

Background and Goals for Fellowship Training

A. Doctoral Dissertation and Research Experience

My research interests in understanding the aging process and improving the quality of life for older adults were first developed in the three-year research assistant experience in the lab of aging and cognition at Zhejiang University. I applied for the Zhejiang Province Undergraduate Innovation and Entrepreneurship Fellowship and was funded to test the reliability and feasibility of using an internet administered 9-item Patient Health Questionnaire (PHQ-9) as a depression screening tool for Chinese older adults. Furthermore, we developed a cellphone application, integrating the function of self-diagnosis, mood monitoring, and online intervention materials. The mobile app encompasses Problem Solving Therapy courses filmed by our team to improve patients' access to therapy resources. I was drawn to explore the potentials of employing information and communication technology (ICT) to improve older adults' quality of lives through the first experience of using mobile technology to deliver mental health services. This research experience produced a paper published in *Asia-Pacific Psychiatry*.

As a first-generation college student at Zhejiang University, I seized as many opportunities to get research training as I possibly could. I found gratification in building new knowledge and was fascinated by the possibilities in making positive change using research. I visited the University of Surabaya to collaborate with researchers in Indonesia to conduct cross-culture research. I worked with Dr. Christ Mayhorn on the topic of evaluating the social engineering of phishing attacks at North Carolina State University. I was selected as one of the three undergraduates at Zhejiang University to work as a paid research intern at the University of Alberta at the School of Nursing. During the three-months internship, I worked with Drs. Carole Estabrooks and Matthias Hoben on the Translating Research in Elder Care program. I studied how does the working environments of nursing homes affect the physical and mental health of its employees. I also participated in a systematic review on the topic of the barriers and facilitators of oral health care for older adults residing in nursing homes, which was published in the *International Journal of Nursing Studies*. My experiences at multiple cities in China, Indonesia, Canada, and the United States exposed me to the rich cultures at diverse regions of the world, which inspires and empowers me to research with populations with diverse backgrounds. Through working on aging-related research topics, I realized the vast unmet needs in research and practice with the older adult population in my China and globally. I decided to commit my research to this vulnerable group with complex challenges.

By the end of my undergraduate training, I had a strong aspire and a clear vision of becoming an investigator in applied science. Therefore, I applied for the MSW/PhD dual degree program at the University of Southern California Suzanne Dworak-Peck School of Social Work (USC SSW). Located in central Los Angeles, USC provides a unique research environment for studying older adults with diverse cultural backgrounds and linguistic preferences. Driven by my interest in employing technology to improve older adults' health outcomes, I participated in the Intergenerational Mobile Technology Opportunities Program (IMTOP) led by Drs. Shinyi Wu and Iris Chi. The Intergenerational Mobile Technology Opportunities Program (IMTOP) is a mHealth intervention that recruited college-student tutors to help older patients to learn how to use mobile technology and a health tracking app to facilitate diabetes self-management. Using the data collected in the IMTOP intervention study, my first-authored paper reporting the longitudinal IMTOP intervention effects in rural Taiwan won the 2018 APHA Nobuo Maeda International Research Award. The manuscript was submitted to *The Diabetes Educator* and is currently under review. Additionally, I presented more results from the IMTOP study at annual scientific meetings of the Society of Social Work and Research and Gerontological Society of America. The hands-on research activities conducted with IMTOP not only helped me learn substantial knowledge in designing and implementing mobile health (mHealth) interventions but also gained excellent training in theoretical thinking and scientific writing. Furthermore, IMTOP study leads to two more research opportunities in which I contributed significantly – IMTOP pilot study for immigrant populations in Los Angeles and a feasibility study of an intergenerational mHealth program for affordable housing communities (ImPAHC) in Sacramento.

Encouraged by the promising intervention effects found in Taiwan, we decided to adapt the IMTOP intervention to meet type 2 diabetes management needs for immigrants in Los Angeles. I led IMTOP pilot study to test the feasibility of using the technology-facilitated diabetes self-management intervention to address the prevalent problem of type 2 diabetes (T2D) among first generation Chinese and Hispanic immigrants. The research project adopts a mixed-method approach, using both survey and individual semi-structured interviews to collect data. The research project is a collaboration between USC Edward R. Roybal Institute on Aging and four community-based organizations serving recent Chinese and Hispanic immigrants. I paid weekly visits to all four community collaborators and communicated with managers and staff members of the organizations to formulate our research plan. I supervised 3 MSW students and one undergraduate student and provided training in qualitative research methods and questionnaire administration. Working together, we have collected 140

questionnaires with recent immigrants with type 2 diabetes and conducted 24 in-depth individual interviews with participants who speak Cantonese, Mandarin, and Spanish. Because of this pilot study, I had the opportunity to work closely with community-based organizations and gained experience in data collection and research program management. The IMTOP pilot study yields two manuscripts under preparation.

The results of the IMTOP pilot study highlighted the importance of social, cultural environments on health outcomes. Collaborating with community-based organizations significantly increased our access to the target population of the intervention and provided future avenues for disseminating the research results. Employing what we learned in both IMTOP and IMTOP pilot study, Dr. Wu, Dr. Chi, and I submitted a proposal to the USC SSW Adult Mental Health and Well-being (AMHW) department and were awarded a pilot funding for exploring the feasibility of delivering a mobile health facilitated T2D intervention at affordable retirement communities (ImPAHC). I served as a co-investigator on the ImPAHC study. We paid visits to three retirement communities and conducted semi-structured interviews with professionals and staff and had focus group discussions with older adult residents. I am working with two other graduate students to analyze the qualitative data with thematic content analysis methods. Working with retirement housing communities inspires me to investigate the aging process and social determinants of health through the lenses of ecological theory, which leads to my decision of investigating the physical and social environments in my dissertation research.

Besides research opportunities provided in the doctoral program, the MSW training of the dual degree program provided opportunities for me to gain clinical practice experience and work directly with older adults in my field placement. I interned at ABC Adult Day Health Care Center for 20+ hours per week during my first year in the MSW/PhD dual degree program. In my clinical practice, I witnessed the prevalent loneliness and social isolation among seniors and observed the strong wishes of older adults in getting connected with family and friends. Social isolation and loneliness have become the primary outcomes in my research since then. Many older adults came to consult me on how to use their mobile phones to contact friends and sharing meaningful memories online with their families. My experience working closely with older adults affirm the value of addressing social isolation by bringing information technology to older adult's life.

