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UNIVERSITY OF CALIFORNIA, IRVINE

Beyond the Vulnerabilities of Loneliness: The Protective Role of Social Resources against Daily Stress

DISSERTATION

submitted in partial satisfaction of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

in Psychological Science

by

Joanna H. Hong, M.A.

Dissertation Committee:
Professor Susan T. Charles, Ph.D., Chair
Distinguished Professor Emerita Karen S. Rook, Ph.D.
Associate Professor Belinda Campos, Ph.D.

2020

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DEDICATION

To

my parents,

because I owe it all to you.

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I would also like to thank my committee members, Karen Rook, and Belinda Campos. Every conversation with Karen was filled with detailed insights, wisdom, and encouragement, which allowed me to think outside of the box. Every interaction with you has allowed me to challenge myself and grow as an academic and a researcher I am today, thank you, Karen. Belinda's passion and enthusiasm, in addition to her deep knowledge, for cross-cultural research made a large impact on my research career. I still remember our meeting when we were so excited about a new finding that we almost screamed and high-fived in your office. It was those moments that filled me with energy and motivation to persist even when the road got tough, thank you, Belinda. I am also so grateful to be mentored and trained by amazing faculty at UCI. Thank you Drs. Linda Levine, Jenny Rinehart, Daniel Mann, Amy Dent, Larry Jamner, Elizabeth

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I also could not have asked for better friends and colleagues at UCI, who made every day of graduate school an unforgettable experience. Thank you to my incredible lab mates Kate Leger, Emily Urban, Jennifer Robinette, Dmitry Tsukerman, Christie Fung, Colette Brown, Danielle Oleskiewicz, Julie Ann Kircher, Amandeep Kaur, and Sangha Jeon. I would also like to thank my best friends and cohort mates Cortney Simmons, Brendon Butler, Meg Ringel, Alissa Knowles, Jacob Rohde, for their constant love and support. You have always been right by my side through the hardest and the happiest moments of this journey, thank you for being the best teammates and a family for me. I would also like to thank my friend and housemate, Hyunjin Koo. Thank you for always making me laugh and smile. I also want to thank all my fellow Pedagogical Fellows for sharing their passion for teaching and mentoring. I am also deeply grateful for my friends outside of UCI. Thank you, Joanne Yang, Soomin Yoon, Dahyun Kim, Narae Kim, Jane Hyun, Amanda Sohn, Laura Bae, Arthur Choo, for your constant support. Lastly, thank you, Sang Hyuk Kim for filling the last year of my graduate school with so much purpose and meaning.

Lastly, I cannot begin to express my gratitude to my parents Daesik Hong and Kyungmi Ahn, and my brother, Seongsoo Hong, aunt and uncle, and my grandparents. I would never have dreamed of starting this journey without your love, support, and encouragement. Thank you for giving me the courage to challenge myself and to live a meaningful life. This was only possible because of you. Thank you for being the best life role models, and I will always strive to be like you. I love you.

CURRICULUM VITAE

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EDUCATION

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M.A. Social Ecology

University of Massachusetts, Amherst **2012**
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AWARDS AND HONORS

Pedagogical Fellowship **2018 - present**
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A competitive teaching fellowship that includes training in advanced pedagogy (over 100 hours of training which includes: Inclusive teaching, Student Learning Outcomes, Active learning Strategies, Backward Design, Effective Grading, Online Teaching, Teaching Observations/Assessments).

Science in Action Initiative Ambassador Fellowship **2018 - present**
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"*Ambassadors are elected to design and facilitate programs and workshops that allow graduate students to establish multidisciplinary collaborations and make research applicable, relevant, and useful to their communities.*"

Outstanding Graduate Student Mentoring Award **2017 - present**
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Social Ecology Dean's Advancement Fellowship **2018**
(University of California, Irvine; $6684)
A competitive fellowship awarded to doctoral students with evidence of superior academic achievement and original dissertation research plan.

PUBLICATIONS

Hong, J. H., Charles, S. T., Lee, S., & Lachman, M. (2019). Perceived changes in life satisfaction from the past, present and to the future: A comparison of U.S. and Japan. *Psychology and Aging*. doi: 10.1037/pag0000345

Charles, S. T. & **Hong, J. H.** (2016). Second generation socioemotional selectivity theories. In *Encyclopedia of Geropsychology*. (pp. 1-5). Springer Singapore.

Charles, S. T. & **Hong, J. H.** (2015). Theories of emotional well-being and aging. In V. Bengtson & R. Settersten (Eds), *Handbook of Theories of Aging (3rd Edition)*: New York: Springer.

Rabbitt, S. M., Kazdin, A. E., & **Hong, J. H.** (2015). Acceptability of robot-assisted therapy for disruptive behavior problems in children. *Archives of Scientific Psychology, 3*, 101-110. doi: 10.1037/arc0000017

Rabbitt, S. M., Kazdin, A. E., & **Hong, J. H.** (2014). Acceptability of animal-assisted therapy, psychotherapy, and medication for the treatment of child disruptive behavioral problems. *Anthrozoös, 27,* 335-350. doi: 10.2752/175303714X13903827487881

Pace-Schott, E. F., Bennet, T., Verga, P., **Hong, J. H.**, & Spencer, R. M. C. (2011). Sleep promotes consolidation and generalization of extinction learning in simulated exposure therapy for spider fear. 2011 Abstracts. *Journal of Sleep and Sleep Disorders Research,* Supplement, A80, Abstract.

Manuscript Under Review

Hong, J. H., Charles, S. T., Fingerman, K. L., & Birditt, K. S. (*Under review*). Social interactions in the eyes of lonely older adults: Implications for daily well-being.

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Hong, J. H., Kim, E. S., VanderWeele, T. J., Lachman, M. E., & Charles, S. T. (*In progress*). Sense of mastery and subsequent physical, behavioral, and psychosocial health.

CONFERENCE SYMPOSIUM PRESENTATIONS

Hong, J. H., Charles, S. T., Birditt, K. S., & Fingerman, K. L. (2018). Loneliness and daily social interactions: The role of loneliness in daily emotional and physical well-being.

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Hong, J. H., Charles, S. T., Lee, S., & Lachman, M. E. (2018). Perceived changes in life satisfaction from the past, present and to the future: A comparison of U.S. and Japan. Talk presented at the *Gerontological Society of America Annual Scientific Meeting*, Boston, MA.

Charles, S. T., **Hong, J. H.,** Birditt, K. S., & Fingerman, K. L. (2018). Role of personality in older adults' daily social interactions & well-being. Talk presented at the *Gerontological Society of America's Annual Scientific Meeting*, Boston, MA.

Hong, J. H., Charles, S. T., Rook, K. S., & Almeida, D. M. (2017). Relationship status and daily well-being in middle and older age. Talk presented at the *National Council on Family Relations*, Orlando, FL.

Hong, J. H., Charles, S. T., Lee, S., & Lachman, M. E. (2017). Well-being and age: A comparison of two cultures. Talk presented at the *inaugural University of California Well-Being Conference (UCWBC)*, Riverside, CA.

CONFERENCE POSTER PRESENTATIONS

Martinez, R., **Hong, J. H.,** & Charles, S. T. (2018). Navigating daily stress with low sense of control: The protective factors of eudaimonic well-being and personality traits. Poster presented at the *Gerontological Society of America Annual Scientific Meeting*, Boston, MA.

Chang, S., **Hong, J. H.,** & Charles, S. T. (2018). Purpose in life and self-rated health across adulthood: The importance of the bidirectional relationship. Poster presented at the *Gerontological Society of America Annual Scientific Meeting*, Boston, MA.

Hong, J. H. & Charles, S. T. (2017). The role of recollected past life satisfaction on psychological well-being: Age differences in Japan. Poster presented at the *21st International Association of Gerontology and Geriatrics World Congress of Gerontology and Geriatrics*, San Francisco, CA.

Hong, J. H., Ringel, M., & Charles, S. T. (2017). Bad for your health? Comparing the associations between pessimism, optimism, and health-related well-being outcomes in U.S. and Japan. Poster presented at the *Annual Conference of the Society for Affective Science*, Boston, M.A.

