beogo et al. (2023) pointed out that customized training programs that consider the specific needs and preferences of older adults significantly improve their comfort and proficiency with technology.

Although specific details on linguistic or cultural tailoring were not extensively covered, some studies implicitly considered cultural factors by prioritizing family interactions, which are significant in many cultures (Ibarra et al., 2020).

Additionally, the study by Latikka et al. (2021) highlights a scarcity of research focusing on solutions for social isolation, particularly in detecting and predicting social isolation or loneliness among older adults. More research is needed in this area. Beyond incorporating theoretical frameworks to guide the research direction, considering philosophical perspectives could also be a valuable approach for guiding studies on loneliness. Future research should consider philosophical approaches as a paradigm to serve as a guide.

Discussion

This synthesis of the review articles provides a more comprehensive profile of the types, methods, trends, and effectiveness of existing ICTs in reducing loneliness among older adults. It is also found that these latest reviews all ignore sociocultural factors, which may influence both technology usage and loneliness of older adults simultaneously, which may also be one of the keys affecting the effectiveness of ICT (Akhter-Khan et al., 2020). Based on the main findings, the trends and effects of ICT interventions on loneliness in older adults, and cultural perspectives on ICT interventions for older adults' loneliness are discussed as follows.

The trend and effect of ICT interventions to reduce loneliness among older adults

Existing ICT interventions are characterized by diversity and tend to promote multi-level

functions, such as social participation and cognition. ICT interventions explicitly targeting older adults are gradually increasing. Being able to follow an older adults-centered design while taking into account their interests and preferences, especially in terms of ease of use, has been reported to help them overcome technological barriers (Choi & Lee, 2021). Recent studies have shown that age-centered design intervention attracted participants increased to use ICT interventions more frequently and had positive attitudes toward technologies (Arlati et al., 2019; Czaja et al., 2018; Rochat et al., 2018; Vercelli et al., 2019). According to Choi & Lee (2021), the creation of multifunctional online social platforms will be the next rising star, as online social platforms can provide multiple functions, such as improving loneliness and isolation, preventing falls, and managing medications, which can promote active and healthy aging and prevent cognitive impairment. Since most of the previous studies were based on the application of readily available technologies, more researchers are considering the need and the digital divide of older adults. The development of older adults centered ICT has the potential to become mainstream in the future.

Early review articles and studies have shown that ICT interventions can alleviate loneliness in older adults compared to control groups (Cohen-Mansfield & Perach, 2015; Czaja et al., 2018; Jarvis et al., 2019), but all the various kinds of reviews showed that there is insufficient strong evidence to support the effectiveness of ICT in reducing loneliness in older adults (Ibarra et al., 2020; Jin et al., 2021; Shah et al., 2021; Wiwatkunupakarn et al., 2022; Lei

et al., 2024). Despite this, most of the research also mentioned that the use of ICT positively impacts the loneliness of older adults, supporting the effectiveness of ICT in improving the social connection and quality of life of older adults. Overall, the design of individual studies displayed significant differences in many aspects, such as the means of social connection, the method of application, the frequency of use, and the characteristics of users. The high heterogeneity increases the difficulty of comparison and may also explain the ineffectiveness of existing interventions (Choi & Lee, 2021; Shorey & Chan, 2021). Focusing on reviewing experimental and quasi-experimental studies, Casanova et al. (2021) also concluded that ICTs use is beneficial for older adults in terms of lessening loneliness, but methodological shortcomings make it challenging to establish causality. Consequently, the continued development of more effective interventions and well-designed studies is required. Most of the reviews included in this paper have similar suggestions.

After a more detailed analysis of the reasons why loneliness interventions were unsuccessful, Akhter-Khan et al. (2020) presented another point of view, pointing out methodological limitations that researchers often cite, such as small sample size, and short follow-up may be just one of the main reasons the effect is not as good as expected. They argue that the underlying reasons for the failure of the intervention may be more than that. Instead, when designing interventions, researchers did not consider the nature and characteristics of loneliness, including the heterogeneity and complexity of loneliness structures, the lack of

attention to the different backgrounds, contexts, and individual needs of those experiencing loneliness, and the cultural factors that continued to shape human interaction and social relations. For example, more robust trends in individualism and urban migration may reduce opportunities for older adults to provide and receive support in the community or intergenerational settings. Based on the 2019 World Health Organization Recommendations on Integrated Care for the Elderly (ICOPE), they propose a precise healthcare approach to managing loneliness, arguing that many existing interventions can address loneliness and that there is no need to redevelop; instead, making them more effective and includes assessing dimensions of loneliness (emotional or social loneliness) (Weiss, 1973), physical and mental characteristics and preferences, and digital literacy in older adults. It is emphasized that the subjective burden of loneliness varies from person to person. Thus, it is suggested that a holistic cultural, person-centered perspective should be taken to look at the specific burdens of different individuals experiencing loneliness. Furthermore, interventions should be tailored to meet the individual contexts and needs (the right person), ensuring the right solutions are integrated, adapted, and delivered at the right time.

Opportunities and challenges driven by the COVID-19 pandemic

During and following the COVID-19 pandemic, the use of Information and Communication Technologies (ICT) had a significant impact on older adults (Balki et al., 2022b). The pandemic accelerated the adoption of ICT applications among older adults,

ranging from traditional telephones to more advanced online platforms, such as Skype, FaceTime, Zoom, or Google Meet, to maintain social connections and address issues of social isolation and loneliness (Wiwatkunupakarn et al., 2022; Beogo et al., 2023; Gunnes et al., 2024). The spectrum of ICT usage encompassed a wide range of categories, including video calls, robotic systems, and traditional internet and social media platforms. ICT interventions, particularly video conferencing programs, have demonstrated positive effects on depression, loneliness, and quality of life among residents of elderly care homes, showcasing the benefits of digital tools in enhancing the mental health and well-being of older adults (Latikka et al., 2022; Beogo et al., 2023). However, the pandemic also underscored certain dilemmas and challenges in technology use among some elderly individuals, such as technological illiteracy, lack of necessary devices and network connections, and resistance to digital technology adoption due to perceived complexity or cognitive decline (Gunnes et al., 2024; Lei et al., 2024). This highlights the ongoing need to overcome barriers to ICT interventions among older adults, emphasizing the importance of targeted support and training, including addressing individual capabilities, access and use, intervention design, and implementation challenges.

Cultural consideration on ICT interventions for older adults' loneliness and social isolation

Taking the above viewpoint, apart from the conceptual and design challenges, another problem with applying ICT to improve loneliness among older adults is the failure to consider

critical factors, especially cultural aspects, which may affect loneliness and the digital divide in older adults. Researchers focusing on interventions for loneliness in older adults continue to mention the importance of developing tailored interventions for specific groups (Cattan et al., 2005; Mann et al., 2017; Saito et al., 2012; Shorey & Chan, 2021). Therefore, it is vital to understand the loneliness characteristics of the target population and identify those at high risk before selecting or developing interventions (Ige et al., 2019). Immigration and culture, such as living situation and socioeconomic status, have been identified as social determinants of loneliness (Akhter-Khan et al., 2020). While demographic factors, such as gender, age, and education, have also been widely shown to significantly impact ICT availability (Niehaves & Plattfaut, 2014). Some researchers also considered race/ethnicity a factor (Cresci et al., 2010). However, few researchers reckon with cultural influences when implementing ICT interventions to manage loneliness in older adults. For example, of the six studies reviewed by Shah et al. (2021), only two reported the ethnicity of the participants and lacked detailed data, such as white (54%) and non-white (46%) (Czaja et al., 2018), Asian Indian (numbers not reported) (Jarvis et al., 2019).

Loneliness is a unique and subjective experience that is contextual and culture-bound (Dong & Chen 2017). Researchers have long focused on the relationship between loneliness and culture (Barreto et al., 2021; Heu et al., 2020; van Staden & Coetzee, 2010), noting that differences in participant backgrounds, especially in terms of age, gender, and culture, and

different types of ICT, may lead to heterogeneity in outcomes (Shah et al., 2021). Most of the retrospective review articles included in this article did not focus on the effects of participants' characteristics, and only one article mentioned that the heterogeneity of older adults was largely ignored by researchers (Jin et al., 2021). Gunnes et al. (2024) further point out that within various studies, the definition of "older adults" varies, and individuals within different age groups may face varying degrees of digital gap. Familiarity with and acceptance of technological products also differ among these groups. This not only limits the comparability and universality of findings but also adds complexity to evaluating the effectiveness of ICT interventions for specific age cohorts. According to the data presented, the demographic backgrounds of the participants varied considerably. Take gender as an example, only one article provided more detailed gender information, in which males accounted for 23.8%, females accounted for 66.1%, and 10.1% did not report gender (Shah et al., 2021). After further investigation of relevant studies, it also demonstrated that most of the research participants were female (Tsai et al., 2010; Tsai et al., 2011; Tsai et al., 2020). So far, the research results on gender differences and loneliness are still inconsistent. Most studies showed that older females are more prone to loneliness (Dong & Chen, 2017), which may be related to women's longer life expectancy and more likely to be widowed and living alone (Takagi et al., 2020), while other studies have not found gender differences (Wilson & Moulton, 2010), or older males are lonelier than older females (Wang et al., 2011). Dong and Chen (2017) believe that

culture may cause such differences, and advocate that when discussing gender differences in loneliness, specific cultural groups should be targeted to clarify the complexity of loneliness better. Their population-based study of U.S. Chinese older adults found that older Chinese women were significantly lonelier than older men and were devoid of companionship. In particular, older women who live with fewer people, have poorer health, have a poorer quality of life, and have worsened health conditions in the past year are more likely to feel lonely than men. The author explains the collectivism of Chinese culture and the traditional Chinese gender role division of labor, so-called "men are the breadwinners and women are the homemakers" (男主外，女主内), that is, women are responsible for the family and childcare, and men are in charge of earning money to support the family. This traditional Chinese belief may lead to differences in the level and frequency of interactions between the two with family members throughout life, thereby affecting the size and composition of interpersonal networks in older adults, and ultimately gender differences in loneliness (Dong & Chen, 2017). While older Chinese American women lack social connections other than the family, men are less willing to express loneliness and seek help due to traditional Chinese gender roles and "save face" culture; these factors should be considered when designing interventions for loneliness in older adults.

In addition, older adults are often regarded to have a digital divide, and the most relevant sociodemographic variables in technology adoption and digital divide research include age,

gender, ethnicity, income, education, marital status, family status, and housing data (Niehaves & Plattfaut, 2014). These demographic characteristics also overlap significantly with demographic factors that influence loneliness (Chen et al., 2014), suggesting that sociodemographic characteristics must be prioritized when designing ICT interventions to alleviate loneliness in older adults. Nonetheless, these key factors are rarely taken heed of in the existing relevant scientific and technological interventions, which can be seen from the fact that most of the seven papers reviewed did not incorporate these factors into the analysis and discussion. Only one of the thirteen articles mentioned the sex ratio, mean age, and race of the included studies in more detail (Shah et al., 2021), but upon further review of their original studies, up to four (66%) did not mention the race of the participants, even though more detailed information is provided, the authors also do not incorporate these sociocultural factors into the analysis and discussion. All the reviewed literature has relatively complete data on sociodemographic variables, and only two did not mention age (Noone et al., 2020; Beogo et al., 2023), and the age range is vast, ranging from 55 to 95 years old. The age of older adult participants is generally over 70 years old (Casanova et al., 2021). The effect of age on technology use has long been identified, whereas the authors have not discussed this in-depth. After conducting a scoping review, Fakoya et al. (2020) suggested that there is no single one-size-fits-all approach to loneliness or social isolation. Interventions need to be tailored to the needs of individuals, specific populations, or the level of loneliness experienced. It is suggested

that future research should aim at identifying which interventions work for whom, in what specific settings, and how. This highlights the need for further consideration to include participants' age, gender, and cultural background, a view that echoes Akhter-Khan et al. (2020)'s claim that the right person must be considered when conducting loneliness interventions.

The importance of theoretical guidance and interpretation of research findings has long been established. After exploring the reasons for the success of existing interventions for loneliness, Akhter-Khan et al. (2020) highlighted the urgent demand for precise, comprehensive, and theory-driven interventions that focus on individual needs and the subjective burden of loneliness in the context of aging. Fan (2016) using qualitative review summarizes three kinds of theories applied to ICT research in elderly loneliness, including cognition and learning behavior theory, social interaction theory, and social work theories. The cognition and learning theories, such as self-efficacy theory has been fundamental to ICT innovation in older adults (Hall et al., 2015). Social interaction theory is based on the principle that ICTs are designed for older people to help them live as independently as possible without losing their social connections (Choi & Dinitto, 2013). In terms of social work theory, Fan (2016) indicated that empowerment is seen as solid support for bridging the digital gap, and in a case study of data, self-empowerment training programs help alleviate cultural barriers in older Vietnamese women (O'Mara, 2012). Other commonly used related theories include those

related to the use of technology, such as the Technology Acceptance Model (Davis, 1989). Appropriate theoretical guidance should be selected when designing interventions and research to alleviate loneliness in older adults. Besides that, this paper applied the ecological systems theory as a framework to examine the results. The principles and approaches of interventions in the studies included in the updated review articles predominantly promote social connection, and the subjects of connection are mainly family members and friends. Studies targeting macro-system that integrate social resources are rare. Since loneliness is profoundly affected by the social and cultural environment, future research should consider incorporating more social and community resources to manage loneliness of older adults more precisely and comprehensively.

Conclusion

The latest reviews reveal that there is still a lack of well-designed research to verify the ICT intervention in alleviating loneliness among older adults, particularly for high-risk groups, such as older Chinese immigrants in the United States. Failure to consider the sociocultural determinants of loneliness and ICT use among older adults is an essential factor affecting the effectiveness of measures, and may also be responsible for many unclear and inconsistent results in the existing literature. However, evidence suggests that loneliness among older adults can be addressed and improved through effective interventions, which means that this is a research direction worthy of further exploration and continuous efforts. It is recommended that loneliness interventions for older adults should take a holistic, human-

centered design (HCD) on the specific burdens of different individuals experiencing loneliness, consider designs that meet individual contexts and needs, and provide the right solutions at the right time to truly reduce the harm of loneliness to older adults, and achieve the United Nations Sustainable Development Goals (SDGs) of reducing health inequalities.