My clinical practice and research experiences made me aware that the majority of the currently available technology tools, such as social media sites, mobile health apps, are not designed with older adults' unique needs in mind. Older people often are not included as part of the intervention/technological tool development team, which adds barriers for older people to learn to use technology. To address this issue, I serve as a co-investigator on a research project, led by Drs. Wu and Chi, employing a participatory co-design approach to develop a caregiver self-management program (CSMP) app for the Chinese immigrant caregivers of older adults. The co-design CSMP app proposal was funded by the USC Clinical and Translational Science Institute (CTSI) and AMHW pilot awards. We have completed the conceptual design, interactive prototype testing, and internal real-life condition testing phases of the co-design process. I am currently working with a graduate student colleague to conduct qualitative data analysis and drafting the manuscript reporting the unique needs of the Chinese immigrant caregiver population and their acceptance of technology-facilitated interventions. The CSMP app co-design study preliminarily supported the feasibility of delivering a traditional in-person intervention with a mobile technology platform. I also gained first-hand experience using the co-design process for intervention tool development and pilot research.

I pursued my interest in studying social isolation and loneliness in directed research tutorials and my qualifying exam project. Using data from the Health and Retirement Study (HRS), I examined the longitudinal association between internet use and loneliness for older people. The manuscript prepared with this work is currently in revision and resubmission. Because of my strong interests in statistical methodology, I sought training in structural equation modeling (SEM) and longitudinal data modeling at the Inter-university Consortium for Political and Social Research (ICPSR) summer training at the University of Michigan. Learning advanced statistical methodology enabled me to model the relationships of key variables of interests in a sophisticated manner. I further honed my data management and modeling skills in the process of conducting independent research with the qualifying exam. The qualifying exam project examined the longitudinal bidirectional relationship between the accumulation of geriatric conditions and loneliness. The study results were rich enough to be reported in two separate manuscripts that will be submitted to top gerontology journals.

Socially isolated older adults are at high risk of cognitive decline and the onset of Alzheimer's disease and related dementias (ADR). My past research experiences shaped the path for me to study the longitudinal association between environmental factors, social isolation, and cognitive health. With the awareness that cognitive health in later life is a new research field for me, I sought the highly individualized training opportunities that could be made possible with the F99/K00 award. If awarded, this funding opportunity will enable me to

receive exceptional training and mentored research, transition my research directions and help me grow into an independent investigator conducting social isolation and cognitive health research from an ecological perspective.

B. Training Goals and Objectives

My research is guided by the overarching goal of promoting long, healthy, and meaningful lives. My long-term career development objective is to build substantial knowledge that leads to effective interventions from a social-ecological/community engagement perspective to reduce social isolation and prevent cognitive decline. I envision myself to be a leading scientist in a renowned research-oriented university and making impacts with my research on social isolation and cognitive health. For the F99/K00 award tenure, I aspire to gain knowledge in cognitive health and ADRD research, receive training in analyzing high-frequency digital biomarkers longitudinal data and neuroimaging methodologies, and expand experience in intervention development, implementation, and assessment. Working with my sponsors, I developed the following specific training goals and objectives and described how we plan to collaborate to achieve the training goals.

Training Goal 1: increase knowledge in prevention, intervention, and policy pertaining to cognitive decline in normal aging and the development of ADRD. I will work with my co-sponsors, Dr. Iris Chi, Dr. Shinyi Wu, and Dr. Hiroko Dodge, to get immersed in cognitive health research. I will systematically learn the protective and risk factors of cognitive decline, currently available treatment, and interventions for ADRD through mentored research. I have already been actively engaged in the academic activities at the USC Edward R. Roybal Institute on Aging and have been attending research meetings where frontier aging and ADRD related research findings are presented. With the receipt of the F99/K00, I will get involved with the Alzheimer's Disease Research Center (ADRC) at USC and the Layton Aging and Alzheimer's Disease Center at Oregon Health and Science University (OADC). Dr. Wu will help me to get connected with researchers at USC ADRC. I will learn new progress in ADRD research by getting engaged with USC ADRC and building collaborative relationships for future research. Dr. Dodge will be the liaison for the resources at OADC, directing me to the personals and research cores according to my learning needs. Dr. Dodge and Dr. Wu will provide directed reading to facilitate my learning for substantial topics related to cognitive decline and ADRD. I will present and discuss the papers with peers and mentors in our regular journal club hosted by Dr. Wu. Additionally, I will join through Zoom the monthly OADC investigator meeting held at OHSU where researchers present to critique their ongoing research and proposals. I plan to take a course at the USC School of Gerontology dedicated to discussing special issues on cognitive decline and ADRD. This course covers cognitive decline for people with Alzheimer's Disease or

The new knowledge in cognitive health gained through the F99 phase will enable me to conduct informed cutting-edge research at the K00 phase and beyond.

Training Goal 2: gain skills in analyzing high-frequency digital biomarkers longitudinal data and employing neuroimaging methods. Through conducting research with the IMTOP study data, I had some experience in utilizing biomarker measures, such as blood pressure and blood glucose, yet I have not systematically learned about assessing and analyzing biomarker data in ADRD related research. Cognitive health studies often require the use of bio-marker indicators to objectively evaluate the intervention effect or longitudinal changes in brain functioning. Neuroimaging methodology is widely used in ADRD related research, which allows the researchers to link the variation observed in behavioral testing of cognition with activities in the brain. Learning to assess biomarkers as key variables in my research and using neuroimaging methods will enable me to have in-depth discussions with a broader scientific audience, including but not limited to researchers in fields of Social Work, Neurology, Gerontology, and Engineering. Using biomarker and neuroimaging methodology will also equip me to build knowledge on detecting early-stage brain changes related to cognitive decline, which can produce scientific evidence that informs social work intervention and practice with the socially isolated older adults. I plan to receive training conduct hands-on research in Neuroimaging methods in the K00 stage, at the OADC Neuroimaging core. The OADC is also specialized in collecting digital bio-marker data. Digital biomarkers are collected using wearable devices in a nonintrusive manner, such as walking speed assessed using in-home sensors. Enhancing my capacity of understanding and using digital biomarker data will expand the spectrum of outcomes I can investigate, including those indicators that are essential for ADRD research.

I will hone my longitudinal data analysis skills in the process of analyzing four waves of longitudinal data from the NHATS study, which prepares me to analyze high-frequency digital biomarker longitudinal data in the K00 phase. I will complete a self-directed course on using R programming to handle large longitudinal datasets and run sophisticated models that is suitable for answering my research questions, such as multi-level modeling, structural equation modeling, and Bayesian inference models.

Specific Aims

Social well-being and cognitive health are two essential components of successful aging.¹ Three decades of research have consistently shown that social isolation is associated with the onset of cardiovascular disease,^{2–4} declines in cognitive function,^{5–7} higher risks of depression and anxiety,⁸ and lower overall life satisfaction.^{9–11} Perceived social isolation was associated with a higher cortical Amyloid burden in older adults, supporting the crucial role of social isolation in preclinical Alzheimer's disease and related dementia.¹² The potential causes of social isolation are multi-faceted. While the existing literature studied individual-level factors that were associated with social isolation, such as age,^{13,14} personality^{15–17} and health status,^{18–21} only a few studies have examined the extent to which the living environment influences the experience of social isolation among older adults.