Urban, E. J., Charles, T. S., Leger, K. A., & **Hong, J. H.** (2017). State rumination predicts affective reactivity to and exaggerated memory for acute stressor. Poster presented at the *Annual Conference of the Society for Affective Science*, Boston, M.A.

Hong, J. H. & Charles, S. T. (2016). Negative effect of hidden emotion: Role of anger suppression on sleep quality. Poster presented at the *Society for Personality and Social Psychology*, San Diego, CA.

Hong, J. H. & Charles, S. T. (2016). *Well-being and age: A comparison of two cultures.* Poster presented at the *Gerontological Society of America Annual Scientific Meeting*, New Orleans, LA.

Ebert, M., Ivcevic, Z., Widen, S., Linke, L., **Hong, J. H.**, & Brackett, M. A. (2014). Emotion vocabulary in early adolescence. Poster session presented at *the annual meeting of the American Psychological Association*, Washington, D.C.

Farr, R. H., Grant-Marsney, H. A., Grotevant, H. D., & **Hong, J. H.** (2013). Adoptees in emerging adulthood: How do adoption communication and attachment to adoptive parents matter to birth family contact*?* Poster presented at the biennial meetings of the *Society for Research in Child Development*, Seattle, WA.

Hong, J. H., Pietromonaco, P. R., & Powers, S. I. (2012). Spouses' attachment styles as a predictor of salivary alpha-amylase responses to a conflict discussion. Poster presented at the *University of Massachusetts Undergraduate Research Conference*, Amherst, MA.

EDITORIAL SERVICE

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American Journal of Epidemiology
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Polish Psychological Bulletin
Proceedings of the National Academy of Science of the United States of America
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Psychotherapy and Psychosomatics
Social Science & Medicine

RESEARCH AND PROFESSIONAL EXPERIENCE

Graduate Researcher, Emotion Research Lab **2014 - present**
Director: Dr. Susan T. Charles, University of California, Irvine

Senior Intern Supervisor, Yale Parenting Center **2012 - 2014**
Director: Dr. Alan E. Kazdin, Yale University

Research Assistant, Yale Center for Emotional Intelligence **2013 - 2014**
Director: Dr. Marc Brackett, Yale University

Research Assistant, Rudd Adoption Research Program **2011 - 2013**
Director: Dr. Harold D. Grotevant, University of Massachusetts, Amherst

Research Assistant, Growth in Early Marriage (GEM) Lab **2011 - 2012**
Director: Dr. Paula Pietromonaco and Dr.Sally Powers, Umass, Amherst

Research Assistant, Hormone and Cognition Lab **2011**
Director: Dr. Agnes Lacreuse, Umass, Amherst

ADVANCED STATISTICAL AND METHODOLOGICAL TRAINING

Power Analysis with SAS (Instructor: Farideh Dehkordi-Vakil)	**2019**
Meta-analysis (Instructor: Amy Dent)	**2019**
Longitudinal Structural Equation Modeling (Instructor: Sandra Simpkins)	**2018**
Salivary Analyte and Immunoassay Basics (Instructor: Douglas Granger)	**2017**
Structural Equation Modeling (Instructor: John Hipp)	**2017**
Applied Longitudinal Data Analysis (Instructor: JoAnn Prause)	**2016**
Advanced Quantitative Methods (Instructor: JoAnn Prause)	**2015**
Applied Psychological Research (Instructor: Roxane C. Silver)	**2015**

TEACHING/MENTORING EXPERIENCE

Invited Guest Lectures

Well-being in Old Age (*Nursing Department*)	**2018**
Cognitive Development (Fundamentals in Psychology)	**2017**
Using Health Services (*Health Psychology*)	**2017**

Graduate Teaching Assistant

Department of Psychological Science, *University of California, Irvine*
Responsibilities:

- Preparing materials for and teaching weekly discussion sections
- Leading review sessions
- Holding office hours
- Tutoring/mentoring students
- Grading exams and papers
- Creating and managing online course websites (e.g., Canvas)
- Managing iClicker data
- Proctoring exams
- Writing letters of recommendation

Course Name (# of students)

Naturalistic Field Research (250)*	**2017**
Health Psychology (428)*	**2017**
Fundamentals in Psychology (400)*	**2016, 2017**
Naturalistic Field Research (212)*	**2016**
Clinical Psychology (142)	**2016**
Health Psychology (428)	**2015**
Fundamentals in Psychology (400)*	**2015**
Abnormal Psychology (330)*	**2015**
Health Psychology (355)	**2014**

**Included teaching weekly discussion sections that ranged from 5 - 60 students*

Research mentorship experiences **2015 - present**
Supervised the design and implementation of research studies for undergraduate, post-baccalaureate students (4), and doctoral students (6) resulting in:

- Conference presentations
- UCI Undergraduate Research Opportunities Program Grant

- Independent/honors thesis projects

TRAININGS/CERTIFICATES

Training and Certificates

Certified CIRTL Scholar **2019**
Center for the Integration of Research in Teaching and Learning

Pedagogical Fellows Program **2019**

Activate to Captivate **2018**
A 16-hour certificate course on public speaking techniques and best practices for communicating scientific research to general audiences

Certificate in Improvisation for Teaching **2018**

Certificate in Public Speaking **2018**

CIRTL Training **2017**
Earned CIRTL Associate status

Certificate in Teaching Excellence **2017**
Included a 10-week course in pedagogy and three 1-hour teaching observations

Certificate in Course Design **2017**
Included creating a full syllabus, sample activities, and course learning objectives

Certificate in Mentoring Excellence **2015**
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Pedagogical Workshops

Enhancing Metacognition, Grit, and Growth Mindset for Student Success **2017**

Grading Essays Successfully: Rubrics, Fairness, and Feedback **2017**

PROFESSIONAL SERVICE

Pedagogical Fellow at UCI Division of Teaching Excellence and Innovation **2018 - present**

Elected to serve as Science in Action Ambassador **2018 - present**

Diverse Educational Community and Doctoral Experience Committee **2019**

T.A. Professional Development Program (TAPDP) **2019**
Created and facilitated our school's T.A. training program (12 hours of instruction), including a variety of workshops on T.A. duties and effective pedagogical practices

Panelist: Graduate Student Panel for TAPDP Social Ecology Students **2018**
Participated in a panel to answer questions and provide advice for incoming Social Ecology graduate students

UCI Psychological Science Department Grant Organizer **2017 - 2018**
Organized monthly grant workshops for graduate students and compiled a list of successful grant applications

Elected to serve as a Clinical Neuropsychology and Aging Faculty Search Committee Member **2017**

PROFESSIONAL AFFILIATIONS

American Psychological Association (APA)
Society for Health Psychology
Society for Personality and Social Psychology
Gerontological Society of America

ABSTRACT OF THE DISSERTATION

Beyond the Vulnerabilities of Loneliness:
The Protective Role of Social Resources against Daily Stress

By

Joanna Heejeong Hong

Doctor of Philosophy in Social Ecology

University of California, Irvine, 2020

Professor Susan T. Charles, Ph.D., Chair

Lonely individuals are more vulnerable to the harmful effects of everyday stressors. Yet, little work has examined potential protective factors that may reduce lonely individuals' negative experiences of daily stress. Across three studies, this dissertation identifies the situations in daily life that are related to differences in well-being between lonely and non-lonely adults, as well as factors that may be protective against everyday stressors for lonely individuals' daily well-being. The first study used an ecological momentary assessment design to examine how loneliness was related to different facets of well-being (emotional and physical well-being) across varying social contexts. Results indicated that being with others (vs. being alone) was a positive experience for both lonely and non-lonely older adults (increased positive affect and energy and decreased tiredness); yet, lonely individuals also showed an increased negative affect. In addition, lonely older adults reported a greater increase in negative affect than non-lonely individuals following a stressful interaction (vs. no stressful interaction). The next two studies examined positive factors that may serve a buffering effect for lonely individuals' greater reactivity to daily stress. In the second study, *positive network quality* buffered the adverse effects of negative social interactions on emotional well-being (positive and negative affect) for lonely older adults, but not non-lonely

adults (Chapter 3). The third study examined a protective factor that can vary from day to day – the occurrence of positive events. Results revealed that experiencing a positive event on the same day as experiencing a stressor was only protective for lonely individuals, but not non-lonely individuals. Importantly, only daily positive social events (i.e., positive interpersonal exchange) were related to a blunted increase in daily negative affect, whereas daily positive *non-social* events (i.e., those not involving a social component such as daily uplift at work) didn't show a protective effect. Together, findings from this dissertation expand our knowledge about the daily vulnerabilities of lonely individuals and further identify positive factors that protect against the harmful effects of everyday stressors. Results indicate that potentially modifiable resources, such as positive social networks and daily positive social events, may be important points of future interventions.