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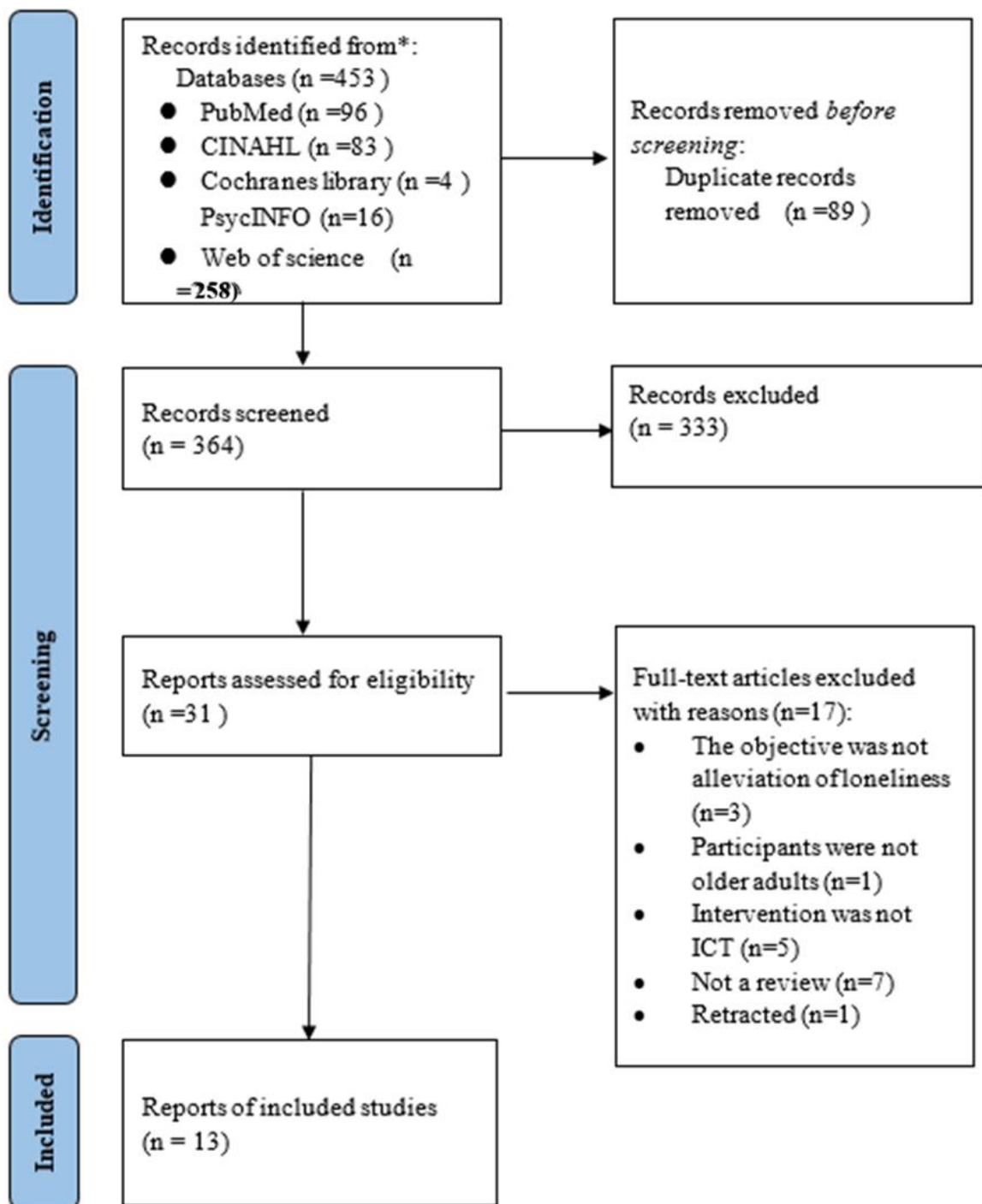


Figure 3.1 PRISMA flow chart delivered the phases of paper identification and selection.

Appendix 3.1 Search keywords

PubMed

("Cultural Competency"[Mesh] OR culturally sensitive OR culturally competent OR cultural competence OR culturally appropriate) AND ("Digital Technology"[Mesh] OR "Computers"[Mesh] OR technology OR computer OR virtual) AND ("Loneliness"[Mesh] OR "Social Isolation"[Mesh] OR "Social Networking"[Mesh] OR loneliness OR lonely OR "social isolation"[tiab:~4] OR "social connectivity"[tiab:~4] OR "social networks"[tiab:~4]) AND ("Minority Groups"[Mesh] OR "Ethnic and Racial Minorities"[Mesh] OR "Minority Health"[Mesh] OR "Asian American Native Hawaiian and Pacific Islander"[Mesh] OR "Black or African American"[Mesh] OR "Hispanic or Latino"[Mesh] OR "Asian People"[Mesh] OR "Indigenous Peoples"[Mesh] OR racial minority OR ethnic minority OR Black OR African American OR Latino OR Latinx OR Indigenous OR Native American OR Asian) AND (meta-analysis[Filter] OR systematicreview[Filter] OR "systematic review"[tiab:~4] OR "meta analysis"[tiab:~4]) AND (2019:2024[pdat]) AND (english[Filter])

- 1 results total published 2019-2024 in English for systematic reviews and meta-analyses
- Exclusion reasons:
Wrong intervention (non-ICT Technology): 1

("Cultural Competency"[Mesh] OR culturally sensitive OR culturally competent OR cultural competence OR culturally appropriate) AND ("Digital Technology"[Mesh] OR "Computers"[Mesh] OR technology OR computer OR virtual) AND ("Loneliness"[Mesh] OR "Social Isolation"[Mesh] OR "Social Networking"[Mesh] OR loneliness OR lonely OR "social isolation"[tiab:~4] OR "social connectivity"[tiab:~4] OR "social networks"[tiab:~4]) AND ("Minority Groups"[Mesh] OR "Ethnic and Racial Minorities"[Mesh] OR "Minority Health"[Mesh] OR "Asian American Native Hawaiian and Pacific Islander"[Mesh] OR "Black or African American"[Mesh] OR "Hispanic or Latino"[Mesh] OR "Asian People"[Mesh] OR "Indigenous Peoples"[Mesh] OR racial minority OR ethnic minority OR Black OR African American OR Latino OR Latinx OR Indigenous OR Native American OR Asian) AND (2019:2024[pdat]) AND (english[Filter])

- 17 results total published 2019-2024 om English, not limited to systematic reviews and meta-analyses
- Exclusion reasons:
Wrong intervention (non-ICT Technology): 2 articles
Wrong outcome (non-loneliness and social isolation): 10 articles
Wrong population (non-elderly): 4 articles
Wrong design: 1 article (this one is a letter to the editor)

CINAHL

(MH "Cultural Competence" OR culturally sensitive OR culturally competent OR cultural competence OR culturally appropriate) AND (MH "Technology+" OR MH "Digital Technology+" OR MH "Computers and Computerization+" OR technology OR computer OR virtual) AND (MH "Loneliness" OR MH "Social Isolation+" OR MH "Social Networking+" OR loneliness OR lonely OR (social N4 isolation) OR (social N4 connectivity) OR (social N4 networks)) AND (MH "Minority Groups+" OR MH "Ethnic Groups+" OR MH "Asians+" OR MH "Black Persons+" OR MH "Hispanic Americans+" OR MH "Indigenous Peoples+" OR MH "People of Color+" OR racial minority OR ethnic minority OR Black OR African American OR Latino OR Latinx OR Indigenous OR Native American OR Asian) AND (meta-analysis[Filter] OR systematicreview[Filter] OR "systematic review"[tiab:~4] OR "meta analysis"[tiab:~4]) AND (2019:2024[pdat]) AND (english[Filter])

- 0 results total published 2019-2024 on English, not limited to systematic reviews and meta-analyses

(MH "Cultural Competence" OR culturally sensitive OR culturally competent OR cultural competence OR culturally appropriate) AND (MH "Technology+" OR MH "Digital Technology+" OR MH "Computers and Computerization+" OR technology OR computer OR virtual) AND (MH "Loneliness" OR MH "Social Isolation+" OR MH "Social Networking+" OR loneliness OR lonely OR (social N4 isolation) OR (social N4 connectivity) OR (social N4 networks)) AND (MH "Minority Groups+" OR MH "Ethnic Groups+" OR MH "Asians+" OR MH "Black Persons+" OR MH "Hispanic Americans+" OR MH "Indigenous Peoples+" OR MH "People of Color+" OR racial minority OR ethnic minority OR Black OR African American OR Latino OR Latinx OR Indigenous OR Native American OR Asian)

- 49 results total with no filters or limits applied
- Exclusion reasons:
 - Wrong intervention (non-ICT): 7 articles
 - Wrong outcome (non-loneliness and social isolation): 22 articles
 - Wrong population (non-elderly): 18 articles
 - Wrong design: 2 articles

Cochrane Library

(culturally sensitive OR culturally competent OR cultural competence OR culturally appropriate) AND (technology OR computer OR virtual) AND (loneliness OR lonely OR social isolation OR social connectivity OR social networks) AND (racial minority OR ethnic minority OR Black OR African American OR Latino OR Latinx OR Indigenous OR Native American OR Asian)

- 25 results total, all in English and within the required date range. Link not available, just copy and paste to run the search.
- Exclusion reasons:
 - Wrong intervention (non-ICT): 1 article
 - Wrong outcome (non-loneliness and social isolation): 15 articles
 - Wrong population (non-elderly): 15 articles

PsycINFO

(DE "Cultural Competence" OR DE "Cultural Sensitivity" OR culturally sensitive OR culturally competent OR cultural competence OR culturally appropriate) AND (DE "Technology" OR DE "Computers" OR DE "Digital Computers" OR DE "Online Social Networks" OR DE "Social Networks" OR technology OR computer OR virtual) AND (DE "Loneliness" OR DE "Social Isolation" OR " DE "Social Networks" OR DE "Online Social Networks" OR loneliness OR lonely OR social isolation OR social connectivity OR social networks) AND (DE "Minority Groups" OR DE "Racial and Ethnic Groups" OR DE "African Cultural Groups" OR DE "Asians" OR DE "Blacks" OR DE "Indigenous Populations" OR DE "Latinos/Latinas" OR DE "Middle Eastern and North African Cultural Groups" OR DE "Multiracial" OR DE "Oceanian Cultural Groups" OR DE "People of Color" OR DE "Ethnic Bias" OR DE "Ethnic Identity" OR DE "Ethnic Diversity")

- 2 results published 2019-2024, no filters applied
- Exclusion reasons:
 - Wrong outcome (non-loneliness and social isolation): 1 article
 - Wrong design: 1 article

Web of Science

(culturally sensitive OR culturally competent OR cultural competence OR culturally appropriate) AND (technology OR computer OR virtual) AND (loneliness OR lonely OR social isolation OR social connectivity OR social networks) AND (minority OR minorities OR Asian OR Black OR African American OR Hispanic OR Latino OR Indigenous OR Native American OR ethnic OR African)

- 20 results published 2019-2024 in English, no other filters applied
- Exclusion reasons:
 - Wrong outcome (non-loneliness and social isolation): 14 articles
 - Wrong population (non-elderly): 6 articles

Appendix 3.2 Search keywords

PubMed

("Aged"[Mesh] OR aged[Filter] OR "older adults" OR elderly OR geriatric OR aging OR aged OR seniors) AND ("Digital Technology"[Mesh] OR "Computers"[Mesh] OR "Social Networking"[Mesh] OR technology OR computer OR virtual) AND ("Loneliness"[Mesh] OR "Social Isolation"[Mesh] OR "Social Networking"[Mesh] OR loneliness OR lonely OR "social isolation"[tiab:~4] OR "social connectivity"[tiab:~4] OR "social networks"[tiab:~4]) AND (meta-analysis[Filter] OR systematicreview[Filter] OR "systematic review"[tiab:~4] OR "meta analysis"[tiab:~4]) AND (2019:2024[pdat]) AND (english[Filter])

- 96 results published 2019-2024 in English for systematic reviews and meta-analyses

CINAHL

("older adults" OR elderly OR geriatric OR aging OR aged OR seniors) AND (MH "Technology+" OR MH "Digital Technology+" OR MH "Computers and Computerization+" OR MH "Social Networking+" OR technology OR computer OR virtual) AND (MH "Loneliness" OR MH "Social Isolation+" OR MH "Social Networking+" OR loneliness OR lonely OR (social N4 isolation) OR (social N4 connectivity) OR (social N4 networks))

- 83 results published 2019-2024 in English for systematic reviews and meta-analyses

Cochrane Library

("older adults" OR elderly OR geriatric OR aging OR aged OR seniors) AND (technology OR computer OR virtual) AND (loneliness OR lonely OR social isolation OR social connectivity OR social networks)

- 4 results total.