The Ecological Theory of Aging (ETA) posits that the living environment profoundly influences the aging process.^{22,23} The process of personal and environmental resource exchange determines the aging outcomes through building their identity, evoking or reducing stress, and maintaining or hindering the autonomy of an older person.²² Environments not only affect social well-being of older adults, but it also serves as one of the most pervasive and complex stimuli to the brain and contribute to shaping cognitive functionality through the mechanism of neuroplasticity.²⁴ Socially isolated individuals are at higher risk of cognitive decline.^{25,26} Social isolation might mediate the association between environments and cognitive health. The proposed dissertation work aspires to investigate the longitudinal effects of multiple dimensions of the living environments on social isolation and cognitive health for older adults, including physical environment measured by community and in-home disorder and social environment measured by neighborhood cohesion.

Information and Communication Technology (ICT) has brought a revolution to the way people communicate and access resources.^{27,28} With increased popularity among older people,^{29,30} ICT provides excellent opportunities to address social isolation and promoting cognitive health.³¹ An increasing amount of research investigating the association between ICT use and social isolation have been published, however, whether ICT use would interact with the effect of environmental factors on the risk of social isolation has not yet been empirically tested.³¹ Because ICT increases access to information and resources, adopting ICT possesses the potential to mitigate the effect of a disadvantaged living environment.

For the F99 phase, I will examine the longitudinal impact of the environments of living on social isolation and cognitive health with four waves of data from the National Health & Aging Trend Study (NHATS). The subjective perception of the environmental influence on social well-being will be elicited using focus groups. With the older adult participants' input, I will explore the possible designs of a community-based, technology-facilitated approach that could sustainably enhance the social well-being and cognitive health of isolated older adults.

Cognition health is the foundation for independent living and quality of life. The effect of ICT use on cognitive health has not been extensively researched. Promoting social interaction using technology-based approaches can alleviate the social isolation among older people and prevent cognitive decline at the same time, yet only a few randomized controlled intervention studies have been conducted to examine the effectiveness of ICT-enhanced tools on cognitive functioning and social isolation.³² The existing trial showed positive effects for ICT-enhanced intervention.

At the K00 phase, I will use the longitudinal data from the ongoing randomized controlled trial "Internet-based Conversational Engagement Clinical Trial (I-CONECT)" (NIA R01AG056102, R01AG056628 & R56AG051628) to investigate the mechanism of conversational engagement on the cognitive functioning. The I-CONECT trial is currently collecting digital bio-marker and neuroimaging data, including medication adherence, speech and language characteristics, and region-specific structural and functional pre-post changes in the brain. Using this rich data set, I plan to examine why and how social interaction affects the cognitive functioning of older adults, which is not well understood in literature, as well as how technology can be used effectively to alleviate isolation and improve cognitive functions.

Aim 1: In the F99 phase, I will examine the effect of physical and social environments on social isolation and cognitive health using a mixed-methods approach. ICT use is hypothesized to moderate the influence of physical and social environments.

Aim 2: In the K00 phase, I will examine the effectiveness of an ICT-enhanced conversational intervention on social isolation and its effect on cognitive health among older adults with normal cognition or mild cognitive impairment (MCI). I will explore the potential to co-design a technology-facilitated community-based intervention from an ETA perspective for social isolation and cognitive decline with older adult participants.

Successfully achieving the aims of this proposal will produce knowledge on the environmental factors on the risk of social isolation among older adult, contribute to the existing literature on the mechanisms of social engagement on cognitive health, and lead to the development of a technology-facilitated intervention program for social isolation and cognitive decline from the perspective of ETA.

Research Strategy

1. Significance

1.1. Environment and Social Isolation

Social isolation is the absence of contact with other individuals and a lack of relationships and social integration.³³ Empirical evidence repeatedly showed that social isolation is associated with death by cardiovascular disease and early morbidity among older adults.²⁻⁴ A meta-analysis with 70 studies published between 1980 and 2014 showed that socially isolated individuals had a 29% increased likelihood of mortality.⁴ The research and practice fields have increasingly recognize the significance of addressing the problem of social isolation. AARP estimated that about 4 million older adults enrolled in Medicare are socially isolated, and Medicare spends an additional \$6.7 billion on isolated individuals than otherwise if they are socially connected.³⁴ Eradicate the problem of social isolation requires a social approach. However, while the current literature has explored the individual-level risk and protective factors of social isolation, such as personality and health concerns, how does the physical and social characteristics of the living environment affects the experience of social isolation has not been well researched.

The Ecological Theory of Aging (ETA) posits environmental factors have significant influences on health and social wellbeing.^{22,35,36} Living environment provides access to resources, and the settings for social interaction as well as an essential source of cognitive simulation.²⁴ Living environments are often assessed through diverse dimensions including physical and social aspects of environments.^{22,36} Physical environments refer to the objective aspects of the neighborhood and the facilities, for example, the safety of the neighborhood, access to amenities, green open spaces and aesthetics.³⁷ While social environment often been operationalized as the social participation and social integration perceived by people, such as participate in social activities, sense of community, and trust in people.³⁸

For the association between **physical environmental factors and social isolation**, previous research reported that older residents of a high-crime neighborhood are more likely to be socially isolated despite their strong desire for social integration.^{8,39} The community disorders, which can present itself as litters on the streets, deserted buildings, and vandalism, could lead to the perception of lack of safety, thus causes increased likelihood of social isolation. Outdoor space & public buildings, and common areas have a critical role in keeping the residents living an active social life and contribute to their general wellbeing.³⁷ Although existing literature shed light on the role of the physical environment on social isolation, the evidence is built mainly on cross-sectional data, the longitudinal association between the two warrants further research. The proposed dissertation work aspires to build evidence with longitudinal data, and the following hypothesis was derived based on cross-sectional results and theoretical reasoning of ETA.

H1: Negative physical characteristics of the environment, i.e., disorders in the community and at home, predicts the increased social isolation in the community.

Social environmental factors like community support & health services, communication & information, civic participation, & employment have been empirically supported as protective factors of social isolation.^{40,41} Sense of belongingness, togetherness, and trust were found to be associated with a less sedentary lifestyle and more social participation and interpersonal interaction, and thus, predicts a lower extent of social isolation.⁴²

Residential satisfaction and sense of belonging was found negatively associated with perceived social isolation.⁴³

H2: Positive social environment factors (e.g., trust neighbors, people in the community, helping each other) are associated with less social isolation longitudinally.