CHAPTER 1:

Introduction

INTRODUCTION

Loneliness is the fastest-growing public health crisis in the U.S. (Polack, 2018). Defined as the *subjective perception* of a mismatch between desired and experienced social belonging, a research survey revealed that nearly half of U.S. adults reported feeling lonely (Perlman & Peplau, 1981; Polack, 2018). Among older adults, nearly one-third of those over the age of 65 reported feeling lonely (Malani et al., 2019). With our world population aging at an unprecedented rate, the prevalence of loneliness is only like to increase (Holt-Lunstad, 2017).

Even more alarming is that loneliness is deadly, and quite literally so. Loneliness has the same impact on premature mortality as smoking 15 cigarettes a day, making it more life-threatening than obesity (Holt-Lunstad et al., 2010). Lonely individuals are also at a higher risk for experiencing a wide range of physical and psychological health problems, including greater functional limitations (e.g., inability to carry out daily activities of living), cognitive declines (e.g., Alzheimer's disease, dementia), heart disease (e.g., stroke, hypertension), disrupted sleep, depression, and anxiety disorder (Donovan et al., 2016; for reviews, see Hawkley & Cacioppo, 2010; Luo et al., 2012). Importantly, loneliness adversely affects not only long-term health outcomes but also daily well-being (Hawkley et al., 2007).

Loneliness exerts a direct influence on health and well-being, but an indirect influence by exacerbating the effects of daily stressors. Daily stressors, compared to major life events, are experienced more frequently with strong implications for both immediate and long-term health outcomes (Leger et al., 2018; Sapolsky, 1996). One study, for example, found that negative affect that lingers following a daily stressor was associated with worse health outcomes ten years later (Leger et al., 2018). Accumulating evidence suggests that lonely individuals are more vulnerable to the exposure and reactivity to everyday stressful experiences. One reason why

loneliness exacerbates daily stressors may be that lonely individuals construe their environments as more threatening and stressful compared to their non-lonely counterparts (Hawkley et al., 2007). This negative perception, therefore, makes lonely individuals particularly more susceptible to the harmful effects of daily stressors (Cacioppo et al., 2006). For example, loneliness is related to a greater decrease in emotional (e.g., positive and negative affect) and physical well-being (e.g., physiological reactivity) when experiencing a stressful event (Hawkley et al., 2007; van Roekel et al., 2014). Thus, identifying protective factors that reduce lonely individuals' negative experiences of daily stressors is vital for securing their daily and long-term health and well-being.

Although little research has examined how positive factors may influence stress reactivity among lonely individuals, a growing number of studies have found a range of factors that protect well-being when people encounter daily stressors (Leger et al., 2019; O'Donovan & Hughes, 2007). For example, strong evidence suggests that positive emotions allow individuals to build resources they can utilize during stressful times (for a review, see Fredrickson, 2013). One daily diary study found that experiencing an above-average positive emotion on the day of a stressor was related to a blunted increase in negative affect (Leger et al., 2019). Thus, protective factors such as positive social network quality (i.e., a network that one can rely on), and daily positive events (i.e., positive event related to work, pleasant social interactions) may be a particularly important source of resilience for lonely individuals as they respond to daily stressors.

When examining the effects of protective factors for lonely adults, however, researchers have primarily focused on the positive assets for people's overall levels of well-being (e.g., overall emotional well-being in the past 30 days) or protection against artificially induced stressors in an experimental study (e.g., Trier Social Stress Test) (O'Donovan & Hughes, 2007). Little research

has examined the role of positive resources in the context of lonely individuals' *daily lives*, such as identifying positive resources that may buffer against naturally occurring daily stressors (e.g., traffic jam, negative experience at work, engaging in a negative interaction with a social partner).

This dissertation aims to strengthen and contribute to the burgeoning field of loneliness research. Previous research has elucidated the associations between loneliness and daily stressors and the implications for daily emotional well-being. Across three studies, the overarching purpose of this dissertation is to further examine associations between loneliness, daily experiences, and daily emotional and physical well-being (more comprehensive facets of daily well-being) and identify protective factors that may buffer against everyday stressors for lonely and non-lonely individuals' daily well-being.

The first study of the dissertation aims to establish associations between loneliness and multiple facets of daily well-being by examining both emotional (positive and negative affect) and subjective physical well-being (energy and tiredness) across different social contexts (being with others and engaging in stressful interactions). Findings from this ecological momentary assessment (EMA) study revealed that for lonely older adults, being with others is both beneficial and costly (increased positive affect, energy, and decreased tiredness but also increased negative affect), whereas being with others was a solely positive experience for non-lonely individuals. Further, consistent with previous research, engaging in a stressful interaction was particularly harmful to lonely older adults' negative affect compared with non-lonely older adults. In contrast, daily stressful interactions were related to less tiredness for non-lonely individuals. This study is novel in that it expanded our understanding of the relationships between loneliness, daily social experiences, and different facets of daily well-being (emotional and physical). The results confirmed lonely individuals' heightened vulnerabilities to daily

stressors and identified even a bigger gap between how lonely and non-lonely older adults experience daily stressors.

The second study of the dissertation further builds on the first study and examines whether a positive structural factor, *positive network quality*, may buffer against the adverse effects of stressful daily interactions for lonely and non-lonely older adults' emotional well-being (positive and negative affect). Experimental studies have examined the relationship between perceived social support and blood pressure reactivity to lab-induced stressors (O'Donovan & Hughes, 2007). Yet, the buffering effect of positive network quality against naturally occurring daily stressors has not been tested among lonely and non-lonely individuals. Results of this EMA study revealed that positive network quality is protective against daily stressors for lonely older adults' emotional well-being (positive and negative affect), but not for non-lonely older adults.

Findings from the second study identified a positive structural factor, positive network quality, as a protective resource against daily stress for lonely individuals. The final study of this dissertation paper further examines whether *daily positive event*s, a daily positive factor, buffer against daily stressors for lonely and non-lonely individuals' daily well-being. Employing a daily diary study design, this paper examines a wider age range to ensure the generalizability of our findings, compared to only examining older adult samples in the first two studies. Further, the last study distinguishes between social (a positive event that involves a pleasant social interaction) and non-social daily protective factors. The results showed that experiencing a daily positive social event is protective against stressful events for lonely individuals' negative affect, but not for non-lonely individuals. Further, only daily positive events involving a positive social interaction had a protective effect against daily stressors.

Given the alarming prevalence and the dire consequences, loneliness is now being recognized as a "global epidemic" and a unifying issue for nations worldwide (Polack, 2018). The United Kingdom appointed its first minister for loneliness and launched a U.K. loneliness strategy in 2018. In the same year, the National Academies of Sciences, Engineering, and Medicine in the U.S. created a committee dedicated to investigating the topic of loneliness (Fried et al., 2020). This dissertation further adds to current efforts in combatting loneliness by identifying protective assets that may allow lonely individuals to better navigate daily stressful experiences, with important implications for future interventions.