PsycINFO

("older adults" OR elderly OR geriatric OR aging OR aged OR seniors) AND (DE "Technology" OR DE "Computers" OR DE "Digital Computers" OR DE "Online Social Networks" OR DE "Social Networks" OR technology OR computer OR virtual) AND (DE "Loneliness" OR DE "Social Isolation" OR " DE "Social Networks" OR DE "Online Social Networks" OR loneliness OR lonely OR "social isolation" OR "social connectivity" OR "social networks")

- 16 results published 2019-2024 in English for systematic reviews and meta-analyses

Web of Science

("older adults" OR elderly OR geriatric OR aging OR aged OR seniors) AND (technology OR computer OR virtual) AND (loneliness OR lonely OR social isolation OR social connectivity OR social networks) AND (systematic review OR meta-analysis)

- 258 results published 2019-2024 in English for systematic reviews and meta-analyses

Appendix 3.3 Amstar 2 of 13 reviews

Study	Q1	Q2*	Q3	Q4*	Q5	Q6	Q7*	Q8	Q9*	Q10	Q11*	Q12	Q13*	Q14	Q15*	Q16	Quality
Noone et al., (2020).	Y	Y	Y	PY	Y	Y	Y	PY	Y	N	Y	Y	Y	Y	N	N	H
Ibarra et al., (2020)	Y	PY	N	Y	N	N	PY	N	PY	N	N/A	N/A	N	Y	N/A	Y	L
Casanova et al., (2021)	Y	PY	N	PY	Y	N	Y	N	N	N	N/A	N/A	N	Y	N/A	Y	CL
Choi & Lee (2021)	Y	PY	Y	PY	Y	Y	PY	N	PY	N	N/A	N/A	Y	N	N/A	Y	L
Shah et al., (2021)	Y	Y	N	Y	Y	Y	PY	PY	Y	N	Y	N	N	N	N	Y	CL
Jin et al., (2021).	Y	PY	Y	PY	Y	Y	PY	Y	PY	N	Y	N	N	Y	N	Y	CL
Todd et al., (2022)	Y	PY	N	PY	Y	N	PY	PY	N	N	N/A	N/A	N	Y	N/A	Y	CL
Latikka et al., (2021)	Y	Y	N	Y	Y	Y	PY	PY	N	N	N/A	N/A	N	N	N/A	Y	CL
Beogo et al., (2023)	Y	N	N	PY	Y	Y	Y	PY	N	N	N/A	N/A	N	Y	N/A	Y	CL
Lei et al., (2024)	Y	PY	N	PY	Y	Y	PY	PY	N	N	N/A	N/A	N	Y	N/A	Y	CL
Döring et al., (2022)	Y	PY	N	PY	Y	N	N	PY	N	N	N/A	N/A	N	N	N/A	Y	CL
Gunnes et al., (2024)	Y	N	N	PY	Y	Y	PY	PY	N	N	N/A	N/A	N	N	N/A	Y	CL

Wiwatkunupakarn et al., (2022)	Y	Y	N	PY	Y	Y	PY	PY	N	N	N/A	N/A	Y	N	N/A	Y	CL
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Key: * denotes Critical; H signifies High with 0/1 non-critical weakness; M indicates Moderate with more than 1 non-critical weakness; No critical flaws present; L denotes Low with 1 critical flaw with/without non-critical weaknesses; CL signifies Critically Low with more than 1 critical flaw with/without non-critical weaknesses.

Appendix 3.4 Table 3.1 Characteristics and summaries of included reviews

Authors, country	Aims	Search Period/ Publication time/Number of articles includes	Participants (age, gender/ethnicity/ location)	ICT intervention	Type of intervention /Level of ecology	Main finding and key recommendations
Noone et al., (2020). Ireland	To evaluate the efficacy of video calls for reducing loneliness and social isolation among older adults, and to assess the effectiveness of video calls in relieving depressive symptoms and improving quality of life	Databases: CENTRAL, MEDLINE, PsycINFO, and CINAHL. From 1 January 2004 to 7 April 2020 3 articles were included	Sample size: 209 (male:83; female:126) Location: Nursing homes in Taiwan Mean age: 76 years old Ethnicity: not identify	Video calls	<i>Microsystem:</i> help older people keep in touch with family and friends.	Video calls seem to have minimal to no impact on loneliness in older adults over periods of 3, 6, or 12 months. Similarly, there is little to no improvement in their quality of life. While older adults using video calls for one year may experience a slight reduction in depressive symptoms compared to those receiving usual care, this difference is negligible after three or six months. The effectiveness of video calls in alleviating loneliness in older adults remains uncertain. To better understand their impact, more rigorous studies with a diverse and representative sample of older adults, particularly those who are lonely or socially isolated, are needed.

Ibarra et al., (2020). Russia	To evaluate and summarize current technology-supported interventions in helping older adults living in situations of reduced mobility to overcome loneliness and social isolation	Database: Elsevier's Scopus database Published until January 2020. 25 studies were included	Number of participants (all included studies):1421 Age:55 to 95 Ethnicity: unidentified Gender: unidentified	Internet, Skype, Line, Facebook, WhatsApp, E-mail, Broadcast, Virtual classroom, and Video chat	Interventions range from <u>Microsystem</u> (focusing on connections with family and friends), <u>Mesosystem</u> (social circle extended by family and friends), to <u>Exosystem</u> (Mass media)	Although all interventions are feasible for use among older adults and yield positive outcomes, many studies fail to report on human factors and technology usage, nor do they utilize standard instruments for measuring loneliness and social isolation. Furthermore, most research focuses on training for using specific technologies, neglecting (1) the design of interventions that encourage or promote the use of technology in specific ways, such as organizing and facilitating access to chat rooms with particular topics, and (2) the use of persuasive technologies that incorporate motivational components and help users initiate and maintain conversations on shared interests. Bridging these gaps would enable researchers to better understand how technology can improve loneliness.
Casanova et al.,	The authors analyzed experimental	Databases: Ovid-Medline, Ovid-	Number of participants (all included	Facebook, Instagram, LinkedIn,	Interventions range from <u>Microsystem</u>	ICT interventions demonstrated positive but weak correlations with older adults' feelings of loneliness, sense of self-

(2021). Italy	or quasi-experimental research investigating the causal effect of ICT and SNS use on older adults to lessen loneliness. The aims were to compare and contrast study designs and the conclusions of these studies and underline their limitations	EMBASE, and the Cochrane library. Article published before May 2020. 11 articles were included	studies):953 Age:58 to 93 (mean age: 71) Ethnicity: unidentified Gender: unidentified	Twitter, and Computer	(focusing on connections with family and friends), <u>Mesosystem</u> (social circle extended by family and friends), to <u>Exosystem</u> (Mass media)	worth, strength of personal identity, and self-esteem. However, the studies reviewed lacked robust experimental designs, with insufficiently rigorous sampling methods and recruitment strategies. Future research should adopt a multidisciplinary approach, integrating clinical, psychological, and sociological research methods, and take into account the diverse characteristics of older adults. The body of research on the use of social networking sites (SNS) by older adults is still limited, particularly regarding its impact on health and well-being. Review studies should concentrate on the interplay between loneliness, social isolation, and the use of ICT and SNS among older adults to better understand these relationships, rather than examining them in isolation.
Choi & Lee (2021).	To deliver a meticulous summary of	Databases: Ovid-Medline, Ovid-	Number of participants (all included	Animal Robot, Humanoid	Interventions range from <u>Individual:</u>	The trend in loneliness interventions for older adults is evolving from the use of animal robots to online social platforms.

Korea	the trends and effectiveness of ICT Interventions for older adults to reduce loneliness	EMBASE, and the Cochrane library. Studies had been published between 2003 and 2019. 23 articles were included	studies):644 (male:161; female:445; not identified: 38) Age: 55 to 93 Location: seven studies from Europe, one from North America, five from South America, five from Asia, one from Africa, and two from multiple continents Ethnicity: not identify	Agent, Mobile Robot, Exercise Game, Interpersonal Communication, and Online Social Platform	Addressing the individual's companionship needs, no intervene from other systems, <u>Microsystem</u> (focusing on connections with family and friends), <u>Mesosystem</u> (social circle extended by family and friends), to <u>Exosystem</u> (Mass media)	These interventions are expanding from providing simple emotional support to offering multi-faceted systems that enhance social participation, cognition, physical activity, nutrition, and sleep. Older adults are increasingly utilizing ICT interventions and have expressed positive feedback about their experiences.
Shah et al., (2021). United	To identify digital technology interventions	Database: PubMed, MEDLINE, CINAHL,	Number of participants (all included studies):646 (male:	Videoconferencing, CareTV including	Interventions range from <u>Microsystem</u> (focusing on	This meta-analysis found no substantial evidence supporting the effectiveness of DTIs in reducing loneliness among older adults. The quality of evidence in

Kingdom	(DTIs) used to reduce loneliness in older adults and assess the effectiveness.	Embase, and Web of Science Included articles were published from January 1, 2010, to July 31, 2019 A total of 6 studies were selected.	154, 23.8%; female: 427, 66.1%; not identified: 65, 10.1%) Mean age: 73 to 78 Locations: Facilities (such as nursing home) (n=3); Home (n=2); Mixed(n=1) Ethnicity: 4 papers do not identify; 1 paper reported White/non-White; 1 paper reported mostly Asian (of Indian origin)	Caret duplex video, social internet-based activity, Personal Reminder Information and Social Management (PRISMe system), EasyPC (a customized computer platform with a simplified touchscreen interface), and WhatsApp	connections with family and friends), <u>Mesosystem</u> (social circle extended by family and friends), to <u>Exosystem</u> (Mass media)	the trials ranged from very low to moderate. Despite this, digital technology may offer short-term relief from loneliness and still provides valuable tools and methods to foster social connections.
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Jin et al., (2021). China	To assess the effectiveness of DTIs in reducing loneliness in older adults	Databases: Cochrane Library, PubMed, Web of Science, SpringerLink, EMBASE, and China National Knowledge Infrastructure and Wanfang Search from inception to April 2021 6 articles were included	Number of participants (all included studies): 391 Age: 60 to 93 Locations: not identified Gender: not identified Ethnicity: not identified	Smartphone-based video calls and computer-based training with Internet usage	Interventions range from <u>Microsystem</u> (focusing on connections with family and friends), <u>Mesosystem</u> (social circle extended by family and friends), to <u>Exosystem</u> (Mass media)	The interventions demonstrated little to no difference in reducing loneliness compared to the control group, with no evidence suggesting that technology-based interventions are effective in alleviating loneliness among older adults. The quality of current studies is mostly low to moderate, and the heterogeneity among older adult participants is high. Older adults are generally more prone to loneliness and social isolation than younger populations. Notably, loneliness does not increase linearly with age; it peaks among the oldest-old, those aged 80 and over. Therefore, high-risk groups should be prioritized as target populations for future research.
Todd et al., (2022). Australia	To identify, evaluate, and summarize the findings of studies focusing on	Databases: PubMed, Embase, CINAHL, Cochrane (Cochrane	Sample sizes ranged from 6 to 300 Lowest average age: 66; highest: 82 Locations: studies	Internet-based applications, Telephone support networks,	Interventions included <u>Microsystem</u> (focusing on connections with family	Many older adults are reluctant to adopt ICT due to difficulties or a limited understanding of how to use the technology. However, during the COVID-19 pandemic, there has been a greater willingness among older adults

	<p>ICTs in reducing social isolation in older people and provide recommendations for future research</p>	<p>Reviews), RURAL and PsycINFO Papers published between 2007 and 2020 15 studies were included</p>	<p>took place across eight countries, Australia, Brazil, Canada, Italy, Taiwan, the Netherlands, the UK, and the USA Gender: not identified Ethnicity: not identified</p>	<p>Applications for phones and tablets, and Videoconferencing</p>	<p>and friends), <i>Mesosystem</i> (social circle extended by family and friends)</p>	<p>to embrace new technologies when they are perceived as easy to use and user-friendly. It is recommended to provide training and ongoing technical support for older adults adopting new ICTs. Involving older adults in the selection and application of technology can help minimize the difficulties and confusion associated with new technologies. Additionally, intuitive and simple designs can enhance the acceptability and usability of ICT for older adults. The review indicated that the methodological quality of qualitative research and mixed methods research is generally good, while the overall methodological quality of quantitative research is relatively poor. Strong conclusions about the effectiveness of different interventions are limited by the heterogeneity of interventions and the diversity of outcome measures.</p>
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<p>Latikka et al., (2021). Finland</p>	<p>To gain insight into how technology (specifically, physical ICTs) can help overcome loneliness and social isolation beyond merely fostering social communication with people, and to identify the main open-ended challenges as reported by the reviewed studies.</p>	<p>7 Databases: Scopus (Elsevier), Web of Science (Clarivate), EBSCOhost (EBSCO), Social Science Premium Collection (ProQuest), PsycINFO (Ovid), PubMed (National Library of Medicine), and IEEE Xplore Digital Library (IEEE). Papers published between 2006</p>	<p>Sample Sizes: Ranged from 10 to 216. Age Range: Lowest age 55, highest 100. Locations: Primarily in the United States (n=10), with studies also in Germany (n=2), and Singapore (n=2). Additional countries include Australia, Canada, Ireland, Mexico, the Netherlands, New Zealand, and Taiwan. Two studies included cross-national data.</p>	<p>Smart Home Solutions: Seven papers utilized smart home solutions, or a combination of smart homes and smartphones. Social Robots: Ten studies conducted research using social robots. Virtual Reality (VR) Systems: Two papers examined the</p>	<p>Interventions range from <u>Microsystem</u> (focusing on connections with family and friends), <u>Mesosystem</u> (social circle extended by family and friends), to <u>Exosystem</u> (Mass media)</p>	<p>ICT solutions, such as smart homes, have the capability to detect and predict loneliness and social isolation, while robotic pets and social robots can help alleviate loneliness to some extent. This is particularly relevant during the COVID-19 era, which has seen increased social restrictions and a surge in related research. Major challenges in this field include the need for more robust study samples and designs, as well as overcoming technology- and topic-specific obstacles. This study, which focuses on older adults experiencing loneliness and social isolation, suggests that future research should expand its scope to include a wider range of technologies and dimensions related to these issues.</p>
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		and 2021. The final data set consisted of 23 studies.	Gender: Seventeen papers reported the ratio of female participants, ranging from 46.15% to 85.37%. Five papers included multiple data types, and five did not mention gender. Ethnicity: Not specified.	use of VR systems. Activity System: One study used an activity system that includes an activity sensor (AAL-VU system).		
Beogo et al., (2023). Canada	To synthesize the impact of ICT-based communication interventions — encompassing SMS text	10 databases: PsycINFO-Ovid, Ovid-MEDLINE, CINAHL-EBSCO, Cochrane Library, Web of Science,	The included studies reached 349 participants ranging from 22 to 132 studies. Locations: Studies were conducted in Germany, the United States,	Robot temi with embedded videotelephony; Telephone or Video; Utilization of video calls	interventions range from <i>Microsystem</i> (focusing on connections with family and friends), <i>Mesosystem</i> (social circle	This review highlights the innovative use of humanoid robots in long-term care facilities (LTCFs) for their versatile functions, including remote communication, as a method to reduce social isolation and loneliness (SIL) among residents. It also examines how ICT applications for social engagement can continue to play a crucial role