One's perception of the social environment is likely to be influenced by the physical characteristics of the environment. Sampson and Raudenbush (2004) reported that physical deterioration and disorder has a social meaning beyond just the observation of neighborhood disorder.⁴⁴ Physical characteristics of a living environment could change an individual's opinions of the social environments, resulting in less perceived opportunities in the neighborhood. For example, visible vandalism on the street could prevent residents from walking on the streets, which could increase the incidence of social isolation.⁴⁵

H3: Social environmental factors mediate the longitudinal association between physical environmental factors and social isolation.

Why is it that the social and physical aspects of the living environment affect the social wellbeing of its older residents? This question remained unanswered with previous research. ETA provided three propositional processes for the environment to "get under the skin", i.e., autonomy defined as the older adult take action to change the environment to fit their needs, belonging defined as a sense of security, inclusion and connectedness, and stress defined as the "environmental press" to which made the individual suffer.^{22,36} Yet the corresponding measures are not available in nationally representative longitudinal studies. A qualitative exploratory approach will be employed in this proposed dissertation work to elicit older adults' own experiences

on the impact of the living environment for the experience of social isolation. ETA will be used to guide the design of the interview guide. No hypothesis was derived for the qualitative inquiry with exploratory nature.

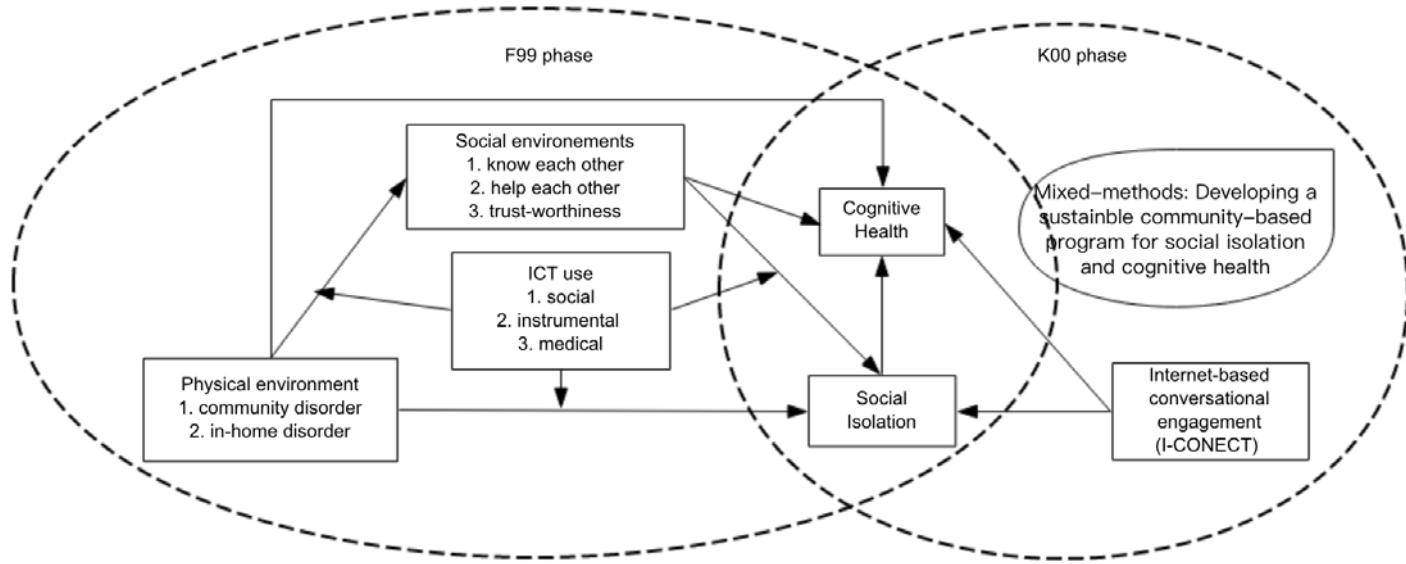


Figure 1. Conceptual framework of the F99 and K00 phases of research

1.2. Environment, Social Isolation, and Cognitive Health

Physical and social environments not only affect the social wellbeing of older people but also fundamentally influences their cognitive health. Environments serve as one of the most pervasive and complex stimuli to the brain and contribute to shaping cognitive functionality through the mechanism of neuroplasticity.²⁴ Environmental challenges, as simple as daily tasks like shopping, was hypothesized to simulate the brain because it requires an older person to remember the route and shopping list despite the distractors in the environments. Environmental stimuli, just like education and cognitively-demanding jobs, were theorized to be associated with increased cognitive reserve and prevent cognitive decline.²⁴ Considerable amount of research/practice interests and effects have been paid to building aging-friendly communities,^{46,47} however, little is known about the cognitive effects of the physical and social environments.²⁴ **Carefully investigating specific aspects of visual simulation in the living environment, such as disorder at home and in the community, is granted.**

Community disorder, such as cluttered and unsafe environment, increase the cognitive burden and the environmental stressors on the residents. Older adults living in communities with a higher number of adverse physical environmental characteristics are more likely to be deprived of health care resources and cognitively stimulating activities.⁴⁸ Positive social environments provide the resources and opportunities that are necessary for cognitive simulating engagements.^{38,49} Social environments were found to be significantly associated with cognitive functioning with cross-sectional data.⁴⁹ **Although the theoretical reasons supporting the association between specific physical and social environments and cognitive decline is substantial, empirical examinations of the relationships are scarce.^{24,50}** The proposed research project aspires to contribute to the knowledge by building empirical evidence on physical environmental factors and cognitive health using longitudinal data. The following hypotheses were derived.

H4: Negative physical environments, i.e., the disorder in community and homes, were longitudinally positively associated with deterioration in cognitive function.

H5: Positive social environment, i.e., neighborhood cohesion, longitudinally associated with deterioration in cognitive function.

Social isolation could mediate the association between physical and social environments and cognitive functioning. The literature review in the previous section established the reasoning for the associations between physical and social environments and social isolation. Social isolation was found to predict cognitive decline longitudinally.²⁵ Perceived social isolation was associated with a higher cortical Amyloid burden in older adults, supporting the crucial role of social isolation in preclinical Alzheimer's disease and related dementia.¹²

H6: Social isolation mediates the longitudinal association between physical and social environments and cognitive function.

Although ETA highlights the importance of the environment in the aging process in general, the theory did not specifically discuss the effect of environments on cognitive health.^{22,23} The knowledge that will be built in the proposed study could enrich the content and expanding the scope of ETA.