References

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Donovan, N. J., Okereke, O. I., Vannini, P., Amariglio, R. E., Rentz, D. M., Marshall, G. A., ... & Sperling, R. A. (2016). Association of higher cortical amyloid burden with loneliness in cognitively normal older adults. *JAMA Psychiatry*, *73*, 1230-1237. doi: 10.1001/jamapsychiatry.2016.2657

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Fried L., Prohaska, T., Burholt, V., Burns, A., Golden, J., Hawkley, L., … & Victor, C. (2020). A unified approach to loneliness. The Lancet, 395(10218). Retrieved from https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(19)32533-4/fulltext

Hawkley, L. C., & Cacioppo, J. T. (2010). Loneliness matters: A theoretical and empirical review of consequences and mechanisms. *Annals of Behavioral Medicine, 40,* 218-227. doi: 10.1007/s12160-010-9210-8

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CHAPTER 2:

Daily Interactions in the Eyes of Lonely Older Adults: Implications for Daily Well-being

Abstract

Loneliness is detrimental for well-being. Yet, little research has examined how loneliness shapes older adults' responses to daily social interactions. The current study examined how lonely and non-lonely older adults experience being with others and engaging in stressful social interactions. Participants (N=313, M_{age}= 73.94) were from the *Daily Experiences and Well-being Study* (DEWS) and reported their social interactions and well-being every three hours across approximately five days. Individuals indicated whether they were with others (vs. alone) and had engaged in stressful compared to non-stressful conversations with social ties. Well-being measures included daily affective well-being (positive and negative affect) and fatigue (energy and tiredness). Multilevel models revealed that older adults reported increased positive affect and energy, and decreased tiredness when with others compared to being alone. Yet, lonely older adults also experienced higher levels of negative affect in the presence of others, whereas non-lonely individuals did not. Stressful social interactions were associated with decreased affective well-being (decreased positive affect and increased negative affect), and more so for lonely compared to non-lonely adult's daily negative affect. Further, stressful interactions were related to decreased levels of tiredness for non-lonely adults. Findings are discussed in terms of the evolutionary model of loneliness and differential reactivity hypothesis.

Daily Interactions in the Eyes of Lonely Older Adults: Implications for Daily Well-being

Loneliness is a significant problem in modern society, so much so that public health officials have declared it a major health concern (Gerst-Emerson & Jayawardhana, 2015). A recent review found that 25 to 29 percent of older adults aged 70 years and older report global levels of loneliness (Ong et al., 2016). Global levels of loneliness (a general feeling of loneliness rather than a temporary or fleeting experience of daily/momentary loneliness) (Miller, 2011; Ong et al., 2016) is related to poor emotional and physical well-being. For example, global loneliness is related to higher levels of depression, emotional dysphoria, anxiety, and anger (Cacioppo et al., 2006; Luanaigh & Lawlor, 2008), and higher rates of functional limitations, sleep problems, morbidity, and mortality (Seeman, 2000; for review see Hawkley & Cacioppo, 2010).

Loneliness is defined as the *subjective perception* of a mismatch between desired and experienced social belonging (Perlman & Peplau, 1981). Although loneliness is often associated with social isolation (Cornwell & Waite, 2009; Coyle & Dugan, 2012), people can feel lonely even in the presence of others (Cacioppo & Cacioppo, 2018; Larson, 1990). This finding raises questions about whether lonely and non-lonely older adults have different experiences when interacting with others. The current study, involving adults aged 65 to 92, examines how global loneliness (i.e., global report) influences daily well-being, and how well-being may vary when people are with others (compared to being alone) and when engaging in stressful social interactions.

Loneliness and Well-being

Although many studies have examined global levels of loneliness and well-being (Cacioppo et al., 2006), only a handful of studies have examined this association in daily life (Chui et al., 2012; Jaremka et al., 2014; Lee & Ko, 2018; Russell et al., 2012). These studies

have found that lonely older adults report lower average levels of daily positive affect and higher average levels of daily negative affect than do non-lonely peers (Chui et al., 2014; Russell et al., 2012).

Loneliness and fatigue. In addition to affective well-being, high levels of global loneliness have been associated with general reports of greater fatigue (Jaremka et al., 2014). Yet, no study has examined how loneliness may be related to *daily* levels of fatigue. Fatigue is a subjective perception that reflects both the *emotional* and *physical* dimensions of functioning (Molassiotis, 1999; Winningham et al., 1994) and is strongly related to other health outcomes, including increased functional limitations and disability, greater morbidity, and earlier mortality (Avlund, 2010; Gill et al., 2001; Hardy & Studenski, 2008; Jaremka et al., 2014; Solomon & Ferrell, 2015). Measures of fatigue vary from single-item questionnaires to multi-item scales (e.g., Cleanthous et al., 2012; Liao & Ferrell, 2015; Molassiotis, 1999), but researchers often differentiate aspects of fatigue into categories of tiredness and lack of energy based on their associations with different aspects of functioning (Molassiotis, 1999). For example, one study found that physical level of energy is related to the social environment and psychological symptoms of distress, whereas tiredness is associated with physical and cognitive symptoms among chemotherapy patients (Molassiotis, 1999). We examined both constructs of fatigue, although we speculated that the energy aspect of fatigue would more strongly vary by social context (e.g., being with others versus alone) than would tiredness.

Global Loneliness as a Moderator between Daily Social Interactions and Well-being

Loneliness shapes how people perceive social environments and react to stressful interactions, which may influence well-being outcomes (Cacioppo et al., 2003; Hawkley & Ernst, 2006). According to the evolutionary model of loneliness, loneliness is associated with

negative cognitive biases whereby the social environment is perceived as stressful, threatening, and unsafe (Hawkley & Ernst, 2006). Lonely individuals, therefore, may report greater alertness, hypervigilance, and negative affect when with others than when alone (Cacioppo et al., 2002; Hawkley & Cacioppo, 2007). Further, the differential reactivity hypothesis (Cacioppo et al., 2003) posits that lonely and non-lonely older adults may be exposed to similar proportion of stressful social contexts; yet, lonely individuals show *greater reactivity* to stressors. Thus, stressful interactions may be particularly harmful to lonely individuals' daily well-being than for their non-lonely peers. To understand how global loneliness influences older adults' daily social interactions and well-being, the current study examined lonely and non-lonely older adults' experiences when they have engaged in 1) social interactions (vs. time alone) and 2) stressful conversations (vs. no stressful interaction).

Loneliness and daily social interactions. Loneliness and the size of the social network show a weak to a moderate inverse association (Coyle & Dugan, 2012; Larson, 1990; for review, see Heinrich & Gullone, 2006). Yet, less is known about whether daily social experiences vary by levels of global loneliness. Extensive research has documented the importance of social relationships for older adults' physical and psychological well-being (Antonucci & Akiyama, 1987; Kahn & Antonucci, 1980; Rook & Charles, 2017). Thus, interacting with others may be beneficial for both lonely and non-lonely older adults.

Based on the evolutionary model of loneliness (Hawkley & Ernst, 2006), however, lonely adults may also perceive social interactions as sources of anxiety and social pressure. As such, being alone may also be a peaceful and protected time to maintain well-being for more so for lonely than non-lonely individuals (Goffman, 1971; Rook & Charles, 2017). For example, research indicates that greater loneliness is often associated with a stronger preference for being

alone than interacting with others (Burger, 1995; Long & Averill, 2003). Further, Birditt and colleagues (2018) used the same data as the current study and found that solitude is associated with decreased negative affect among those embedded in a conflictual social network. Based on previous work, we expected time with others to be both beneficial and costly for lonely older adults' emotional and physical well-being (increased levels of positive affect, energy, and increased levels of negative affect and tiredness). Daily social interaction may be a double-edged sword for lonely older adults such that it creates a sense of support and positivity but also anxiety and stress (Cacioppo & Hawkley, 2003, 2009). In contrast, we hypothesized that daily interactions with others would only be a positive experience for non-lonely older adults.

Loneliness and daily stressful interactions. Global loneliness may also moderate the associations between daily stressful interactions and well-being. As explained by the differential reactivity hypothesis (Cacioppo et al., 2003), loneliness is associated with stronger emotional and physiological reactions to social stressors (Cacioppo et al., 2000; Cacioppo et al., 2006). This may partially explain why lonelier individuals perceive stressful interactions as more negative and recall a greater proportion of stressful exchanges compared to their less lonely counterparts (Cacioppo et al., 2006; Eronen & Nurmi, 1999; Jones et al., 1981). The costs of stressful interactions, therefore, may be greater for lonely older adults' daily affective well-being compared to non-lonely older adults.