	<p>messaging, chat, video, voicemail, and photo sharing—on reducing social isolation and loneliness (SIL) among residents of long-term care facilities (LTCFs) during the COVID-19 pandemic.</p>	<p>Scopus, DirectScience, Communication & Mass Media Complete, IEEE Xplore, and ACM Digital Library. Papers published 2019. 4 studies were included in this review.</p>	<p>France, and the United Kingdom. Aged ≥ 65 years. Gender: not identified Ethnicity: not identified</p>	<p>and videoconferencing through software like Skype, Zoom, and FaceTime, or via social platforms on desktop computers, laptops, tablets, and smartphones.</p>	<p>extended by family and friends), to <u>Exosystem</u> (Mass media)</p>	<p>beyond the COVID-19 pandemic. This study is among the first to systematically explore the effectiveness of ICT social applications in mitigating SIL in LTCFs during the pandemic.</p>
<p>Lei et al., (2024). Australia</p>	<p>To synthesize the findings regarding the mediators of the relationship between social</p>	<p>3 databases: PsycINFO, PubMed, and CINAHL</p>	<p>Sample sizes ranged from 6 to 16925 Lowest mean age: 65; highest: 85+</p>	<p>social media, social media apps, video conferencing apps, and customized online social</p>	<p>interventions range from <u>Microsystem</u> (focusing on connections with family and friends),</p>	<p>Cross-sectional studies frequently associate social media use with positive psychosocial outcomes, but longitudinal studies present mixed and inconclusive results over time. The diverse range of outcomes studied, including loneliness, depression, anxiety, life satisfaction,</p>

	media use and older adults' psychosocial outcomes, so that the critical components of social media use could be better understood.	Papers published: 2008 to 2023. 64 studies were included in this review. including cross-sectional (n = 38), observational longitudinal (n = 6), interventional (n = 9), mixed-methods (n = 4), and qualitative (n = 7) studies.	Locations: in 20 different countries with the highest number coming from the United States (n = 17). One multi-site study was conducted across seven countries. Gender: 9 papers didn't identify the gender ratio, female ratio in the rest of the papers ranged from 40% to 100%. Ethnicity: not identified	networking platform	<u>Mesosystem</u> (social circle extended by family and friends), to <u>Exosystem</u> (Mass media)	and social connectedness, complicates the analysis. The overlapping nature of emotional symptoms like depression, anxiety, and loneliness further complicates the attribution of specific effects without precise controls. Moreover, the impact of social media engagement on these outcomes can vary significantly.
Döring et al., (2022).	To summarize the presence of communication technologies	5 databases: MEDLINE, Institute of Electrical and	Sample sizes ranged from 36 to 8895.	Internet Computer Videoconference system	Interventions range from <u>Microsystem</u> (focusing on	The majority of the included reviews focused on general internet and computer use, with 82% addressing both topics (RQ1). Among the 28

Germany	(CTs) (review question RQ1), theoretical frameworks (RQ2), study designs (RQ3), and positive effects of technology use (RQ4) in the research field.	Electronics Engineers (IEEE) Xplore, Association for Computing Machinery (ACM) Digital Library, Scopus, and PsycINFO. Papers published: between 2005 and 2021. (Publication Years of Primary Studies: 1970-2020) 28 studies were included in this review.	Locations: not identified Age: not identified Gender: not identified Ethnicity: not identified	other technologies Email Telephone SNS Videogame console social robot Smartphone Tablet Chat/messaging app AR/VR system	connections with family and friends), <u>Mesosystem</u> (social circle extended by family and friends), to <u>Exosystem</u> (Mass media)	reviews, only one (4%) employed a theoretical framework (RQ2), and 26 (93%) reviewed primary studies with quantitative-experimental designs (RQ3). Technology use showed positive effects in 55% of loneliness outcomes and 44% of social isolation measures (RQ4). Although reviews suggest that communication technologies (CTs) can reduce loneliness and social isolation among older adults, causal evidence remains scarce, and there is limited insight into innovative technologies such as augmented reality systems.
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<p>Gunnes et al., (2024). Norway</p>	<p>To synthesize evidence on ICT interventions for loneliness and social isolation in community-dwelling older adults, detailing technology types, impacts, facilitators, barriers, and research gaps.</p>	<p>8 databases: PubMed, Scopus, Medline, Cochrane Library, Web of Science, PsycINFO, CINAHL, and Epistemonikos Papers published: between 2012 and 2024 39 studies were included in this review.</p>	<p>Sample in the range of 5- 3500 participants. Lowest age: 8; highest: 105 (Numbers of paper of criteria age Age\geq45*1 \geq50*17 \geq60*15 \geq70*2 Across lifespan*2) Locations: Most reviews were conducted in the North American, European and Western Pacific regions, with several of the primary studies represented from</p>	<p>Gameplay*8 Social robots and conversational agents*9 Video-mediated ‘friendly visits’ *17 Social media ‘virtual communities’ *25 General (mixed) ICT*30</p>	<p>Interventions range from <u>Microsystem</u> (focusing on connections with family and friends), <u>Mesosystem</u> (social circle extended by family and friends), to <u>Exosystem</u> (Mass media)</p>	<p>ICTs generally showed positive effects on reducing social isolation and loneliness, despite methodological diversity and some contradictory results that make firm conclusions challenging. Factors influencing these outcomes included individual competencies, access and usage, as well as the design and implementation of interventions. Research gaps highlight the need for targeting specific subgroups, investigating new technologies, diversifying study designs, refining research methodologies, and focusing on usability and accessibility. Future studies should aim to identify the older adult populations most likely to benefit from ICTs, explore innovative technologies, employ various study designs, and prioritize usability and accessibility.</p>
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			<p>the USA and the Netherlands.</p> <p>Gender: 3 reported mixed gender, 1 reported female participants, 1 high proportion of men, 6 reviewed predominance of women. Not identified in the rest of the research papers.</p> <p>Ethnicity: not identified</p>			
<p>Wiwatkun upakarn et al., (2022).</p> <p>Thailand</p>	<p>To examine the relationship between SNS usage and social isolation, loneliness, and depression</p>	<p>3 databases: Pubmed, Cochrane Library, and CiNAHL.</p> <p>Papers published:</p>	<p>Sample sizes ranged from 32 to 12300.</p> <p>The mean age of the sample varied between 61.5 to 80.7 years.</p>	<p>Social network site, social media</p>	<p>Interventions range from <i>Microsystem</i> (focusing on connections with family and friends), <i>Mesosystem</i> (social circle</p>	<p>Observational studies suggested that social networking site (SNS) usage might be associated with lower depression and loneliness scores, but few experimental studies reported similar outcomes. No studies demonstrated significant reductions in social isolation with SNS use. Further research is needed to conclusively</p>

	among older adults.	between 2001 and 2020 15 studies were included in this review. (10 observational and 5 experimental studies.)	Locations: USA, Netherland, Canada, UK, China Gender: the ratio of female is between 51-82%. Ethnicity: not identified		extended by family and friends), to <u>Exosystem</u> (Mass media)	determine the effectiveness of SNS for addressing depression, loneliness, and social isolation in older adults.
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CHAPTER 4

Designing a Culturally Sensitive Intervention—VOCALE OCI for Older Chinese Immigrants to Reduce Social Isolation and Loneliness

Abstract

Background

This study, building on the findings of two previous studies (Chapters 2 and 3) that explored the experiences of loneliness and social isolation among older Chinese immigrants and their use of technology, as well as incorporating evidence from updated literature on Information and Communication Technology (ICT) measures, specifically designs a Virtual Online Community for the Elderly for older Chinese immigrants (VOCALE-OCI).

Objectives

To develop and preliminarily test the usability and acceptability of the VOCALE-OCI, with the aim of assessing its potential to mitigate levels of loneliness and social isolation among older Chinese immigrants.

Methods

This study employed a human-centered design approach that considers cultural sensitivity, usability, and accessibility. The VOCALE-OCI online community was developed to provide a user-friendly and culturally resonant environment for older Chinese immigrants. To assess the online community's usability and acceptability. To assess the online community's usability and acceptability, preliminary feedback was collected from participants

via the think-aloud method.

Results

The preliminary feedback from 8 participants indicated a positive reception, highlighting the online community's potential to foster a sense of belonging and community among its users. By integrating elements that reflect Chinese cultural values and providing content in Chinese, the online community ensures inclusivity and ease of use.

Conclusions

This study underscores the significance of adopting a culturally sensitive approach in developing ICT interventions to address loneliness among older Chinese immigrants and the necessity of including participants in the design phase, as they best understand their own needs. Future research should further test the effectiveness of this online community in alleviating loneliness and social isolation.

Keywords: Older Chinese Immigrants; Online Community; Cultural Sensitivity; Loneliness and Social Isolation; User-Centered Design

Introduction

According to the latest statistics, people of Chinese descent are the largest Asian group in the United States and one of the fastest-growing ethnic groups. Notably, the number of older Chinese immigrants is increasing rapidly due to rapid population aging (U.S. Department of Commerce, 2023). After immigrating, older immigrants typically abandon their social networks in their homeland. Coupled with limited language proficiency, cultural adaptation difficulties, decreased physical activity, and limited technological skills and experience, they find it challenging to integrate into new social networks, making older immigrants particularly susceptible to loneliness, thereby exacerbating social isolation and exclusion (de Jong Gierveld et al., 2015). Given the clear evidence of the harm of loneliness and social isolation to mental and physical health (Van As et al., 2022; World Health Organization, 2024), it is necessary and urgent to develop effective measures to alleviate psychological distress for this vulnerable and high-risk group of older Chinese immigrants.

Through in-depth interviews, the research results of Chapter 2 of this dissertation reveal the critical role of culture in loneliness and social isolation, emphasizing the importance of developing culturally sensitive measures to alleviate their loneliness and social isolation.

Chapter 3 involves an extensive literature review, showing that while many information and communication technology interventions aim to improve, solve, or mitigate older adults' loneliness and social isolation, the effects are limited. Scholars believe this may be due to the

lack of consideration of differences in race, cultural background, gender, age, and other factors of older adults. This indicates the subjective complexity of loneliness and the heterogeneity of the cultural background of the research participants, but not considering these factors may be the cause of the ineffectiveness of the interventions. Therefore, adaptive intervention measures based on individual needs are needed to differentiate between different groups of elderly, employing methods to determine which interventions are effective for specific subgroups, especially for high-risk groups (Akhter-Khan & Au,2020; Jin, et al.,2021; Fakoya, et al.,2020).

To date, research on older Chinese immigrants remains very limited, and their loneliness issues have received little attention (Dong, et al. ,2012; Simon, et al.,2014) nor are there information and communication technology interventions designed for older Chinese immigrants to alleviate their loneliness and social isolation. There is evidence that providing culturally appropriate care for older Chinese immigrants and considering cultural background and experience in psychological support interventions is necessary (Dong, et al.,2010; Dhingra, et al.,2020).

Moreover, the discussions in the previous chapters have clarified that changes at the individual, familial, and cultural levels are closely related to the loneliness of older Chinese immigrants. Although it is well known that culture affects health and healthcare behaviors, research incorporating culture into theoretical models and as a key variable is extremely

limited (Garcia Diaz et al., 2019; Gurung, 2019). As mentioned in the literature review of Chapter 3, the lack of a proper theoretical framework to guide is a reason for the ineffectiveness of loneliness intervention measures. Therefore, after a broad exploration of theories related to loneliness and culture, this study has chosen the social ecological theory (Bronfenbrenner, 1979) as the theoretical framework to guide the intervention design for exploring the loneliness of older Chinese immigrants. Bronfenbrenner's theory provides a layered perspective for observing the interactions between individuals and their environments. For older Chinese immigrants, their experiences are shaped by multiple environmental systems, including close family relationships, community interactions, and a broader sociocultural background. This layered analytical framework aids in deeply understanding the multifaceted factors affecting feelings of loneliness.

In summary, this study aims to design and implement a virtual online community specifically for older Chinese immigrants. The design of this virtual community will be based on principles of accessibility, usability, and cultural sensitivity. Key considerations include ease of use, addressing potential technological literacy challenges, and incorporating elements that reflect and respect Chinese culture and values. The structure of this community will encourage active participation, creating a supportive and engaging online environment.

Method

The intervention was modeled on a Virtual Online Community for the Elderly

(VOCALE) developed by Chen et al. (2021) and Zaslavsky et al. (2022) and modified according to the study's aims. VOCALE is an online support group intervention designed to promote problem-solving and health management strategies in older adults. It has been pilot-tested respectively by pre-frail and frail older adults (Chen et al., 2021) and caregivers of persons with Lewy Body Dementia (LBD) (Zaslavsky et al., 2022). The older adults participated in an 8-week moderated online discussion. A web-based discussion topic and descriptions will be offered each week on the featured subject on an online social platform. The participants are encouraged to share their aging-related experiences and management strategies with others in the weekly discussions on health-related topics. A group moderator will facilitate the discussion, reply to participants' posts and statements within a day to recognize and motivate participation, and answer follow-up questions. The researchers conducted qualitative data analysis to examine participants' discussion responses; health self-efficacy, chronic disease management self-efficacy, and health literacy were measured for the study on older adults with pre-frailty and frailty.

The findings of two studies consistently support the benefits of online communities. The research conducted by Chen et al. (2021) demonstrated that the platform effectively facilitated information exchange among frail elderly individuals, contributing to improved average self-reported health and self-efficacy scores in chronic disease management. Experimental studies also confirmed the efficacy of participant information exchange

platforms in enhancing average self-reported health and chronic disease management self-efficacy scores. The results further indicated that participants' active acceptance of patient-oriented technologies improved health self-efficacy, supporting elderly individuals in addressing health changes associated with aging (Chen et al., 2021). On the other hand, the study by Zaslavsky et al. (2022) revealed that for family caregivers of individuals with Lewy Body Dementia (LBD), this intervention approach provided a deeper understanding of LBD, increased confidence in handling challenging behaviors of the care recipients, and enhanced caregiving capabilities. This represents an economically viable and convenient supportive intervention measure (Zaslavsky et al., 2022).