1.3. ICT, Social Isolation and Cognitive Health

ICT use has been found associated with reduced social isolation.^{51,52} A systematic review reported that ICT alleviates the elderly's social isolation through four mechanisms: connecting to the outside world, gaining social support, engaging in activities of interests, and boosting self-confidence.⁵² The ETA hypothesized ICT use promotes the wellbeing of older adults through enhancing their agency.³⁶ However, the effect of ICT interventions on social isolation were not able to last for more than 6 month after termination.⁵² Previous research noted that the ICT intervention might not work for everyone in the diverse population of older adults with heterogenous personal characteristics and life experiences.⁵² Future research are needed to identify how to implement and contextualize ICT interventions in the older adult's daily life so that the population would be more likely to benefit from the ICT use.⁵² Additionally, the nature and content of ICT use might result in different effects. Internet use for social purposes was reported to be associated with decreased perceived social isolation in the following year, while the association between social isolation with instrumental use of internet was insignificant.⁵³ **Contextualizing the effect of ICT use within the ecological living environment of older adults could contribute to the literature on what kind of ICT is effective in alleviating social isolation under what circumstances.**

The impact of ICT use within the context of the living environment will be explored for the first time in the proposed dissertation work and postdoctoral research. ICT adoption has the potential to reduce the negative influence of disadvantaged physical and social environments by providing a new avenue for older adults who suffer health issues to interact with family, peers, and society.^{27,28} ICT users reported that internet made it easier to reach people and increased the quantity of communication with others, thus supporting them in feeling less isolated.⁵¹ ICT corresponds to the information & communication aspect of the community environment, we hypothesize the effect of physical and social environment on social isolation is different for ICT users and non-ICT users. In the F99 phase, I will investigate the interacted influence of physical and social environments and using ICT for different purposes (social, instrumental, and medical) on social isolation.

H7: ICT use will moderate the longitudinal association between physical and social environments and social isolation experienced by older adults. More specifically, individuals who use ICT for social purposes are less likely to be socially isolated.

The effect of ICT use on cognitive health has not been extensively researched and well-understood. Besides, ICT is an umbrella term summarizing a variety of technological tools that could facilitate interpersonal interaction. I-CONECT intervention employs a Randomized Controlled Trial (RCT) study design to investigate the effect of a specific type of ICT use, i.e., Internet-facilitated conversational engagement via video-chat, on cognitive functioning among older adults who are cognitively intact or with Mild Cognitive Impairment (MCI). The task of conversation is highly cognitively simulating, which requires control of attention, working memory, executive functions, and mental interpretation of other's emotions and intentions.^{54,55} Linguistic ability is known as highly related to cognitive health among older adults.⁵⁶ In the K00 Phase, I will utilize data collected in the I-CONECT project to examine the longitudinal intervention effect of ICT facilitated conversation on the social wellbeing and cognitive health of older adults.

The current I-CONECT intervention did not explicitly take into consideration the impact of physical and social environments. With the evidence will be built in the longitudinal secondary data analysis and qualitative focus groups of in the dissertation, I will explore the possibility of designing a sustainable community-based program to offer a technology-facilitated solution to alleviate social isolation and prevent cognitive decline.⁵⁷ Studying the effectiveness of technology in the living environment and explore new approaches of technology-facilitated care could transform the older adults' home to become more than a living space, but also a service platform.⁵⁸

Figure 1 illustrates the conceptual framework for both F99 and K00 phases. Examining the physical and social environmental impacts on social isolation and cognitive health among older adults, this the proposed research has the potential to produce a sustainable solution to the challenge of social isolation among older adults and the increased likelihood of cognitive decline and ADRD onset accompanies with it. By contextualizing the role of technology in older adults' living environments, knowledge will be built in the proposed research will address the challenges of independent living and aging in place with technology tools that fit the circumstances. Although the distinction between physical and social environments was proposed by the ETA, empirical evidence has examined the subjective aspect of the living environment (i.e., social environment) less adequately.²² The proposed work will contribute to the literature and expand the scope of ETA by studying both the physical and social environments and their relationships with social isolation and cognitive health.

2. Approach

2.1. F99- predoctoral stage

2.1.1. Quantitative inquiry using NHATS data

2.1.1a. Dataset

The proposed dissertation will use data from NHATS wave 5 (collected in 2015) to 8 (collected in 2018). NHATS is a longitudinal study that annually surveys Medicare beneficiaries aged 65 and above in the contiguous United States (excluding Alaska, Hawaii, and Puerto Rico). Medicare beneficiaries constitute more than 98% of the US population age 65 and older.⁵⁹ NHATS used a stratified three-stage sample design: 95 individual counties or groups of counties were selected as primary sampling units (PSUs), and 655 zip codes were sampled from them as secondary sampling units (SSUs). Individuals were sampled from the Medicare enrollment data bases (EDBs) of the SSUs with oversampling of non-Hispanic black individuals and the oldest old. The probabilities of sampling at all three stages aimed to create equal probability samples and achieve the goals of sample sizes by age group and race/ethnicity. The waves 5 to 8 were selected because the measures of the physical environment were included since wave 4, and the NHATS sample was replenished in the 5th wave (2015). Starting the analysis from wave 5 prevents the problem of having a high percentage of missing in the baseline of longitudinal analysis. In total, there were 8,334 complete cases in wave 5 data collection.⁶⁰ The overall response rate at wave was 76%, which consist of 96% of the continuing sample and 63% of the newly enrolled sample.⁶⁰ Table 1 presents the baseline (wave 5) NHATS sample composition by race/ethnicity and age groups.

Table 1. wave 5 NHATS sample characteristics		
Demographic variables	n	%
Age groups		
65-74	2847	34.16
75-84	3124	37.48
85+	2067	24.8
Gender-female	4927	59.12
Race		
Non-Hispanic White	5703	58.43
Non-Hispanic Black	1710	20.52
Others	244	2.93
Hispanic	467	5.6
Social Isolation		
least isolation	3095	37.96
somewhat isolated	4084	50.08
Socially isolated	976	11.97
Cognition		
No dementia	5825	70.63
Possible dementia	779	9.45
Probably dementia	963	11.68

2.1.1a. Measurements

Physical environments were reported by the interviewers who visited the respondents at their home. Standing in front of the respondent's home/building and looking around, the interviewer rated on a four-point scale (1=none, 4=a lot) regarding 1) the amount of litter on the street, 2) graffiti on buildings and walls, 3) vacant or deserted houses or stores. The physical condition of the **respondent home** was rated dichotomously (yes/no), in terms of, 1) any broken windows, 2) a crumbling foundation or open holes, 3) missing bricks or siding, 4) roof problems, 5) uneven walking surface or broken steps, 6) continuous sidewalks in both directions (reverse coded). The physical condition **inside the responder's home/apartment** was assessed by observing the existence of 1) peeling paint, 2) evidence of pests, 3) broken furniture, 4) flooring need of repair, 5) tripping hazards, and 6) cluttered room. The scale score of the physical conditions of the community, home/building, and inside home/apartments will be derived from the sum score of the corresponding items. The use of interviewers' observation could provide more accurate information regarding the physical environment of each participant than using the census data by zip code, which tends to reduce the complexity of the real-life condition.