Because fatigue reflects both affective and physical perceptions of one's functioning (Molassiotis, 1999; Winningham et al., 1994), the pattern of results for fatigue may be similar to those for affective experiences. Based on previous research, we may expect a particularly strong association between daily social contexts and energy than daily levels of tiredness. Yet, another study found no relationship between loneliness and daily experiences of pain, which is a physical

symptom but one that has a strong affective component (Wolf & Davis, 2014). Given the lack of existing literature, we made no specific predictions regarding how fatigue may vary based on loneliness in these different social situations.

The Current Study

The present study first examines lonely and non-lonely older adults' experiences of daily affective well-being (i.e., positive and negative affect) and fatigue (i.e., tiredness and energy level). Next, we examine how global loneliness shapes older adults' daily well-being when alone (vs. with others) and when engaging in stressful interactions (vs. no stressful interaction). Older adults' social interactions and well-being were assessed using daily ecological momentary assessments every three hours across five to six consecutive days. We expected that lonely older adults would report increased levels of positive affect and energy but also experience higher levels of negative affect and tiredness when with others (vs. being alone). In contrast, we hypothesized that non-lonely older adults would only benefit from daily social interactions such that they would report higher emotional and physical well-being (increased positive affect and energy and decreased negative affect and tiredness). Further, we predicted that stressful interactions would be more detrimental for lonely individuals' daily affective well-being compared to their non-lonely peers. We explored how global loneliness may shape daily levels of fatigue when lonely and non-lonely individuals experience stressful interactions (vs. no stressful interaction).

Method

Participants

Participants were from the *Daily Experiences and Well-being Study* (DEWS), a daily sampling study which included 333 older adults over the age of 65 (65–92, M_{age} = 73.94). Data

were collected in 2016-2017 from the Greater Austin, Texas Area. Older adults were eligible to participate if they resided independently in the community and were employed less than 20 hours a week. Participants were contacted by telephone to assess eligibility, and the sample represented approximately 80% of the target population. Approximately 56% of the participants were females, 57% had a bachelor's degree or higher, and 31% were ethnic or racial minorities, including African Americans and Hispanic/Latino. Although the sample is more highly educated than the U.S. population of older adults, 45% of adults over age 65 in the greater Austin area have a college degree (U.S. Census Bureau, 2017).

Procedure

Participants (*N*=333) completed an in-person home interview lasting approximately two hours that assessed social network composition, sociodemographic characteristics (e.g., age, gender, marital status, ethnicity, education, work status), and health (i.e., number of chronic illnesses) and global loneliness. Of the original sample, 313 participants completed the momentary ecological assessment (e.g., EMA). Using a handheld Android device, participants reported their experiences of affective well-being (positive and negative affect), fatigue (tiredness and energy level), whether they had interacted with others, and engaged in stressful social interactions every 3 hours approximately 5-6 times throughout the day. Participants received $50 for completing the initial in-person interview and an additional $100 upon finishing the daily surveys (EMAs). Procedures were approved by the University of Texas at Austin Institutional Review Board.

In-Person Interview Measures

Global loneliness. During the in-home interview, participants rated their overall levels of loneliness using a validated three-item scale from the Health and Retirement Study (Hughes et

al., 2004; Luhmann & Hawkley, 2016). Participants rated how often in the past month, they felt *that they lacked companionship, left out,* and *isolated from others* on a three-point scale (1= Hardly ever, 2=Some of the time, and 3=often; α = .733. Using the same scoring method as previous research (Perissinotto et al., 2012), participants who reported a score of 2 (*Some of the time*) or 3(*often*) on any of the three items were categorized as "lonely" (1), whereas those reporting a score of 1 (*Hardly ever)* on all three items were categorized as "Non-lonely" (0).

Covariates. We adjusted for several covariates associated with our variables of interest (global loneliness, daily social interactions, and daily affective well-being and fatigue). They included demographic information: age, marital status (0 = *never married, divorced, widowed;* 1= *married/remarried*), gender (0=fe*male;* 1=*male*), highest level of education (1 = *no formal education*; 2= *1-8 years, elementary school*; 3 = *some high school*; 4=*12 high school*; 5=*13 to 15 years some college/vocational or technical school*; 6 = *16 college graduate*; 7 = *17+ post-college; no additional degree*; 8 =*17+ advanced degree*), minority status (0 =*not minority;* 1= *ethnic or racial minority*), work status (0= *not working;* 1=*working)*, and global social network size (ranging from 0 to 30). Participants also indicated their residential status by checking one or more of the following: living alone, living with a spouse, unmarried romantic partner, grown child, child-in-law, grandchild, or others. Participants indicated (yes or no) whether their doctors had ever diagnosed them with any of the following eight conditions: high blood pressure/ hypertension; diabetes/high blood sugar; cancer/a malignant tumor (excluding minor skin cancer); chronic lung disease (e.g., chronic bronchitis or emphysema); a heart attack/coronary heart disease/angina/congestive heart failure/other heart problems; a stroke; arthritis/rheumatism; osteoporosis/osteopenia. Questions were adapted from the Health and Retirement Study and were summed to create a summary number of chronic illness scores ranging from 0 to 8 (Section

B: Health Status in the HRS 1992-2001). Participants also used the abbreviated 11-item CES-D scale (Kohout et al., 1993) to indicate how often they felt each item in the past two weeks (e.g., "*I did not feel like eating: My appetite was poor*," "*I felt that everything I did was an effort*") using a 4-point Likert scale ranging from 1 (*rarely or none of the time)* to 4 (*most or all of the time;* $\alpha = .78$). A log10 transformation was performed to normalize the positively skewed distribution of the average depression score (corrected skewness = .56).

Ecological Momentary Assessment Measures

For the next five or six days (ensuring that both weekend days were captured in addition to weekdays), participants reported their levels of emotional and physical well-being and social interactions every three hours during the day.

Daily positive and negative affect. For positive affect, participants rated how much they felt *proud, content, loved,* and *calm* in the last three hours ($\alpha = .69$). For negative affect, participants rated how much they felt *nervous/worried, irritated, bored,* and *sad* ($\alpha = .69$). The items were adapted from questionnaires by Shaver et al. (1987) and Watson et al. (1988). Scores based on a 5-point Likert scale ranging from 1 (*not at all)* to 5 (*a great deal)* were averaged across each three-hour block.

Daily tiredness and energy. Participants indicated how physically tired (i.e., "How physically tired have you felt in the past 3 hours?") and energetic (i.e., "How energetic have you felt in the past 3 hours?") they felt in the last three hours on a 5-point Likert scale ranging from 1 (*not at all)* to 5 (*a great deal*). Both items were adapted from the Daily Pittsburg Sleep Diary (Monk, 1994).

Daily Presence of Others. Participants reported whether they engaged in any social interaction in the past three hours. Responses were coded as having no social interaction (0 =

daily time alone), or interaction with one or more social partner (1 = *daily interaction with others*).

Daily Stressful interactions. If participants reported engaging in a social interaction, they indicated whether the conversation involved discussion of anything stressful or unpleasant. Responses were coded as 0 (*No stressful interaction*) or 1 (*Yes, stressful interaction*).

Statistical Analyses

First, multi-level modeling in SAS (Proc Mixed) examined the main effects of global loneliness, social interactions, and stressful interactions on well-being (i.e., positive and negative affect and energy, and tiredness). Next, we examined whether the associations between different types of daily social interactions (i.e., being with others vs. alone; stressful interactions vs. no stressful interactions) and daily well-being (i.e., positive and negative affect and tiredness and energy) varied by level of loneliness. Multi-level modeling was used to capture both the within and between-person variability. A 3-level model was used such that associations between social interactions (e.g., being with others and stressful interaction) and well-being (positive and negative affect, energy, and tiredness) within each participant (Level-1) were nested within the day of the week (Level-2), and then nested within the individual (Level 3). Level 3 variables included between-person factors such as level of global loneliness (the main variable of interest) and covariates (e.g., gender and ethnicity). For each of our two main questions (being with others vs. alone; stressful interactions vs. no stressful interactions), we used separate multi-level models to examine the four outcomes of interest (daily negative affect, positive affect, energy, and fatigue).