In this study, I have adapted and modified VOCALE to include mental health issues, integrated cultural elements, and presented all content in Chinese, as an intervention measure for older Chinese immigrants to reduce feelings of loneliness and social isolation. In order to further refine and adjust VOCALE to meet the needs of older Chinese immigrants and transfer it into VOCALE-OCI, the human-centered design for aging, referred to as HCD+, was adopted. The HCD+ approach incorporates older adults as users and designers in designing, focuses on the users' age-specific characteristics, and addresses the design process with participatory design (Jochems & Sengpiel, 2016; Sengpiel et al., 2019). Older Chinese immigrants were involved in the design process and evaluation to tailor the intervention to meet their specific requirements and needs. The formation process of HCD+ can be divided

into the Ideation, Analysis, Design, and Evaluation phases (Figure 4.1). Each phase of the HCD+ framework emphasizes the involvement of end users (Jochems & Sengpiel,2016; Sengpiel et al.,2019).

The ideation phase involved a divergent thinking process aimed at creating many ideas and potential solutions targeted explicitly at satisfying the identified user needs and priorities (Sengpiel et al.,2019; Moggridge,2007). The primary purpose of the ideation phase was to collect data to understand older Chinese immigrants' lived experiences, the most pertinent problems regarding loneliness and social isolation, and their experiences and challenges with ICT usage. A literature review and interviews with the target population were conducted to understand the needs and requirements of older Chinese immigrants. The literature review investigated the effectiveness and types of ICT interventions in addressing loneliness and social isolation among older adults, with a particular focus on culturally sensitive approaches and the inclusion of racial and ethnic minority groups. Regarding the semi-structured interviews, the topics focused on their lived experience of loneliness and social isolation, the challenges and obstacles they encountered that caused the problems; interviews also covered their tendencies and barriers regarding ICT usage. This phase aimed to understand their perspectives, discover the extent of their lived experiences, summarize the content into a finite number of discussable topics, and understand their preferences for ICT usage.

In the analysis phase, designers and developers analyze the data collected during the

research phase, identify patterns and insights, and use them to define the problem statement and user needs for the ideation phase (Sengpiel et al.,2019). Based on the collected data, including the literature and semi-structured interviews to conceive the direction of the intervention, thematic analysis was conducted to identify the main themes. Next, the themes were grouped into discussable topics that would inform the intervention. According to the VOCALE weekly discussion forum format (Chen et al., 2021; Zaslavsky et al., 2022), the first three weeks focused on peer-to-peer discussions on topics relevant to the target population, while the subsequent five weeks addressed training in problem-solving skills. This phase aimed to analyze the data collected during the ideation phase to inform the content of the prototype developed in the design phase.

The design phase is where designers and developers use the insights and requirements identified in the previous phases to develop and prototype potential solutions that meet the needs and preferences of older adults (Sengpiel et al.,2019). The first three weeks of VOCALE-OCI focused on targeting older Chinese immigrants' social isolation and loneliness. From the fourth to the eighth week, the problem-solving framework used previously in VOCALE, the "ADAPT" Problem-Solving Model (Nezu & D'Zurilla, 2006; Chen et al., 2021), was implemented. In addition, based on the results of the analysis phase, a persona was designed reflecting the experiences of older Chinese immigrants. This persona included background information, experiences, and current issues faced by the character,

serving as the focal point for problem-solving discussions. Table 4.1 presents the themes and sub-themes identified from the Chapter 2 interviews with participants, along with a description of how these elements informed the design of VOCALE-OCI.

The evaluation phase involved designers and developers testing and evaluating the prototypes developed in the design phase with the intended users, gathering feedback, and refining the solutions based on the testing results (Sengpiel et al., 2019). It was an iterative process centered on the context of use, user requirements, design, and evaluation, creating a usable product for the target population (Sengpiel et al., 2019). After the product was developed, the participants tested the primary prototype (with one week's content) using the think-aloud method (Nielsen et al., 2002; Eccles & Arsal, 2017) and were interviewed to determine if it fit their needs and expectations. Participants shared their thoughts at this stage and added or adjusted anything they deemed necessary. Depending on the feedback, we refined the product and tested it again using the same evaluation methods. By conducting interviews and evaluations with older Chinese immigrants, they served as experts for their age group and participated in the design phase to make the product more aligned with their needs.

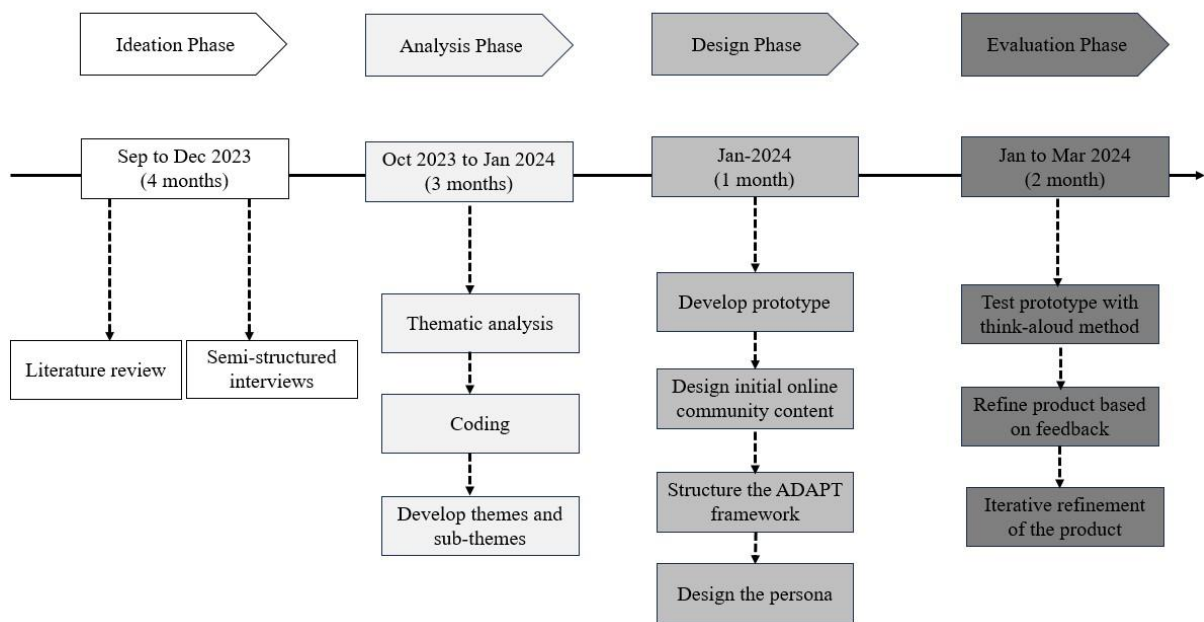


Figure 4.1. HCD+ Framework Phases

Table 4.1 Themes and Sub-Themes from Chapter 2 Interviews and Their Role in the Design of VOCALE-OCI

Theme	Sub-theme	Aspects	Design Considerations
1. Multifaceted Nature: Unveiling Personal, Psychological, and Spiritual Layers	1-1. Subjectivity and Diversity		Week 1 discussion: Icebreaker activities and lighter content for newcomers
	1-2. Internal States and Personal Circumstances		Week 2 discussion: Experiences and causes of loneliness
	1-3. Spiritual Dissatisfaction		
2. Experiences and Challenges of Feelings of Loneliness and Social Isolation	2-1. Life Transitions and Homesickness		Week 1 discussion: Challenges and difficulties encountered when moving to the U.S. Week 2 discussion: Experiences and

			causes of loneliness Persona
	2-2. Disruption and Difficult Reconstruction of Social Networks Amid and Beyond the COVID-19 Pandemic		Week 2 discussion: Experiences and causes of loneliness Week 3 discussion: Experiences and causes of social isolation
	2-3. Limited in English		Week 1 discussion: Challenges and difficulties encountered when moving to the U.S. Week 2 discussion: Experiences and causes of loneliness Week 3 discussion: Experiences and causes of social isolation Persona
	2-4. Health, Aging, and Social Barriers		Week 1 discussion: Challenges and difficulties encountered when moving to the U.S. Persona
	2-5. Mobility Limitations		Week 3 discussion: Experiences and causes of social isolation
	2-6. Desire for Independence		Design: Promote problem-solving and health management strategies in older adults
3. Exploring	3-1. Motivations for	3-1-1. Daily	

Technological Engagement: Driving Forces, Obstacles, and Solutions	Adopting Technology	management	
		3-1-2. Accessing health information or Transitioning to Telemedicine	Design: Facilitate information exchange
		3-1-3. Fostering Social Connection	Design: Provide social support
		3-1-4. Seeking personal entertainment	
		3-1-5. Engaging in Personal growth	Since the use of technology products by older Chinese immigrants is diverse, covering practical needs and personal interests, this supports the intervention modality
	3-2. Barrier to Adoption	3-2-1. Depending on others for help	Design: promote problem-solving and health management strategies in older adults
		3-2-2. Privacy and fraud concerns	Design: An anonymous online community where users choose how much to disclose can make them feel safer and more willing to share and seek support
		3-2-3.	Strengthening Voice

		Physiological limitations related to aging	Input Functionality
		3-2-4. Impact of English-Centric ICT Products on Technology Adoption	Week 1 discussion: Challenges and difficulties encountered when moving to the U.S. Design: Use the user's native language
	3-3. Overcoming Technological Barriers: Strategies Used by Older Chinese Immigrants	3-3-1. Seeking Assistance	
		3-3-2. Online Tutorials and Self-Learning	Participatory design: This demonstrates participants' willingness to engage with technology at their own pace and underscores the importance of user-friendly design
4. Cultural Implicit on ICT Use, Loneliness, and Social Integration	4-1. Influenced by Confucian Thought		Week 1 discussion: Shared experiences and commonalities enhance the sense of connection and belonging Design: Provide social support through compatriots
	4-2. The Traditional Culture of Avoiding Uncertainty		Design: sharing experiences and coping strategies, users may feel empowered to try similar techniques themselves

Theoretical basis

Developing effective interventions to prevent or mitigate feelings of loneliness among older Chinese immigrants requires culturally appropriate services and a solid theoretical foundation. Incorporating a cultural perspective into the theoretical foundation is crucial in shaping loneliness.

Therefore, this study employs Bronfenbrenner's Ecological Systems Theory as the foundation to thoroughly explore the loneliness and social isolation experienced by older Chinese immigrants in the United States. The Social-Ecological System Theory, alternatively known as Human Ecology Theory, was introduced by the American psychologist Urie Bronfenbrenner in 1979 (Bronfenbrenner, 1979; Guy-Evans, 2020). Acknowledging that the social environment is intrinsically linked to human existence, Bronfenbrenner categorized interpersonal relations into five environmental systems arranged hierarchically: the microsystem, the mesosystem, the exosystem, the macrosystem, and the chronosystem. He posited that these systems influence an individual's development. The theory emphasizes the importance of understanding health and behavior from multiple levels (individual, relational, community, and societal), enabling its application in interdisciplinary research, including public health, environmental science, and sociology, among others, to examine individuals' mental health conditions in different environmental contexts (Stokols, 1992). It comprehensively explains the factors influencing human behavior, surpassing other theories

and models in its explanatory power.

Given that loneliness and social isolation can stem from the adaptive processes of immigrants interacting with a new environment, the five systems outlined by this theory offer a holistic framework for understanding the complex interplay affecting the loneliness and social isolation of elderly immigrants. By recognizing the significance of interconnected systems and contextual factors, healthcare providers can devise more effective interventions tailored to the diverse needs of elderly immigrants. de Jong Gierveld et al. (2015) applied this ecological model to analyze the significance of cultural background, community connections, and social networks in determining the loneliness risk among elderly immigrants in Canada, supporting the theory's relevance in addressing the diversity and complexity of immigrant loneliness. Consequently, by examining the multifaceted factors within the systems that contribute to loneliness, this study proposes targeted solutions, particularly emphasizing the potential role of online communities in alleviating feelings of loneliness.

Based on Bronfenbrenner's Ecological Systems Theory, this analysis interprets the concept of loneliness among older Chinese immigrants and demonstrates how interpersonal environments affect this group (Figure 4.2). Within this framework, the innermost layer is the individual, followed by the microsystem, mesosystem, exosystem, and the outermost layer, the macrosystem. These systems, varying according to the frequency and closeness of interaction with the individual, interact with each other, complexly influencing older Chinese

immigrants' personal adaptation and maintaining a balanced state (Bronfenbrenner, 1992).

Individual: Age-related changes can impact the psychological health of older Chinese immigrants. Chronic diseases, sensory impairments, decreased mobility and income, and the loss of close relationships can all increase the risk of loneliness. Personality and hobbies also affect the degree of loneliness.

Microsystem: This refers to the individual's direct living and social environment. For the Chinese American older adults, nearly 95% of their social interactions are with relatives, and family is considered an essential support (Bergren, 2017). People in families of different ages develop their microsystems. Family status significantly impacts mental health. Adhering to Chinese traditional values like filial piety and caregiving positively affects life satisfaction and reduces depressive symptoms (Mjelde-Mossey et al., 2006; Lou et al., 2008). Conversely, living alone without family exacerbates feelings of loneliness (Yeh & Lo, 2004).

Mesosystem: Involves the connections between an individual's immediate environment and the broader community, such as family, friends, and local social structures. For example, older Chinese immigrants often interact with Chinatown, Chinese churches, and community centers.

Exosystem: Includes broader societal systems' indirect impact on an individual, including social services, media, and politics.

Macrosystem: The broader cultural values and health perceptions form the macrosystem.