Social environments. Respondents reported whether the people in the community know each other very well, willing to help each other, and people in the community can be trusted on a three-point scale (1=agree a lot, 2=agree a little, 3=do not agree). A sum score of the three items will be used as the scale score for the social environment.

ICT use. NHATS assessed three types of ICT use: instrumental internet use, social internet use, and internet use for medical purposes. **Instrumental** internet was measured by asking the respondent's weather they shop online and pay bills or banking with the internet. **Social** use was measured with one item asking in the last month if the respondent went online to visit social network sites (such as Facebook or LinkedIn). Use the internet for **medical** purposes had four items: order or refill prescriptions, contact medical providers, handle health insurance matters, and get information about one's health conditions. The three aspects of ICT use will be used as moderators that are independent of each other.

Social isolation was constructed with six dichotomously coded indicators: no marriage or partnership, no family identified to talk with about important things, no friend identified to talk with about important things, never meeting in person with family or friends in the past month, no participation in religious service, and no club, class or organization activities participation.³³ All items of social isolation will be coded as a higher indicates a more isolated situation. The scale score is the sum of six dichotomous indicators, ranging from 0-6. Scores less than 1 represent individuals who were least isolation; scale score 2-3 represent who was somewhat isolated, and scores equal or above 4 indicates social isolation.

Cognitive Health. For sampled persons self-responded cases, NHATS study assessed 1) **memory**: using immediate and delayed words recall; 2) **orientation**: date, month, year and day of the week, naming the President and Vice President of the United States; and 3) **executive function** measured by clock drawing test.⁶¹ If the interview were conducted with a proxy, AD-8 Dementia Screening Interview was used to assess memory, temporal orientation, judgment, and function.^{62,63}

Control variables. Demographics including age, gender, race, education level, marital status, income, and self-rated health have been reported in existing literature as predictors for social isolation among older adults^{13,20,64}. Therefore, the current study includes the variables listed above as control variables.

2.1.1b. Quantitative data analysis strategies

Data management and variable re-coding will be conducted using Stata 15 SE. Prior to model building, univariate analysis and correlation of key variables will be run to estimate the effect size and detect any potential multicollinearity issues. Latent growth curve modeling (LGCM) will be employed to model the longitudinal relationships between physical environments, social environments, social isolation, and cognitive health. LGCM allows nested models at hierarchical levels, such as observations of the same individual are nested within the person, individuals live in the same neighborhood would have similar physical environments with regard to disorder at the community level. As a special case of structural equation modeling (SEM), LGCM is well suited for modeling mediation paths (H3, H6). Besides, the LGCM is capable of testing the moderating effects of ICT use (H7).⁶⁵ Root mean square error of approximation (RMSEA), comparative fit index (CFI), and Tucker-Lewis index (TLI) were used to evaluate the extent to which each model fits the data. RMSWEA<0.05, CFI, and TFI > 0.90 would be considered as an acceptable model fit; CFI and TFI greater than 0.95 indicate good model fit.⁶⁶ LGCM models will be run with Mplus 8. Full Information Maximum Likelihood (FIML) estimation was used to handle missing data in models. FIML is a single step maximum likelihood approach that is widely used in structural equation modeling.^{67,68} Sampling weight will be applied to the models to match the representativeness of the racial/ethnic groups as designed in the sampling strategies.

2.1.2. Qualitative inquiry with I-CONECT participants

2.1.2a. Data collection and procedure

Focus group participants will be recruited purposefully among the current I-CONECT participants. Based on the strategy of maximum variation,⁶⁹ individuals with diverse living environment conditions will be selected to participate in the focus group discussion. Focus group members will be selected from both study sites of I-CONECT (OHSU & UM). Two focus groups will be held at each site: one with intervention group participants, the other with control group participants. It is targeted for each focus group to have 8 participants (total N=32). To avoid contamination of the intervention effect, only participants who have completed the I-CONECT study will be invited to join the focus group study. Given the study timeline of the I-CONECT, the qualitative inquiry will extend from F99 phase to K00 phase. The interview guide will be developed informed by concepts in ETA and in consultation with experts with qualitative/mixed-methods research specialties (Palinkas) and with the best knowledge of I-CONECT participants (Dodge). The PD/PI (Yu) will facilitate the focus group discussion at both OHSU and UM.

2.1.2b. Qualitative data analysis

Conversations in focus group sessions will be audio-recorded and then transcribe verbatim for analysis. The transcripts will be analyzed using inductive content analysis method by at least two trained independent coders.⁷⁰ The coders are going to collaborate with qualitative analysis software Nvivo 12. The qualitative data coding team will meet regularly to discuss the coding framework, procedure, and to reconcile different opinions and interpretations of the quotations in the transcripts. The team will employ Cohen's kappa coefficient as the indicator for inter-rater reliability.⁷¹ Themes identified in the coding process will be reorganized and made sense of according to the personal and living environmental characteristics of the participants.

2.1.3. Integration of quantitative and qualitative data

The qualitative and quantitative inquires of the dissertation work will occur concurrently. The main purpose of adopting the mixed-methods is using qualitative data to explain why there might be effects of physical and social environments on social isolation. The qualitative focus groups expanded the discussions on the findings identified in the quantitative analysis.⁷² Meanwhile, participant's insights on designing a sustainable environmental-focused technology program to address social isolation and promote cognitive health will be elicited. The findings of both qualitative and quantitative components of the dissertation work together as foundations for developing an intervention program that can be pilot tested in the postdoctoral training phase and beyond.

2.2. K00- postdoctoral stage

2.2.1. I-CONECT

2.2.1a. Study design

I-CONECT study is being conducted in collaboration by Oregon Health and Science University (OHSU) and the University of Michigan (UM) (ClinicalTrials.gov Identifier: NCT02871921). One hundred sixty socially isolated adults aged 75 plus will be recruited at each site (OHSU & UM) and randomized into either the video-chat intervention group and the control group. As of October 2019, 105 subjects are already participating in the trial.

The inclusion criteria are aged 75 or older, consent to magnetic resonance imaging (MRI) if eligible, socially isolated, adequate vision and hearing, understand English, and normal cognition or MCI (based on consensus diagnosis). The intervention group participants received computers and internet service during the intervention, which ensures the participants can video chat with study staff for 30 minutes/day, 4 times/week for 6 months (high dose), and 2 times/week for an additional 6 months (maintenance dose). Study staff briefly check-in by phone call (approximately 10 minutes) with both intervention and control group participants once per week. In-home neuropsychological assessments will be administered at baseline, 6 months, and 12 months. All participants would have MRI scans at baseline and 6 months if MRI were safe for them. All video chat and in-home assessment sessions are being recorded for language analysis. Participants at OHSU will have their medication compliance tracked using electronic pillboxes. The estimated primary completion date for I-CONECT study is Oct 2022. The expected study completion date, including the data analysis phase, is Oct 2023.