Results

Descriptive Results

Tables 1.1 and 1.2 presents correlations, means and percentages of the main variables of interest. Approximately one-third of the participants (n=114; 34.2%) were coded as being lonely. Lonely and non-lonely older adults did not differ in the total number of EMA surveys completed, ($t(311) = .30$, $p = 0.76$), or the total number of stressful interactions with social ties, ($t(308) = 1.79$, $p = 0.08$). Lonely older adults, however, reported having no social interactions more often than did non-lonely older adults ($t(170.13) = 2.51$, $p = 0.03$). On average, lonely older adults reported higher levels of daily negative affect and tiredness and lower levels of daily positive affect and energy compared to non-lonely adults, (NA: $t(127.52) = 5.89$, $p < .001$; Tiredness: $t(177.06) = 4.41$, $p < .001$; PA: $t(308) = -5.08$, $p < .001$; Energy: $t(308) = 3.55$, $p < .001$.

Most sociodemographic variables varied by loneliness status in the expected directions. Lonely older adults were more likely to be unmarried ($X^2(1) = 11.29$, $p = .001$), live alone ($X^2(1) = 7.98$, $p = .005$), and have higher levels of depression, $t(250.90) = 2.68$, $p = .01$. Loneliness was also associated with lower levels of education ($t(311) = 0.32$, $p = .03$) but unrelated to age, gender, total number of chronic conditions, racial minority status, work status, number of health conditions, and overall social network size.

Main Effects of Global Loneliness and Daily Social Interactions

We first examined whether global loneliness, daily social interactions, and daily stressful interactions were associated with daily well-being outcomes (Table 1.3, Table 1.4; Table 1.5, Table 1.6; Model 1). Loneliness was associated with lower positive affect and greater negative affect but not energy or tiredness. Being with others (vs. having had no social interaction) was associated with greater positive affect and energy, and less tiredness. The main effect for negative affect was also significant, but in the unexpected direction where people reported higher

levels of negative affect when interacting with others than when alone. Lastly, stressful interactions were related to lower affective well-being, but not energy and tiredness.

Does Global Loneliness Moderate the Associations between Daily Social Interactions and Well-being?

Next**,** we entered interactions in the multi-levels models to test whether global loneliness moderated the associations between daily social contexts (presence of others and stressful interactions) and daily well-being (affective well-being and fatigue).

Being with others versus being alone and daily well-being. The interaction between global loneliness and daily presence of others was significant only in the model for negative affect. Tables 1.3 and 1.4 presents the results of the full models that include the interactions. As hypothesized, simple slope tests revealed that lonely individuals experienced lower levels of daily negative affect (B = -0.06, p = 0.0037) when alone compared to when they had interacted with others; non-lonely people reported similar levels of affect in both situations (B = -0.003, p = 0.85; see Figure 1.1).

Stressful interactions and daily well-being. Next, the interaction between global loneliness and daily stressful interaction revealed that lonely and non-lonely adults differed in their experiences of stressful interactions for negative affect and tiredness (Tables 1.5 and 1.6). Simple slope analyses showed that lonely older adults reported greater increases in negative affect when engaging in stressful interactions compared to their non-lonely peers (Non-lonely: B = 0.01, p <.0001; Lonely: B = 0.28, p <.0001). Further, non-lonely individuals reported less tiredness whereas lonely individuals reported no differences when the situation was rated as stressful (versus not; Non-lonely: B = -0.08, p = 0.04; Lonely: B = 0.09, p =0.08; see Figure1.3).

Discussion

A large number of studies have examined the role of loneliness in older adults' social relationships and well-being (Ong et al., 2016). Fewer studies have examined how global levels of loneliness shape older adults' *everyday* experiences. In general, lonely older adults reported lower levels of affective well-being throughout the day compared to non-lonely individuals, but they did not differ in their reported levels of fatigue. Daily social interactions were beneficial for all, regardless of global loneliness. Yet, lonely adults also experienced increased negative affect. Further, stressful interactions were more harmful for lonely adults than non-lonely individuals. Findings indicate that global loneliness plays an important role in determining the benefits and costs of daily social experiences on well-being. As such, alleviating global loneliness may be an important point of intervention to improve the daily well-being of the rapidly growing older adult population.

Well-being and Loneliness

Loneliness is considered a public health problem associated with high levels of distress and poorer physical health (for review, see Hawkley & Cacioppo, 2010). We found that consistent with prior research, lonely older adults reported lower affective well-being (i.e., lower positive affect and higher negative affect) than did their non-lonely counterparts. In contrast to prior studies, we found no significant association between loneliness and *daily* levels of fatigue (Jaremka et al., 2014). We speculate that perhaps global assessments of fatigue are more influenced by memory biases than reports in the moment (e.g., Levine. 1997), and the effects of loneliness on reports related to physical well-being may be less powerful than effects on affective well-being. Results support the contention that loneliness is more strongly related to individuals' subjective perceptions of affective well-being rather than perceived experiences of one's subjective physical functioning (Cacioppo & Hawkley, 2003).

Loneliness and Daily Presence of Others

In line with previous findings, lonely individuals reported spending a greater proportion of time alone (vs. being with others) than their non-lonely counterparts (Russell et al., 1980; Victor et al., 2005). Confirming our hypothesis that social interactions would confer benefits, being with others was a positive experience for both lonely and non-lonely older adults. Regardless of the level of loneliness, older adults showed increased levels of positive affect, energy, and decreased levels of tiredness when with others compared to being alone. Results are consistent with extensive research that has documented the benefits of positive social relationships on well-being, particularly in later life (Rook & Charles, 2017).

Lonely older adults, however, also experienced greater negative affect when interacting with others. The evolutionary model of loneliness may explain this finding (Cacioppo & Hawkley, 2003, 2009; Cacioppo, Hawkley & Ernst, 2006). Greater loneliness is associated with cognitive biases, such that social context is perceived as more stressful, threatening, and even unsafe. For example, Hawkley and colleagues (2003) found that lonely college students perceived the same daily activities as more negative and stressful than their less lonely peers. Together, daily social interactions may be a double-edged sword for lonely older adults, such that they incur both affective benefits (increased positive affect, energy, and decreased tiredness) and costs (increased negative affect). While some studies have documented both the benefits and costs of solitude for non-lonely individauls' negative affect (Burger, 1998; Pauly et al., 2018), the current study found this pattern only for the lonely older adults.

Loneliness and Daily Stressful Interactions

As expected and consistent with prior research, stressful interactions were particularly detrimental for lonely older adults' daily negative affect compared to their non-lonely peers.

These findings are consistent with the differential reactivity hypothesis (Cacioppo et al., 2003), which suggests lonely individuals show heightened reactivity to social stressors compared with their non-lonely peers. In contrast to our prediction, however, a stressful social interaction was not particularly costlier for lonely older adults' daily positive affect. Loneliness is strongly associated with maladaptive biases such as depression, anxiety, anger, and negative affect (Hawkley & Cacioppo, 2009). These associations may explain why daily stressful interactions were costlier for lonely older adults' negative affect but not for positive affect.

Results for stressful interaction and daily tiredness revealed potential gains for non-lonely individuals. Non-lonely older adults reported decreased levels of tiredness when engaging in stressful interactions (vs. no stressful interactions). These findings suggest that the presence of stressors may not be uniformly negative. For example, one study found that a greater number of stressors is correlated with a greater number of daily positive events (Charles et al., 2010). Results may indicate that those experiencing more stressors may also be more active and engaged in their social environment leading to decreased levels of tiredness. Thus, stressful interactions may be important sources of activation and engagement, yet, only for non-lonely older adults. Alternatively, anger is an emotion that is associated with mobilization of energy (Moons et al., 2010), and perhaps people who are not lonely feel more anger in response to stressful situations, whereas people who are lonely are more likely to experience fear and sadness, which as less activating emotions (Moons et al., 2010). We did not find a significant association between loneliness and stressful interaction for daily levels of energy. Daily energy may be more closely related to experiences of positive arousal, excitement, and vitality. Thus, in contrast to levels of tiredness, levels of energy may be more closely related to positive than negative social contexts.