Cultural norms shape the help-seeking behavior and loneliness interpretation of older Chinese immigrants. Cultural, religious, and philosophical values influence interpersonal dynamics within and between systems. Adaptation to Western culture has changed younger generations' views on traditional values, affecting elders' experiences of care and support. For instance, living alone is more negatively stigmatized in Chinese society than in Western society (So, 2008). Despite the acculturation process, helping older Chinese immigrants understand how to interact with their children may not align with Chinese filial piety culture. They still feel that modern families care less for them, experiencing complex emotions, including sadness and disappointment, and are reluctant to seek additional support (Li, 2011; Zhao et al., 2023).

Chronosystem: Emphasizes the environment's dynamic nature, where changing events impact an individual's health and well-being (Santrock, 2007). Over time, significant changes, such as the departure of loved ones, migration, children growing up, and transformations in the environment (the progress of the development of technology, pandemics), produce dynamic changes significantly affecting immigrants.

As the microsystems of older Chinese individuals are predominantly composed of family members, when these elderly immigrants face adaptation challenges due to new environments, aging, or the passage of time leading to feelings of loneliness and social isolation, and if the microsystem (family) cannot support them, the strategy is to expand outward, increasing interpersonal connections and seeking solutions from other systems.

Furthermore, research indicates that combining different measures and allowing users to choose appropriate tools is effective. For those uncertain about where to expand their social connections, this online community can offer a platform to broaden interpersonal connections (mesosystem), provide information (exosystem), and connect with those of similar cultural backgrounds (macrosystem).

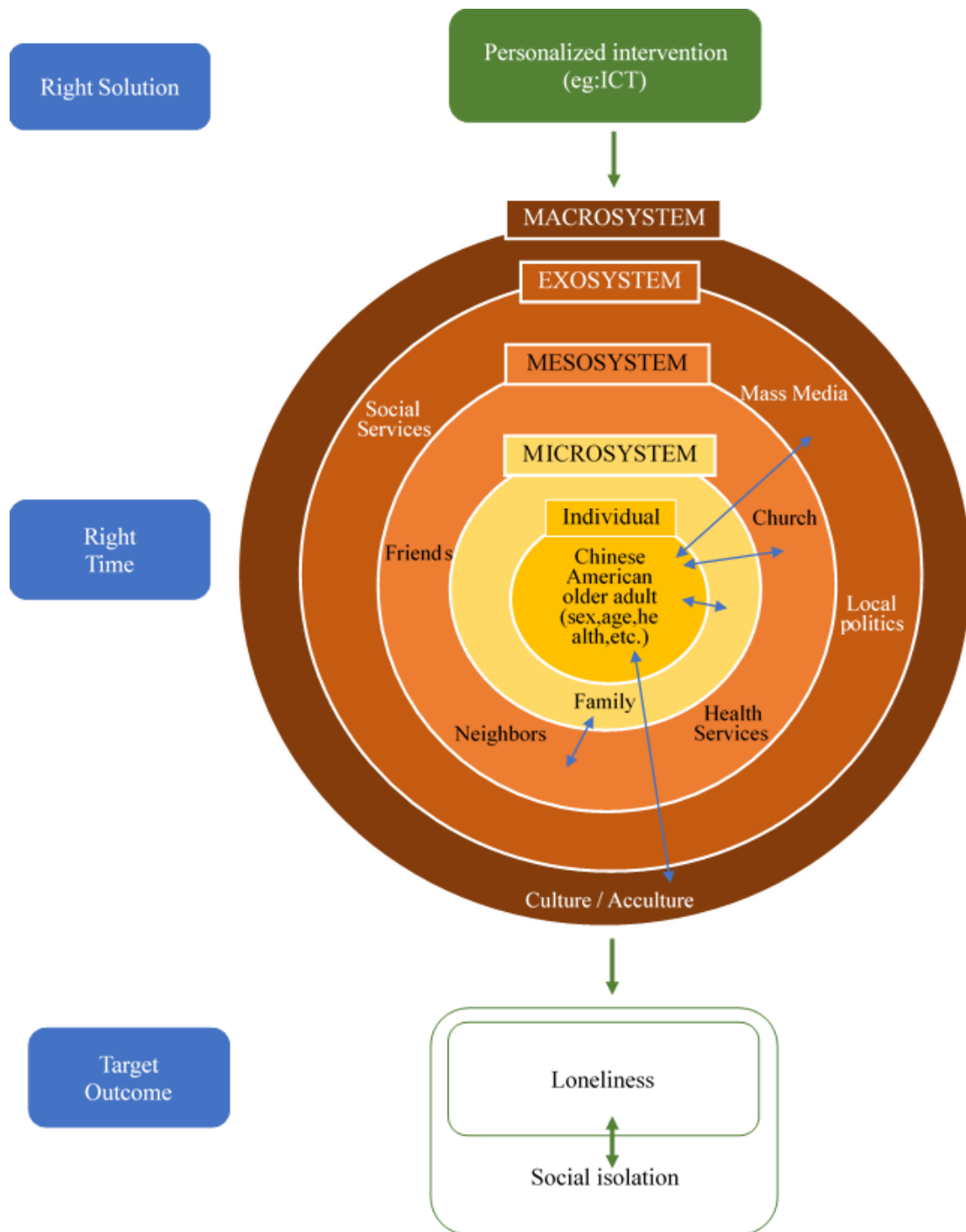


Figure 4.2 Adaptive Ecological Systems Theory for Addressing Loneliness in Older Chinese

Immigrants

Participants

The study consists of a convenience sample of older Chinese immigrants residing in

King County, Washington, aged 60 and above. Participants were recruited through various methods, including collaboration with community centers and organizations potentially hosting older Chinese immigrants, such as the Asian Counseling and Referral Service (ACRS), Chinese Information and Service Center (CISC), Taiwanese Association of Greater Seattle (TAGS), Chinese Churches in King County, and long-term care community.

Recruitment strategies included posting printed and electronic flyers and giving short talks to explain the research objectives and recruitment criteria. Additionally, a snowball sampling method was employed for participant recruitment. Interested individuals were then screened based on inclusion and exclusion criteria. Inclusion criteria included being aged 60 years or older, self-identifying as Chinese, possessing the ability to read, speak, and write/type in Mandarin Chinese, and having internet access along with owning a computer, tablet, or mobile phone suitable for accessing the intervention. Exclusion criteria encompassed having a current diagnosis of a serious mental disorder and any form of cognitive impairment.

After completing the prototype including content for a full eight weeks, the participants tested Week 1's content through the Think-Aloud method. Following this, each participant underwent a single interview to discuss their opinions about VOCALE-OCI. During the interview, participants also reviewed the content for all eight weeks and suggested any necessary adjustments or modifications. If changes were needed, the content was modified based on their feedback.

Results

During the ideation and analysis phases of the HCD+ process, 18 participants were interviewed to understand the loneliness and social isolation experiences of older Chinese immigrants, as well as their concerns about using technological products such as computers, tablets, and smartphones. This information is crucial for providing optimal support and training during the course.

In the design phase, content derived from the interviews was used to develop prototype topics for the online community, focusing on themes most relevant to the target group—older Chinese immigrants. These themes include their life experiences after immigration, loneliness, and social isolation. Open-ended questions were provided to encourage the exchange of experiences and information. In addition to understanding their specific loneliness experiences due to their unique backgrounds and cultures, another aim is to create an environment where participants feel comfortable sharing their thoughts, allowing them to respond to each other and fostering a sense of culture and community.

In the interviews, most participants mentioned that loneliness and social isolation are negative terms and experiences for older Chinese immigrants (Sub-theme 1-1.). Therefore, allowing participants to engage in ice-breaking activities and choose less serious content in the first week was beneficial (Figure 4.3). This approach facilitates easy interaction, helping participants feel the welcoming atmosphere of the community. Consequently, it lowers the barrier to participation, encouraging them to open up and share their personal experiences or

opinions. Moreover, because older Chinese immigrants tend to build relationships with people who have similar language abilities and life backgrounds (Sub-theme 4-1.), through initial communication, participants could learn about each other's backgrounds and experiences, thereby finding common ground and enhancing their sense of connection and belonging.

The first week's discussion prompt, titled "Newcomers" (初來乍到), focuses on sharing and exploring participants' experiences and adaptations when they first arrived in the United States. This prompt aims to foster a sense of community and mutual understanding among participants by encouraging them to share their unique immigration journeys, including the challenges they faced upon arrival, adaptation to the American lifestyle and culture, emotional responses, memorable experiences, and advice for newcomers. To make the online community more interactive, we have listed eight possible initial challenges based on the experiences shared by participants during the ideation phase: Psychological impacts, Cultural differences, Loss of social networks, Language barriers, Healthcare challenges, Unfamiliarity with digital technology, Understanding laws and regulations, and financial pressures (Sub-theme 2-1, 2-3, 2-4, 3-2-4). The discussion also mentions that the aim of this online community is to create an open and supportive environment where participants can learn from each other, grow together, and find their place in their new surroundings. Participants are also encouraged to engage with each other's posts to build a sense of community and

shared experiences.

The screenshot shows a forum interface for VOCALE-OCI. On the left is a navigation menu with categories like '討論話題', '我的貼文', '審核', '管理員', and '分類'. The main content area features a post titled '討論 #第一週 #初來乍到 (Newcomers)' with a moderator icon. The post text includes a welcome message and a poll question: '移居到美國時，你有遇到哪些困難呢？'. The poll options are: 語言障礙, 文化差異, 社交網絡喪失, 心理健康影響-孤獨、焦慮、抑鬱等情緒, 健康照護挑戰, 法律和制度的理解, 經濟壓力, and 數位科技的不熟悉. A sidebar on the right shows the poll progress: '3月 21日', '1 / 8', '3月 21日', and '7天'. Below the poll is a list of 6 questions for users to answer, followed by a call to action: '這是一個開放的討論，我們鼓勵大家分享自己的故事和經驗...'. At the bottom, there are icons for sharing, editing, and replying.

Figure 4.3 VOCALE-OCI Week 1 content

In the second and third weeks (Figure 4.4), we respectively discussed experiences of loneliness and social isolation. In the second week, we posed a series of questions aimed at delving into the situations that trigger feelings of loneliness, its frequency, and its specific

impact on daily life. Additionally, we inquired whether the respondents have effective strategies or specific examples of coping with loneliness. Through these questions, we could understand the triggers of loneliness, its frequency, and how it disrupts everyday life and mental states. Moreover, we explored how individuals can alleviate feelings of loneliness through certain methods or actions, providing practical coping mechanisms or solutions.

討論 #第二週 #孤獨 (Loneliness)

■ General 一般-移居經驗和心理健康



Moderator

2  3月21日

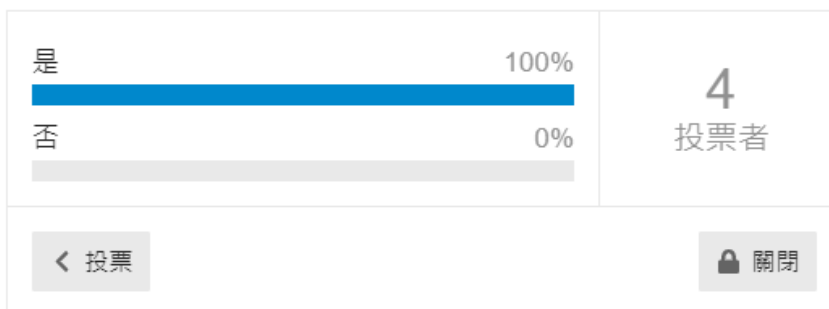
#第二週 #孤獨

本週，讓我們深入探討孤獨這一主題。

孤獨是一種主觀的心理狀態。有些人獨居卻不感到孤獨，而有些人即使身處人群中也可能感到孤單。當我們搬到一個新國家，離開了舊的社交圈，並在文化和語言障礙適應新環境的挑戰中建立新關係時，常常會導致孤獨感。每個人都有自己應對孤獨的方式，找到適合自己的方法很重要。如果你長期感到孤獨，記住，不用著急。讓我們一起思考如何解決這個情況。

以下是一些值得思考的問題：

- 移居美國後，你是否曾經歷過孤獨感？



請回答下列問題：

- 1、什麼樣的情況或環境會讓你感到孤獨？
- 2、你多久感到一次孤獨？孤獨如何影響到你的日常生活？
- 3、你是否有任何有效改善孤獨的具體例子或策略？

Figure 4.4 VOCALE-OCI Week 2 content

The third week's questions focus on experiences of social isolation, including whether individuals have directly experienced or observed others suffering from social isolation, and discussing the possible causes of social isolation. Further, the questions aim to understand the impact of social isolation on an individual's daily life, and to seek whether there are effective methods or strategies to overcome the challenges of social isolation. Additionally, since the results of the ideation phase of the interviews (Chapter 2.) showed that many participants were unclear about the concept and implications of social isolation, a simple and understandable explanation of the definition of social isolation was provided before proceeding with the discussion of the questions.

VOCALE-OCI is designed as an intervention tool to support older Chinese immigrants, rather than as a data collection or research instrument. While weekly discussion topics guide participants to share their experiences, the primary objectives of these modules are to facilitate information exchange, provide social support, and enable users to use storytelling to promote mental health. Furthermore, by sharing experiences and coping strategies, users may feel empowered to try similar techniques themselves.

In the next five weeks, we would guide them to adopt a problem-solving approach to help them combat feelings of loneliness. According to our interview results, feelings of helplessness when encountering problems and difficulties can trigger loneliness, making individuals feel as though no one can assist them. Therefore, in addition to providing

appropriate social support, problem-solving is a key skill for older adults to cope with loneliness. The literature also suggests that enhancing their problem-solving abilities could reduce feelings of loneliness (Ivbijaro,2013; Meyer & Schuyler, 2011).

ADAPT represents the problem-solving framework. A stands for Attitude: a positive attitude towards solving problems (Figure 4.5); D stands for Define: how an individual defines the problem; Another A stands for Alternative: what alternative solutions the individual proposes; P stands for Predict: predicting the consequences of potential solutions; T stands for Try: the individual attempts to take action and evaluate effectiveness (Nezu & D'Zurilla, 2006; Chen et al., 2021). Discussions were tailored more structurally and specifically for different parts within the ADAPT framework.