2.2.1b. Measurements

Cognitive functioning. The primary intervention outcomes are executive and memory functioning assessed with cognitive tests using National Alzheimer's Coordinating Center Uniform Data Set neuropsychological battery (UDS V3: https://www.alz.washington.edu/WEB/dataforms_main.html), cross-validated by NIH Toolbox.⁷³ Region-specific structural and functional pre-post changes in the brain are evaluated with magnetic resonance imaging (MRI). **Speech and language** characteristics are captured during each video chats as well as in-home assessments. **Medical adherence** measured with electronic pillboxes. Compared to traditional self-reported medical adherence, the digital biomarker collected with electronic pillboxes can eliminate the social desirability bias and record the exact time when the participants opened the pillboxes.⁷⁴ **Social Isolation** was defined as: i. Score ≤12 on the 6-item Lubben Social Network Scale (LSNS-6);⁷⁵ or ii. Engages in conversations lasting 30 minutes or longer no more than twice per week, per subject self-report.

2.2.1c. Intervention effects evaluation plan

Among the outcomes measured in I-CONECT, my interests focus on cognitive health and social isolation. I will collaborate with I-CONECT team to examine the intervention effects. The high dose (baseline to 6 months) and the maintenance dose (6 months to 12 months) will be examined separately. Data will be analyzed to evaluate the differences in cognitive function change and extent of social isolation from baseline to 6 months between the intervention and the control groups. Similar analyses will be conducted for the change between 6 months to 12 months. Finally, the combined intervention effects of the high dose and the maintenance dose intervention on cognition and social isolation will be evaluated.

2.2.2. Co-design a technology-facilitated community-based intervention with older adult participants

Despite the empirically supported benefits of ICT for older adults' wellbeing, the majority of the currently available technology tools, such as social media sites, mobile health apps, are not designed with older adults' unique needs in mind. Older people often are not included as part of the intervention/technological tool development team. It was not until recent years the researchers in the health service and related fields start to employ a co-design approach to try to develop programs from the perspective of the populations it aims to serve.⁷⁶⁻⁷⁸ On the other hand, anxiety and resistance remains among the older adult population when it comes to learn, trust and safely adopt new technologies.⁷⁹⁻⁸¹ I aspire to co-design a technology-facilitated community intervention to reduce social isolation and to prevent cognitive decline at the K00 research phase, which can lead to future research agenda on pilot testing the potential effects and feasibility of the intervention program after I become a tenure-track faculty.

Previous research summarized six steps in developing a quality intervention, which are 1) defining and analyzing the problem; 2) identifying modifiable factors; 3) deciding on the intervention mechanism; 4) clarify the intervention delivery process; 5) testing and revising the intervention; 6) a more rigorous effectiveness evaluation.⁸² The proposed dissertation work will address steps 1 to 4 in intervention development. More specifically, the longitudinal quantitative analysis will analyze the problem of social isolation and cognitive decline, identifying physical and social environmental factors as modifiable points and potential intervention mechanisms. The focus groups with I-CONECT participants will help to collect preliminary information on the participant's opinion towards the intervention design and clarify the intervention delivery process that fits the needs of the older adults.

In the K00 phase, I plan to synthesize the evidence build with I-CONECT intervention and conduct more qualitative co-design sessions with isolated older adults who are at risk of cognitive decline. Collaborating with I-CONECT team, my research activities at the postdoctoral stage will further clarify the intervention mechanism and intervention delivery process. Experts panels will be formulated to consult the development of the intervention, which includes the sponsors of the current proposal and other researchers and experts I will meet with in the future.

Sponsor and Co-Sponsor Statements

A. Research Support Available

Chi	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]
Wu	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]
	[REDACTED]	[REDACTED]
Dodge	[REDACTED]	[REDACTED]
NIA R01 AG051628	Conversational Engagement as a Means to Delay Alzheimer's Disease Onset: Phase II (Dodge, PI), 09/01/16 – 05/31/21	
NIA R01 AG056102	Web-enabled social interaction to delay cognitive decline among seniors with MCI: Phase I (Dodge, PI), 07/01/17 – 03/31/22	
NIA U2C AG054397	ORCATECH Collaborative Aging (in Place) Research Using Technology (CART) (Kaye, PI), 09/01/16 - 08/31/20	
Palinkas		
NIDA P30 DA027828	Center for Prevention Implementation Methods for Drug Abuse and Sex Risk Behavior (Brown, PI), 9/1/16 –6/30/21	
NIMH P50 MH113662-01A1	Accelerator Strategies for States to Improve System Transformations Affecting Children, Youth and Families (Hoagwood, PI), 9/21/19 – 4/30/23	
NICHD R01 HD092489-01A1	Dissemination and implementation of the Safe Environment for Every Kid (SEEK) Model for Preventing Child Maltreatment. (Dubowitz, PI), 4/1/19 – 8/31/23	

B. Sponsor's/co-sponsor's Previous Fellows/Trainees

Chi – has mentored 32 doctoral students and postdoc fellows in total

Xinming Song	1991-1995	Professor, Peking University
Vivian Lou	1993-1999	Associate Professor, University of Hong Kong
Angela Leung	2000-2007	Associate Professor, Hong Kong Polytechnic University
Man Guo	2005-2011	Associate Professor, University of Iowa
Ling Xu	2007-2012	Assistant Professor, University of Texas, Arlington

Wu – has mentored 15 doctoral students and postdoc fellows in total

Irene Vidyanti	2009-2014	Data Scientist, Los Angeles County Chief Information Office
Magaly Ramirez	2011-2016	Assistant Professor, University of Washington
Haomiao Jin	2012-2016	Research Assistant Professor, University of Southern California

Dodge – has mentored 17 doctoral students and postdoc fellows in total

Adriana Seeley	2014-2017	Assistant Professor, Minnesota VA hospital
Meysam Asgari	2014-2016	Assistant Professor, Oregon Health and Science University
Junko Nishihira	2014-2016	Assistant Professor, Ryukyu University
Jiayu Zhou	2016-2018	Assistant Professor, Michigan State University
Ming Li	2017-2018	Researcher, Alibaba Seattle

Palinkas – has mentored 70 doctoral students and postdoc fellows in total

Maxwell Davis	2007-2008	Director of the CALSWEC Mental Health Program, University of California, Berkeley
Ian Holloway	2010–2012	Associate Professor, University of California, Los Angeles
Kim Brimhall	2016-2017	Assistant Professor, Binghamton University