Limitations and Future Directions

Findings from the current study are subject to several limitations. First, more frequent sampling of participants' social and emotional experiences may allow for a more nuanced understanding of the role of global loneliness in older adults' daily lives (e.g., shorter time intervals than three hours). Further, the results from the current study are correlational; thus, longitudinal study designs are needed to better examine how loneliness may shape older adults' experiences of well-being across different social contexts. Finally, the sample consisted of mostly highly educated and relatively healthy older adults. Therefore, caution should be taken to generalize the findings to a more diverse population of older adults.

In conclusion, the current study advances prior literature by examining how global loneliness influences older adults' *daily* experiences of affective well-being and levels of fatigue when interacting with others (vs. being alone) and engaging in stressful interactions. Our results indicate that daily social interactions incur both benefits and costs for lonely older adults' daily affective well-being. Further, stressful interactions posed a greater threat to lonely older adults' negative affect well-being compared to their non-lonely peers. It is often thought that increasing social engagement is the solution to loneliness. The current study, however, highlights the need for a more nuanced examination of lonely older adults' daily social needs.

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Table 1.1

Correlations Among All Variables of Interest

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Age	-																
2	Gender (ref=Female)	0.029	-															
3	Education	-0.067	.166**	-														
4	Married (ref=Not married)	-.191**	.383**	.163**	-													
5	Chronic Health Conditions	.241**	-0.095	-.231**	-.182**	-												
6	Working (ref=Not working)	-.145**	-0.001	0.022	0.039	0.005	-											
7	Size of Social Network	-0.065	-.160**	0.079	-0.047	-0.049	.137*	-										
8	Living Stat. (ref= Not alone)	.173**	-.192**	-0.027	-.625**	.164**	-0.036	0.014	-									
9	Minority (ref= Not minority)	-.108*	0.007	-.365**	-0.033	0.107	-0.042	0.017	-.116*	-								
10	Proportion of Time Alone	.119*	-.111*	-0.081	-.500**	0.088	-0.015	-.122*	.478**	-0.068	-							
11	Avg. Numb Stress Int.	-0.109	-0.084	0.083	0.013	0.011	-0.033	0.065	-0.078	-0.060	-.170**	-						
12	Global Avg. PA	-0.106	-0.004	-0.002	.122*	-0.082	-0.034	.217**	-.118*	0.029	-.154**	-.163**	-					
13	Global Avg. NA	-0.019	-0.004	-0.047	0.026	0.083	-0.085	-0.108	-0.065	0.056	-0.060	.407**	-.344**	-				
14	Global Avg. Energy	-.170**	.145*	0.072	.141*	-.320**	-0.036	.124*	-.115*	-0.048	-.150**	-0.070	.555**	-.242**	-			
15	Global Avg Tired	0.110	-.143*	-0.028	-0.045	.264**	0.035	-0.051	0.007	-0.019	0.005	.144*	-.248**	.493**	-.526**	-		
16	Depression	0.013	-0.018	-.261**	-0.090	.217**	-0.065	-.134*	0.096	.231**	0.056	.219**	-.306**	.554**	-.340**	.449**	-	
17	Loneliness	0.037	-0.009	-.126*	-.153**	0.076	-0.012	-.122*	.184**	.119*	.149**	.167**	-.301**	.488**	-.182**	.290**	.618**	-

Note. ** Correlation is significant at the 0.01 level. * Correlation is significant at the 0.05 level (2-tailed).

Table 1.2

Descriptive Information of Participants (N=313)

Characteristics	*Mean*	*SD*	*Range*
Age	73.94	6.38	65-92
Education[a]	5.88	1.61	1-8
Number of Chronic Conditions	2.37	1.45	0-7
Total Network Size[b]	15.1	6.9	0 - 30
Depression[c]	16.46	4.7	11-33
Daily Positive Affect	3.44	0.71	1-5
Daily Negative Affect	1.25	0.31	1-5
Daily Energy	2.98	0.74	1-5
Daily Tiredness	2.03	0.66	1-5
Avg. Number of Stressful Int with All Ties	3.73	3.56	0-18
	Proportion		
Global Loneliness (ref = Not lonely)	34.2%		
Gender (ref= Female)	55.6%		
Marital Status (ref=Not married)	58.8%		
Working Status (ref= Not working)	11.8%		
Living Status (ref=Not living alone)	34.5%		
Minority Status (ref= Not Minority)	31.0%		
Proportion of Daily Interaction with Others (vs. alone)	89%		

Note.[a]1(no formal education), 2 (elementary school), 3 (some high school), 4 (high school), 5 (some college/vocation or trade school), 6 (college graduate), 7 (post college but no additional degree), to 8 (advanced degree); [b]Total number of social partners that participants reported in the in-person interview; [c]Sum of 11 items on a scale from 1(Rarely or none of the time), 2(Some or little of the time), 3(Occasionally or a moderate amount of the time), 4(Most or all of the time).

Table 1.3

Multilevel Models Predicting Daily Emotional Well-being by Being with Others and Loneliness

	Interaction with Others			
Variable	**PA**		**NA**	
	Model 1	Model 2	Model 1	Model 2
Intercept	3.24 (0.23)**	3.25 (0.23)**	1.25 (0.09)**	1.27 (0.09)**
Age	-0.01 (0.01)*	-0.01 (0.01)*	0 (0)	0 (0)
Gender (ref=female)	0.01 (0.08)	0.01 (0.08)	-0.01 (0.03)	-0.01 (0.03)
Education	-0.03 (0.03)	-0.03 (0.03)	0.01 (0.01)	0.01 (0.01)
Marital Status (ref=Not married)	0.08 (0.11)	0.08 (0.11)	-0.03 (0.04)	-0.03 (0.04)
Numb of Chron Conditions	0.02 (0.03)	0.02 (0.03)	-0.01 (0.01)	-0.01 (0.01)
Minority (ref= Not minority)	0.08 (0.09)	0.08 (0.09)	-0.04 (0.03)	-0.04 (0.03)
Work Status (ref=Not working)	-0.19 (0.12)	-0.19 (0.12)	-0.07 (0.04)	-0.07 (0.04)
Size of Social Network	0.01 (0)*	0.01 (0)*	0 (0)	0 (0)
Living Status (ref= Live alone)	-0.03 (0.1)	-0.03 (0.1)	-0.08 (0.04)	-0.08 (0.04)
Proportion Time Alone	-0.01 (0.28)	-0.01 (0.28)	-0.13 (0.11)	-0.13 (0.11)
Depression	-1.55 (0.41)*	-1.55 (0.41)*	1.3 (0.16)**	1.3 (0.16)**
Being with Others (ref= Alone)	0.1 (0.02)**	0.09 (0.03)*	0.03 (0.01)*	0 (0.02)
Trait Lonely (ref= Non-Lonely)	-0.21 (0.09)*	-0.24 (0.1)*	0.11 (0.04)*	0.07 (0.04)
With Others*Trait Lonely		0.03 (0.04)		0.05 (0.03)*

Note. $p<.05$, * $p<.001$**. Standard Errors are indicated by the parentheses.

Table 1.4

Multilevel Models Predicting Daily Physical Well-being by Being With Others and Loneliness

	Interaction with Others			
Variable	**Energy**		**Tired**	
	Model 1	Model 2	Model 1	Model 2
Intercept	3.24 (0.23)**	2.94 (0.23)**	1.8 (0.2)**	1.85 (0.2)**
Age	-0.01 (0.01)*	-0.02 (0.01)*	0.01 (0.01)	0.01 (0.01)
Gender (ref=female)	0.01 (0.08)	0.25 (0.08)*	-0.22 (0.07)*	-0.22 (0.07)*
Education	-0.03 (0.03)	-0.03 (0.03)	0.05 (0.02)*	0.05 (0.02)*
Marital Status (ref=Not married)	0.08 (0.11)	-0.06 (0.11)	0.03 (0.09)	0.03 (0.09)
Numb of Chron Conditions	0.02 (0.03)	-0.1 (0.03)*	0.09 (0.03)*	0.09 (0.03)*
Minority (ref=Not minority)	0.08 (0.09)	-0.04 (0.09)	-0.15 (0.08)	-0.15 (0.08)
Work Status (ref=Not working)	-0.19 (0.12)	-0.15 (0.11)	0.07 (0.1)	0.07 (0.1)
Size of Social Network	0.01 (0)*	0.01 (0)	0 (0)	0 (0)
Living Status (ref= Live alone)	-0.03 (0.1)	0.03 (0.1)	-0.14 (0.09)	-0.14 (0.09)
Proportion Time Alone	-0.01 (0.28)	-0.11 (0.28)	-0.08 (0.24)	-0.08 (0.24)
Depression	-1.55 (0.41)*	-2.11 (0.4)**	2.43 (0.35)**	2.43 (0.35)**
Being with Others (ref= Alone)	0.1 (0.02)**	0.34 (0.05)**	-0.13 (0.04)*	-0.17 (0.05)*
Lonely (ref= Non-Lonely)	-0.21 (0.09)*	0.03 (0.11)	0.05 (0.08)	-0.04 (0.1)
With Others*Lonely		-0.05 (0.07)		0.1 (0.08)

Note. $p<.05$, * $p<.001$**. Standard Errors are indicated by the parentheses.