討論 #第四週 #Attitude (態度)

■ General 一般批判性思考



Moderator

4  15 天

#第四週#Attitude(態度)

接下來的幾週,我們要使用**ADAPT**理論架構來訓練你解決問題能力。

ADAPT理論架構是一種解決題的策略,每個字母代表解決題過程中的一個步驟:

Attitude(態度)、**Define(定義)**、**Alternative(替代方案)**、**Predict(預測)**、**TryOut(嘗試)**

ADAPT理論架構是一結構化深思熟慮的**解決問題方法**,當遇到問題時,套用這個架構可以鼓勵人保持積極態度,清晰地定義問題、探索替代方案、預測結果,並積極實施解決方案。

本週要採取的策略是**Attitude(態度)**

Attitude(態度):這一個步驟強調在面對問題時保持積極和建設性的態度。用開放的心態和找到解決方案的意願來面對困難和挑戰。

Figure 4.5 VOCALE-OCI Week 4 content

Based on the content of interviews during the analysis phase and referring to literature related to older Chinese immigrants (Dong et al., 2012; de Jong Gierveld et al., 2015), we designed a persona of an older Chinese immigrant who is experiencing loneliness and social isolation (Figure 4.6). From the fourth to the eighth week, each week, one strategy of the ADAPT problem-solving framework was applied to help this virtual character. For example, the theme for the fifth week is Attitude, where Mrs. Jiang (a fictional character) maintains a positive and proactive mindset in the face of loneliness. The sixth week is Define, focusing on how to define the problem and identify its root causes. Participants can practice developing critical thinking and problem-solving skills through this.

以下為虛構的角色: 江女士



角色介紹：江女士，65歲，七年前從台灣移居到美國，不大會講英文，只知道簡單的英文單字，不會開車。現住在郊區。前年，她失去了丈夫，從此獨自生活。江女士有一位女兒和一位9歲的孫子，他們住在同一社區，走路約為15分鐘。面對經濟壓力，她的女兒不得不重新投入職場。過去，江女士主要負責照看孫子，包括接送他上學，但隨著孫子逐漸長大，她的照顧責任也隨著減輕。現在，她的日常生活變得空閒，常感到無聊和孤單。隨著農曆新年接近，女兒和女婿卻都需要工作，孫子也要上學，使得江女士感受到更深的孤獨感。

Figure 4.6 Persona of Mrs. Jiang for Week 4 to 8 discussion

(Translation: Character Introduction: Mrs. Jiang, 65 years old, moved to the United States from Taiwan seven years ago. She is not fluent in English, knowing only simple English

words, and does not know how to drive. She currently lives in the suburbs. Two years ago, she lost her husband and has since lived alone. Mrs. Jiang has a daughter and a 9-year-old grandson, who live in the same community, about a 15-minute walk away. Facing economic pressures, her daughter had to re-enter the workforce. In the past, Mrs. Jiang mainly took care of her grandson, including taking him to and from school. However, as her grandson grows older, her caregiving responsibilities have lessened. Now, her daily life has become idle, often feeling bored and lonely. As the Lunar New Year approaches, with her daughter and son-in-law needing to work and her grandson attending school, Mrs. Jiang feels an even deeper sense of loneliness.)

After completing the prototype including content for a full eight weeks, 8 participants were recruited for primary usability testing using the Think-Aloud Protocol and semi-structured interviews, equally divided by gender with a 50% representation of males and females. The age spectrum of the individuals ranged from 60 to 78 years, presenting a mean age of 65.88 years (SD = 5.94). The educational backgrounds of these participants varied, including high school diplomas, undergraduate degrees, and graduate degrees. The mean (SD) interview time was 25.57 minutes (SD = 5.60). Please see Table 4.2 for details.

Table 4.2 Demographic description of study participants

	Participants (n=8)
Age (mean age; SD)	65.88 (5.94) years
Gender	
Male	4 (50%)
Female	4 (50%)
Educational level	
High school diploma	1 (12.5%)
Undergraduate degrees	5 (62.5%)
Graduate degrees	2 (25%)

Think-Aloud Protocol

The Think-Aloud Protocol is a widely used method in usability testing and human-computer interaction research, aiming to deeply understand the cognitive dynamics of users when performing specific tasks or facing problem-solving situations (Nielsen et al., 2002; Eccles & Aarsal, 2017). This study employs this method by asking participants to verbalize their thought processes during the operation, capturing their approaches to problems, problem-solving strategies, questions, and potential errors. This approach is based on the core assumption that participants' immediate verbal responses can intuitively and accurately reflect their internal cognitive and emotional experiences, providing researchers with insights into users' interaction patterns with the product or service.

The Think-Aloud Protocol is valuable for enhancing the usability and user satisfaction of products because it allows for the direct exploration and analysis of users' actual experiences and feedback. This method enables developers to understand users' needs and preferences from their perspective and make targeted improvements based on identified issues during actual use. Through this strategy, development teams can design products that are more user-friendly, easier to operate, and meet users' expectations.

We requested participants to undertake the following tasks to better understand their user experience with VOCALE OCI. Assuming this is the first week of conducting the research, participants are asked to open the discussion board for Week One and read the postings. They

are then requested to respond with their perspectives on the matter. Subsequently, we asked participants to reply to posts addressing the Week One questions. Upon completion, participants should read other participants' comments and respond to them.

In this study, we paid special attention to the challenges and confusion participants may encounter while using the product or service. This includes their reactions to the interface (e.g., whether they can easily find the needed functionality or information), their efficiency and effectiveness in completing specific tasks, and their overall satisfaction with the product and suggestions for improvement. Through detailed observation and analysis, we aimed to reveal the true experiences of users interacting with the product, thereby providing empirical evidence and guidance for product design and development.

Semi-Structured Interviews

Following the completion of the assigned tasks, we presented semi-structured interview questions that concentrated on the participants' experiences with the operation and the crucial elements that facilitate its implementation.

Through the semi-structured interview method, we collected qualitative data to understand users' perceptions of the product's ease of use, the difficulty of completing assigned tasks, the friendliness of the product to new users, and the potential utility of the online community in alleviating feelings of loneliness. The study will also explore whether users are willing to continue using this platform for social interaction and solicit their

suggestions for improving the platform's user-friendliness.

Data analysis

In the analysis of think aloud and interview results for the online community platform aimed at alleviating loneliness among older Chinese immigrants, participants provided valuable feedback on the platform's interface intuitiveness and content resonance. Their insights are crucial for enhancing user acceptance and engagement. This section presents these insights, emphasizing the academic tone suitable for the result section of an analysis.

Interface Intuitiveness and Clarity

Participants found the website's interface clear and intuitive, facilitating easy navigation and potentially increasing user acceptance. For instance, organizing items such as discussion topics and personal posts on the left side, along with welcome words and usage guides on the right, enabled users to understand how to engage in community interactions easily. One participant noted,

"I saw an introduction to a discussion board, and then I also saw many themes for different weeks."(P03, Female, 60yrs). Another reflected on the overall ease of use:

"This website feels very clear. I saw some items on the left side, like discussion topics, my posts, and some classifications... It is not difficult at all. Initially, I mentioned it was very intuitive, the whole scene is very clear. The text can also be enlarged, so I think it is quite convenient." (P01, Female, 64yrs)

Additionally, when testing a product, efficiency is an important usability consideration. High-efficiency operational processes can make it easier to complete necessary tasks, reduce user frustration during usage, and increase satisfaction. In this study, efficiency was measured by the time taken to complete the Week 1 discussion task. The average time recorded for the participants was 10.75 minutes, with a standard deviation of 3.19 minutes. Coupled with the results from the interviews, participants generally found this online community to be intuitive and easy to use.

Content Resonance and Personalization

Participants emphasized the importance of personalized content and the creation of participation motivation. They expressed a greater likelihood of actively using the platform if it offered content relevant to their everyday life experiences.

"If there's such a platform, I would also want to check it out. For example, what benefits are there? Benefits for the elderly. Or issues concerning the elderly." (P04, Female, 67yrs) "This can provide some thoughts and suggestions for some people who have just arrived in the US, or have been here for some time. Perhaps it could serve as advice and help for some Chinese people who come to the US later, especially the older generation." (P02, Male, 63yrs)

Cultural Sensitivity and Considerations of Language and Privacy

Taking into account the cultural and linguistic background of older Chinese immigrants,

the cultural sensitivity in designing content and interface is crucial for enhancing the platform's acceptability. This includes providing support in Chinese and content that reflects Chinese cultural characteristics. Additionally, the option of anonymity allows older Chinese immigrants, who value "face," to share their inner thoughts in a more assured space.

"At the same time, it's anonymous. I think for someone like me who is shy, it makes me more willing to share my feelings without fear of being laughed at, or losing face..." (P01, Female, 64yrs)

"For an immigrant who has just moved to another country, especially from a different cultural background and language, of course, a platform like this can provide them with some information, help them know there are people who have faced similar situations. What kind of experiences they have, maybe they are more willing to share on this platform, and get some help from it." (P02, Male, 63yrs)

Emphasis on Interaction and Participation

Respondents underscored the significance of encouraging user interaction and opinion expression for fostering a sense of community. Social interaction was seen as a key factor in mitigating loneliness. Participants mentioned that the platform provided a safe space for sharing experiences and feelings through discussion threads and mutual support, thereby reducing feelings of loneliness. A participant stated,

"This would definitely help because one advantage of the internet is that it's not

limited by time or space. So, it can definitely increase the chances of interacting with others." (P01, Female, 64yrs)

"Having more options (including voting and case discussions) increases interactivity, making it more lively. This way, users can quickly grasp the general direction. After seeing the questions, if they wish to respond, they can do so more effectively because the question has already outlined a clear structure for them. If they're interested in responding, they can." (P06, Male, 65yrs)

Within the analysis of the think aloud and interview results for the online community platform designed to alleviate loneliness among older Chinese immigrants, participants offered critical insights into the platform's interface and functionality. This section encapsulates those insights, focusing on the themes of intuitive navigation, clear operation instructions, persona relevance, and the importance of enhancing voice input features. Each theme is substantiated with direct quotations from participants, presented in italics for clarity.

Intuitive Navigation and Clear Page Layout

Participants highlighted the importance of an intuitive and clearly structured page layout. One remarked on the visibility of different weekly discussions upon login, signifying the platform's user-friendly design.

"After logging in, you can see discussions from different weeks,"(P03, Female, 60yrs)

and "It is clear enough for users to operate on their own,"(P02, Male, 63yrs) indicating a

straightforward and navigable interface that encourages user engagement.

Enhancement of Operational Instructions

A recurrent suggestion was the need for explicit operational guidance. A participant suggested,

"Then I think, do you have a prompt for voting or selecting... That would be clearer, just directly ask to select or vote."(P01, Female, 64yrs).

This feedback underscores the necessity of precise and unambiguous instructions to facilitate user interaction and reduce potential confusion.

Persona Recommendations

The discussions around the persona feature revealed a preference for consistency and relatability in the personas presented.

"If there were multiple personas, I might think, 'why is there a new one again?'. But I think having two or three is enough, but not a different person every week..."(P06, Female, 60yrs).

This insight suggests that while diversity in personas can cater to varying user backgrounds, a consistent narrative might enhance users' ability to relate and engage with the content more deeply.

Strengthening Voice Input Functionality

Acknowledging the potential difficulties older adult users may face with typing,

participants emphasized the value of robust voice input functionality. One participant expressed,

"Ah, I have to type myself, typing is too hard,"(P03, Female, 60yrs) while another noted, "Using voice to input is obviously more convenient..."(P02, Male, 63yrs).

These comments illustrate the critical role of accessible technology in enhancing user experience, particularly for those with physical limitations.

Community Moderator Selection

The choice of a community moderator emerged as a pivotal factor in fostering an inclusive and supportive environment. Participants advocated for leaders who possess a deep understanding of the immigrant experience, with one stating, "*I think they should at least have experience with immigrant life, it would be best if they had immigrant experience...*"(P01, Female, 64yrs). This perspective underscores the necessity of empathetic and experienced guidance within the community to address users' needs effectively.

In conclusion, these participant insights offer valuable directions for refining the platform's design and functionality. By prioritizing intuitive navigation, clear instructions, relevant personas, enhanced voice input, and thoughtful community manager selection, the platform can better serve its goal of mitigating loneliness among older Chinese immigrants.

Discussion

This study focuses on designing an online community platform aimed at alleviating

loneliness among older Chinese immigrants, employing several principles to create a user-friendly and culturally sensitive environment. Preliminary feedback from participants indicates a positive reception of the platform. This discussion elaborates on the foundational principles used in the design and development of the platform, preliminary findings, and their implications for future research and development.

To maximize user acceptance and engagement, developers need to deeply understand the cultural characteristics of the target user group, consider users' preferences in different cultural backgrounds, and apply this knowledge to product design (Kartal et al., 2018). McAlaney et al. (2020), in a comparative study of UK-China cultures regarding Digital Wellbeing Tools and Messages, noted that messages should be customized based on users' cultural backgrounds, e.g., UK respondents preferred messages based on software usage time, while Chinese respondents were more receptive to suggestions for offline activities. Additionally, they discussed the significant differences between the UK and China in terms of collectivism and individualism, highlighting the Chinese culture's focus on collective interests over individual interests. This aligns with our research, where asynchronous information receipt allows older Chinese immigrants more flexibility to control their own time and space in operation. In collectivist cultures, individual interests often yield to the group or family interests. Chinese society emphasizes unity, harmony, and close family ties. In such a cultural context, individuals may avoid expressing any negative emotions, such as

loneliness, that could be seen as detrimental to family or societal harmony. Therefore, considering these cultural elements, an anonymous online community suits this group well, allowing them to express their feelings and experiences without concern for "face" at appropriate times. Furthermore, users from collectivist cultural backgrounds may value community harmony and group interests more. For these users, the design of technological interventions should emphasize features that promote community interaction and support, and how to strengthen collective connections and collaboration while protecting individual privacy.