C. Training Plan, Environment, Research Facilities

Ms. Yu proposes to examine the longitudinal influence of physical and social living environments on social isolation and cognitive health among older adults with National Health & Aging Trends (NHATS) data. The proposed dissertation will be the known first to contextualize the role of ICT use through examining the interaction effects of the physical environment with ICT use and the social environment with ICT use on social isolation and cognitive decline. An ecological perspective has rarely been adopted to studying the intertwined relationships between social well-being and cognitive health. With the population aging rate continues to increase, Ms. Yu's research will enhance the research field's understanding of the ecological support system on mental health and cognition in the rapidly changing society. Ms. Yu proposes to develop and pilot testing a community-based intervention that has the potential to provide a sustainable solution to keep the older adults socially connected and prevent the onset of dementia. Her work will be meaningful to address the challenge of social isolation and the burden of care brought by the increasingly prevalent ADRD conditions. Ms. Yu's training plan incorporates both coursework, seminars, and mentorship opportunities provided by sponsors with diverse and complementary skillsets. The proposed research and training agenda works together to advance Ms. Yu's research skills and scholarship.

With the receipt of this award, Ms. Yu will have the opportunity to receive training from an outstanding mentoring team made up of leaders in the fields of Neurology, Engineering, Anthropology, and Social Work. Each of the sponsors has influential research works committed to improving the quality of lives for the older adult population. The sponsor team members will collaborate to aid Ms. Yu to achieve her long term career goal of becoming an independent social scientist and an impactful intervention researcher that dedicated to improve social well-being and prevent cognitive decline. Ms. Yu will work with Dr. Wu to further gain expertise in using technology-facilitated tools to improve health outcomes and increase access to health care for the populations in need. She will work with Dr. Dodge to increase her understanding of cognitive health and dementia research, to grow her capacity of neuroimaging methodology and using digital biomarkers in her research. Ms. Yu will work with Dr. Palinkas to refine her skills in mixed-methods research and receive consultation on designing and implementing community-based health interventions. Ms. Yu will apply the skills developed from the individualized training plan to write her dissertation, seek to publish in high-impact journals, and develop a research agenda beyond the postdoctoral training stage than leads to her career success.

I serve as the primary sponsor of Ms. Yu's F99/K00 application. I will be the coordinator for communication among the co-sponsors. Depending on my 30 years of experience in conducting research on health and mental health outcomes with the older adult population, I will provide content and professional development expertise on: (a) interpretation of the longitudinal analysis and qualitative results; (b) integration of qualitative and quantitative findings; (c) developing and/or adapting social isolation and cognitive health intervention in collaboration with the target age group and community-based organizations; and (d) scientific writing and navigating the peer-review process. Working with the sponsoring team, Ms. Yu has identified the following training goals and listed specific plans that lead to achieving these goals.

Training Goal 1: Ms. Yu will increase knowledge in prevention, intervention, and current practice and policy pertain cognitive decline in normal aging and the development of ADRD. Dr. Wu is currently conducting research with older adults with ADRD and their family caregivers. She will connect Ms. Yu with researchers with similar interests at the USC Alzheimer's Disease Research Center (ADRC). Ms. Yu will work with Dr. Wu and myself to develop a literature review database on cognitive health and ADRD research. Dr. Wu leads a health system journal club with graduate students under her supervision. At the bi-weekly journal club, Ms. Yu will have opportunities to present her learned ADRD related knowledge. She will have interactive discussions and receive feedback from peers and Dr. Wu and myself. The journal club and involvement at the USC ADRC will formulate an intellectual community and academic support system that will benefit Ms. Yu's professional development and assist her in achieving the training goal 1.

Dr. Dodge is an expert in pharmacological and non-pharmacological intervention strategies are urgently needed to delay the onset of dementia and reduce its societal burden. She has contributed to the knowledge of distinguishing the normal cognitive aging and pathological cognitive decline. Dr. Dodge is the Principal Investigator of Internet-based Conversational Engagement Clinical Trial (I-CONECT, NIA R01AG056102,

October 2019

MEMORANDUM

From: Michael Hurlburt, Ph.D. [REDACTED]
Associate Professor
Director of Doctoral Programs and Chair of the Ph.D. Program
Suzanne Dworak-Peck School of Social Work
University of Southern California (USC)

RE: **Kexin Yu, PhD Candidate at the University of Southern California, Suzanne Dworak-Peck School of Social Work**

Description of Institutional Environment & Commitment to Training

Dear Sir/Madame,

Social Work Ph.D. Program. The USC Suzanne Dworak-Peck School of Social Work (USCSSW) established the first social work doctoral program in the western United States in 1953. Today we continue the tradition of admitting highly motivated, self-directed individuals interested in university research and teaching. Students pursue an in-depth, customized course of study in an atmosphere of careful mentoring and respect for scholarship. Our doctoral curriculum is highly interdisciplinary with the intent of producing graduates who are capable of original research and passionate about advancing the profession's knowledge base. Our program fosters early engagement in research and publication, together with a structured and sequential experience in classroom teaching. Unique developmental opportunities are offered to improve students' presentation skills, networking with other universities, and leadership potential. Our goal is to make students competitive for the best available positions in this country and elsewhere in this world.

Program Structure. Doctoral students at USCSSW are required to complete a minimum of 45 course units beyond the master's degree (exclusive of the Doctoral Dissertation). During the first year of the PhD program, students complete 8 courses (16 units) in social work policy practice and research and participate in faculty-directed research projects. Core Substantive Courses include: Theories of Human Behavior in the Context of Social Environments; Explanatory Theories for Larger Social Systems; Theories for Practice with Small and Large Systems. Core Research/Statistics Courses include: Introduction to Social Work Statistics; Multiple Regression in Social Work Research; Advanced Social Work Research Methods. During the second year of the PhD Program, students are required to enroll in advanced multivariate statistics and at least three courses (per semester) in other departments or schools within the university. At least eight of these 12 units must be in courses with a substantive rather than a research methodology or statistics focus. Additional second year requirements include three student-directed tutorials (2-unit) under the mentorship of a social work faculty member. Tutorials provide greater understanding of the student's chosen specialty through a closer examination of relevant practice theories, explanatory theories, and research methodologies. Each tutorial is designed to produce a study of publishable quality. In the third year of the PhD Program, students must pass a qualifying examination in their research area, which consists of a written paper of publishable quality and includes an oral defense. After passing the qualifying exam, students are advanced to candidacy. Year Four and Beyond- Dissertation: Before proceeding with the dissertation, students must establish a dissertation committee approved by the Graduate School and submit a dissertation proposal for approval. Students submit their completed dissertation to their dissertation committee and orally defend it.

University of Southern California