Moreover, according to Häkkinen et al. (2020) in their research on designing for cultural sensitivity, one approach to address challenges of user groups, contexts, and cultural sensitivities is to adopt participatory design, involving users in the design process when addressing culturally sensitive designs. Therefore, this study adopts a human-centered design process, based on participants' experiences and feedback. Suggestions from users, including discussion cues, theme suggestions, interactive voting, or character roles, are incorporated. Since participants are most familiar with their needs, this method aims to transform participants into designers, making the content more aligned with their expectations and needs.

Despite the rapid technological development, designing technological interventions with cultural sensitivity has become an important research area. However, existing literature often

discusses this area broadly, lacking an in-depth exploration of how to concretely influence design indicators and guideline items. To make technological interventions more suitable for users from different cultural backgrounds and effectively implement them in practical applications, this study suggests a more detailed investigation and integration of the following key factors.

Firstly, language is the basis of cross-cultural communication and an indispensable element in technological intervention design. Users from different linguistic backgrounds may have significant differences in understanding and using technological products (Häkkinen et al., 2020). Several participants also mentioned that one difficulty when using technological products in the US is facing a language barrier. Even with translation, direct translations of imprecise vocabulary can affect the overall meaning, especially considering that Chinese vocabulary often requires context to understand the exact meaning. Therefore, the design process needs to consider language diversity and cultural connotations, ensuring that information transmission is both clear and culturally resonant. Designing in their native language and letting participants review the overall text can ensure they understand the content.

Secondly, family factors play a core role in Chinese culture. Factors such as family structure, role distribution, and the interaction methods among family members should be fully considered in the design of technological interventions. In interviews, many older

Chinese immigrants shared that if they encounter problems using technological products, they would tend to ask their spouse or children for advice. This means that when older Chinese immigrants use new technological products, with the help and encouragement of family members, they are more likely to get started and be willing to use them, which helps to improve product acceptance and effectiveness.

Additionally, considering the special needs of immigrant elders and aging factors, technological interventions should offer more personalized and adaptable designs. Given the potential differences in technological literacy among the target group, the community discussion adopts a simple and intuitive interface. Using icons and concise text explanations, placing only necessary content on the page, allows users to clearly see the weekly discussion tasks upon logging into the platform. This design principle aims to lower the entry barrier for older users who may not be familiar with digital platforms.

In summary, integrating the above key points into culturally guided design of technological interventions not only promotes the cultural sensitivity and social inclusiveness of technological products but also contributes to higher user satisfaction and better usage outcomes.

Theoretical Foundation Guiding the Study

Given that existing ICT interventions aimed at alleviating loneliness among older adults often lack guidance from a theoretical framework, Akhter-Khan et al. (2020) and Döring et al.

(2022) suggested that future research should be grounded in theories to aid researchers in accurately understanding and measuring these phenomena and to serve as a foundation for interventions.

Therefore, this study employs Bronfenbrenner's Ecological Systems Theory as the theoretical framework to delve into the issues of loneliness and social isolation among older Chinese immigrants in the United States. By analyzing the multifaceted factors affecting loneliness, this research proposes targeted solutions, particularly highlighting the potential of online communities in alleviating loneliness.

At the microsystem level, family and friends are identified as primary factors influencing an individual's immediate social environment. Online communities serve as platforms transcending physical limitations, enabling older Chinese immigrants to connect with others sharing similar linguistic and cultural backgrounds, thus overcoming the constraints of traditional microsystems.

At the mesosystem level, this study underscores the importance of community participation in enhancing relationships with broader social networks and organizations. Online communities offer a platform for sharing information and resources, assisting older Chinese immigrants in addressing challenges of the exosystem, such as social policies and service systems, thereby strengthening their community involvement and social integration.

At the macrosystem level, the role of online communities is to reinforce the cultural

identity and emotional support of older Chinese immigrants. Through sharing cultural stories and traditional activities, online communities help maintain their connection with their cultural background, enhancing their sense of cultural identity and emotional support.

Furthermore, this study posits that with the advancement of technology and changes in social structures, online communities have become a new form of social interaction adapting to modern societal changes, particularly for older Chinese immigrants at risk of loneliness or social isolation. According to research by de Jong Gierveld et al. (2015), the quantity, frequency of contact, and satisfaction with social networks significantly affect the loneliness of elderly immigrants. Therefore, online communities designed for older Chinese immigrants, such as VOCALE-OCI, not only provide a safe and accessible interactive space but also lower barriers to participation by offering content sensitive to their native language and culture, enhancing users' engagement and sense of belonging.

To sum up, based on Bronfenbrenner's Ecological Systems Theory, this research analyzes the loneliness and social isolation problems faced by older Chinese immigrants from the micro to the macro level, proposing the possibility of online communities as an effective mitigation strategy. This offers a new perspective and direction for future research and interventions addressing the issues of loneliness and social isolation among elderly immigrants.

Cultural Resonance and Shared Experiences: Foundations for Alleviating Loneliness

Cross-cultural mental health support plays a vital role in alleviating feelings of loneliness among older Chinese immigrants by taking into account the impact of cultural background, offering more personalized and culturally sensitive intervention measures (Casabianca et al., 2022).

Sharing a similar cultural background implies the possession of common values, beliefs, and traditions. On discussion platforms, sharing experiences helps older Chinese immigrants manage the psychological stress associated with the immigration process, including feelings of loneliness, cultural conflicts, and identity issues. Language being a crucial component of culture, this discussion platform operates in Chinese and encourages participants to adjust the content to a level acceptable to all participants.

A common language not only facilitates more effective communication but also supports deeper exchanges, strengthening connections among members. Due to the participants' similar cultural backgrounds and experiences, they can more easily understand each other's experiences and feelings. This resonance provides group members with a safe environment to freely express their thoughts and feelings without fear of being misunderstood or judged.

Facing similar social and personal challenges, such as adaptation to immigration, generational gaps, and cultural identity, participants, based on shared experiences and understanding, can form a supportive group and offer more need-based advice and solutions.

Additionally, they could share practical information and resources about how to survive and succeed in a new environment.

Implications and Future Directions

Participants expressed affirmation and anticipation for specialized digital interventions aimed at alleviating loneliness and social isolation issues among older Chinese immigrants. Many indicated a future interest in participating in this community. Given the current lack of effective ICT interventions for loneliness and social isolation that consider the characteristics of individuals, I collaborated with participants to design an online community tailored to their experiences and feedback. Future studies aim to conduct actual tests to determine if it can effectively address loneliness and social isolation issues among older Chinese immigrants.

Moreover, this research sets a referential framework for designing intervention measures within different groups of older adults immigrant community, by deeply understanding how various cultural, linguistic, and social factors influence the effectiveness of digital interventions for loneliness. Recognizing these nuances is crucial in designing inclusive and effective solutions that meet the diverse needs of different populations.

In summary, the study demonstrates the potential of online communities to alleviate loneliness and social isolation among older Chinese immigrants by adopting principles of cultural sensitivity, simplicity, and privacy. Encouraging preliminary feedback highlights the importance of user participation and cultural inclusiveness in the design and development of

digital intervention measures. Future research should further explore the long-term impacts and broader applicability of this online community.

Conclusion

This study achieved the development of a prototype for an online community platform tailor-made to alleviate feelings of loneliness and social isolation among older Chinese immigrants. This prototype, grounded in theoretical principles, integrates insights from interviews and the latest evidence-based literature, emphasizing user-centered design, cultural sensitivity, and technical accessibility. The development process was refined based on participant feedback. Preliminary testing has elicited positive responses towards this online community, with participants appreciating its intuitive interface, directness, and the cultural sensitivity of its content and discussions, highlighting its potential to foster a sense of belonging and reduce feelings of loneliness. Participants emphasized that accessibility, inclusivity, and design principles resonating with their cultural experiences are critical to enhancing user engagement and satisfaction. This research underlines the importance of understanding and addressing the unique needs of older Chinese immigrants to design culturally sensitive digital interventions for them. Future research directions could examine the short-term and long-term effectiveness of such interventions and expand the scope to include various groups of older immigrants, ensuring that digital platforms cater to the diverse needs associated with loneliness and social isolation among these populations. This

study contributes to the growing field of digital health interventions and underscores the significance of culturally sensitive approaches in addressing the complex issue of loneliness among older immigrants.

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CHAPTER 5

Conclusion

This dissertation addresses a critical gap in patient-facing technology to improve mental health for older Chinese immigrants. Until now, Chinese immigrants have not been routinely included in IT-based mental health interventions because of language and cultural barriers. Moreover, the study will improve the understanding of cultural and contextual factors that might influence the acceptability of customized web-based interventions for older Chinese immigrants. Results will inform a more extensive investigation to develop scalable ICT solutions to enhance mental well-being. In addition, this study also provides a new solution for the current situation to improve the loneliness and social isolation of immigrant older adults to effectively reduce the negative impact of the pandemic and rapid population aging on the individual, family, and society.

Summary

This dissertation integrates a multifaceted approach including qualitative research, extensive literature review, and the development, prototype design, and preliminary testing of information and communication technology (ICT) solutions, focusing on alleviating psychological health issues of loneliness and social isolation among older Chinese immigrants to promote their physical and mental health and well-being. The outcomes include the completion of a culturally sensitive ICT solution with potential for application to maintain their mental health, contributing to narrowing the health gap among vulnerable

groups, and implementing a sub-item of the United Nations' fifth Sustainable Development Goal, "enhance the use of enabling technology, in particular information and communication technology, to promote the empowerment of women" (Sub-item 5B). The first study (Chapter 2) offers deep insights into the subjective experiences of loneliness and social isolation among older Chinese immigrants. It reveals their emotional and psychological landscape, providing a rich foundation for understanding the complexities they face. The coping strategies identified inform the development of culturally sensitive ICT interventions by highlighting mechanisms this group seeks to overcome feelings of loneliness and social isolation.

The second study (Chapter 3) conducts a comprehensive analysis of the latest evidence on ICT interventions aimed at reducing loneliness and social isolation among older adults, identifying gaps and opportunities for future research and development. This study provides evidence-based insights into the effectiveness of different types of ICT interventions, informing the design of innovative and culturally appropriate new solutions.

The third study (Chapter 4) combines insights from qualitative research and literature review to present the practical application of a specific ICT solution (VOCALE OCI) in its development and testing phases. This intervention is designed to address the unique needs of older Chinese immigrants identified in previous research. The development process includes applying Human Centered Design (HCD) principles to develop a prototype and preliminary

testing to ensure the intervention is user-friendly and effective in reducing loneliness and social isolation.

To my knowledge, there has not been research or products developed for a personalized interactive digital community to reduce feelings of loneliness and social isolation among older Chinese immigrants. This dissertation represents a pioneering effort to bridge this knowledge and application gap.

Overall, this dissertation endeavors to translate theoretical research and evidence into practice. It provides data on the usability and initial effectiveness of VOCALE OCI, making a concrete contribution to the knowledge system of ICT interventions for older adults and offering a model for the development of culturally sensitive technology.

Implications for Future Work

Based on the outcomes of this doctoral dissertation, the following recommendations are proposed for research directions and practical application:

For Research Directions

1. **Increasing Sample Size for Testing:** Expand the sample size in future testing phases to validate the effectiveness of the prototype community. This would provide more robust evidence on its impact and help refine the solution based on a broader range of participant feedback and interaction patterns.
2. **Expand Cultural Sensitivity in Design:** Future research should delve deeper into the

cultural nuances of ICT solutions, investigating the diverse sub-groups within the older Chinese immigrant community to tailor interventions more accurately to their specific needs and preferences.

3. **Employing Rigorous Research Designs:** Utilize rigorous research designs, such as randomized controlled trials (RCTs), to conclusively validate the effectiveness of ICT interventions.
4. **Longitudinal Studies:** Conduct longitudinal studies to evaluate the long-term effectiveness of ICT interventions on the mental health and well-being of older Chinese immigrants, understanding the sustained impact beyond initial improvements.
5. **Broader Participant Inclusion:** Future studies should aim to include a wider range of participants to encompass the variety of experiences and needs among older Chinese immigrants, thereby enhancing the generalizability of findings and applicability of ICT solutions.

For Practical Applications:

1. **Developing Scalable Solutions:** Utilize the insights from this dissertation to create scalable ICT solutions adaptable to other vulnerable populations facing similar challenges of loneliness and social isolation.
2. **Integration with Existing Services:** Explore how ICT solutions can be integrated with existing healthcare and community services to offer a holistic approach to combating

loneliness and social isolation among older Chinese immigrants.

3. Incorporating AI into Practical Applications: Enhance ICT solutions for older Chinese immigrants by integrating Artificial Intelligence (AI). Implement AI-driven continuous feedback mechanisms to systematically collect and analyze user feedback, allowing for the iterative refinement of ICT solutions. This integration ensures that interventions remain current, user-centric, and effective over time, by dynamically adapting to the evolving needs and preferences of users.

This dissertation offers a comprehensive examination and one solution to the issues of loneliness and social isolation faced by older Chinese immigrants in the United States, emphasizing the significance of cultural sensitivity and the application of information and communication technology. Through three interconnected studies, each focusing on distinct yet related aspects—from empirical evidence to practical application—this research addresses the challenges impacting the health and well-being of older Chinese immigrants. It seeks effective solutions to mitigate loneliness and social isolation, laying a foundational basis for future exploration and improvement of the mental health of immigrant elders. Furthermore, the research outcomes present a hopeful outlook for combating loneliness and social isolation in aging immigrant communities through innovative solutions.

In essence, this thesis bridges the gap between theoretical research and practical implementation. It not only contributes valuable data on the usability and preliminary

effectiveness of the VOCALE OCI but also makes a substantial contribution to the body of knowledge on ICT interventions for older adults. By offering a model for the development of culturally sensitive technologies, this work stands as a testament to the potential of ICT solutions in enhancing the quality of life for older immigrants, proving that with thoughtful application and consideration of cultural nuances, technology can play a crucial role in addressing complex social issues. This dissertation advances academic understanding of the influence of cultural background on loneliness and social isolation, as well as the application of ICT, and paves the way for real-world applications that have the potential to significantly improve the lives of elderly immigrants facing these challenges.