Table 1.5

Multilevel Models Predicting Daily Emotional Well-being by Stressful Interactions and Loneliness

	Stressful Interaction			
Variable	**PA**		**NA**	
	Model 1	Model 2	Model 1	Model 2
Intercept	3.37 (0.22)**	3.37 (0.22)**	1.18 (0.08)**	1.19 (0.08)**
Age	-0.02 (0.01)*	-0.02 (0.01)*	0 (0)	0 (0)
Gender (ref=female)	0 (0.08)	0 (0.08)	0.01 (0.03)	0.01 (0.03)
Education	-0.02 (0.03)	-0.02 (0.03)	0 (0.01)	0 (0.01)
Marital Status (ref=Not married)	0.08 (0.1)	0.09 (0.1)	-0.01 (0.04)	-0.01 (0.04)
Numb of Chron Conditions	0.03 (0.03)	0.02 (0.03)	-0.01 (0.01)	-0.01 (0.01)
Minority (ref=Not minority)	0.06 (0.09)	0.06 (0.09)	-0.01 (0.03)	-0.01 (0.03)
Work Status (ref=Not working)	-0.2 (0.11)	-0.2 (0.11)	-0.06 (0.04)	-0.06 (0.04)
Size of Social Network	0.01 (0)*	0.01 (0)*	0 (0)	0 (0)
Living Status (ref= Live alone)	-0.06 (0.1)	-0.06 (0.1)	-0.07 (0.04)	-0.07 (0.04)
Mean Freq Stressful Int.	-0.32 (0.21)	-0.32 (0.21)	0.31 (0.08)**	0.3 (0.08)*
Depression	-1.3 (0.42)*	-1.3 (0.42)*	1.03 (0.16)**	1.03 (0.15)**
Stressful Int (ref= Non-stressful)	-0.11 (0.01)**	-0.09 (0.02)**	0.19 (0.01)**	0.15 (0.01)**
Lonely (ref= Non-Lonely)	-0.22 (0.09)*	-0.2 (0.09)*	0.12 (0.03)*	0.09 (0.03)*
Stressful Int*Lonely		-0.06 (0.03)		0.13 (0.02)**

Note. $p<.05$, * $p<.001$**. Standard Errors are indicated by the parentheses.

Table 1.6

Multilevel Models Predicting Daily Physical Well-being by Stressful Interactions and Loneliness

	Stressful Interaction			
Variable	**Energy**		**Tired**	
	Model 1	Model 2	Model 1	Model 2
Intercept	3.19 (0.22)**	3.2 (0.22)**	1.69 (0.19)**	1.7 (0.19)**
Age	-0.02 (0.01)*	-0.02 (0.01)*	0.01 (0.01)	0.01 (0.01)
Gender (ref=female)	0.25 (0.08)*	0.25 (0.08)*	-0.22 (0.07)*	-0.22 (0.07)*
Education	-0.03 (0.03)	-0.03 (0.03)	0.05 (0.02)*	0.05 (0.02)*
Marital Status (ref=Not married)	-0.01 (0.1)	-0.01 (0.1)	0.03 (0.09)	0.03 (0.09)
Numb of Chron Conditions	-0.1 (0.03)*	-0.1 (0.03)*	0.09 (0.03)*	0.09 (0.03)*
Minority (ref= Not minority)	-0.04 (0.09)	-0.04 (0.09)	-0.15 (0.08)	-0.15 (0.08)
Work Status (ref=Not working)	-0.16 (0.11)	-0.16 (0.11)	0.07 (0.1)	0.07 (0.1)
Size of Social Network	0.01 (0)*	0.01 (0)*	0 (0)	0 (0)
Living Status (ref= Live alone)	-0.01 (0.1)	-0.01 (0.1)	-0.13 (0.09)	-0.13 (0.09)
Mean Freq Stressful Int.	-0.1 (0.22)	-0.1 (0.22)	0.04 (0.19)	0.03 (0.19)
Depression	-2.03 (0.42)**	-2.03 (0.42)**	2.42 (0.36)**	2.41 (0.36)**
Stressful Int (ref= Non-stressful)	0.02 (0.03)	0 (0.03)	-0.02 (0.03)	-0.08 (0.04)*
Lonely (ref= Non-Lonely)	-0.02 (0.09)	-0.03 (0.09)	0.05 (0.08)	0.02 (0.08)
Stressful Int*Lonely		0.05 (0.06)		0.17 (0.06)*

Note. $p<.05$, * $p<.001$**. Standard Errors are indicated by the parentheses.

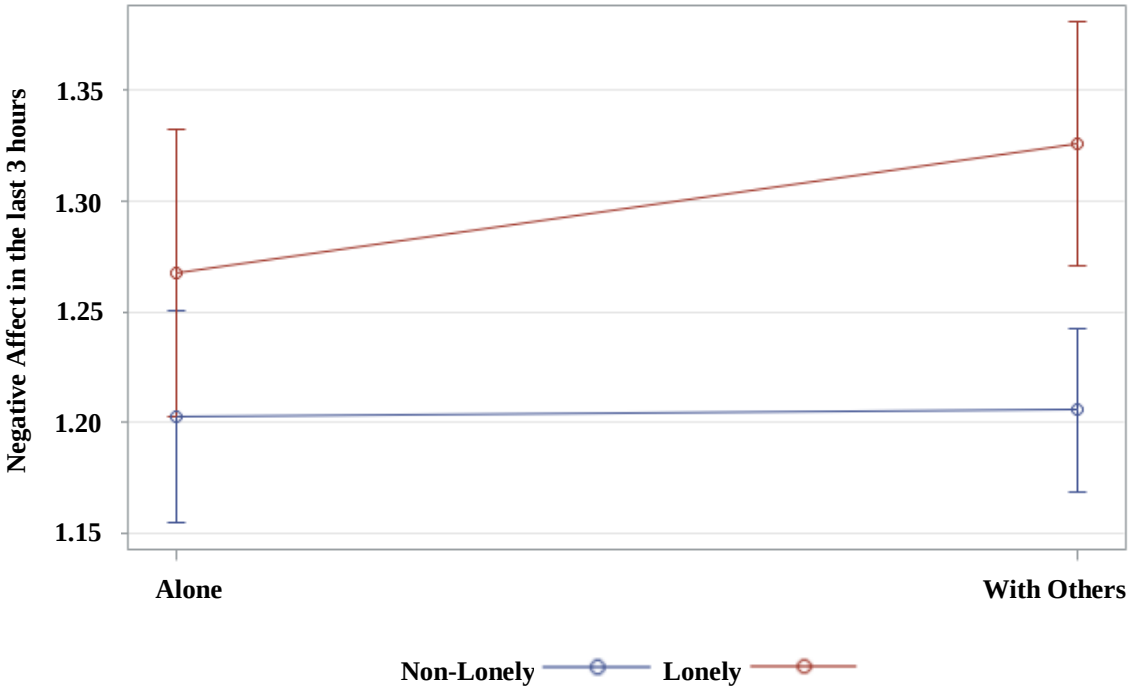

Figure 1.1 Daily negative affect by daily social interaction and loneliness.

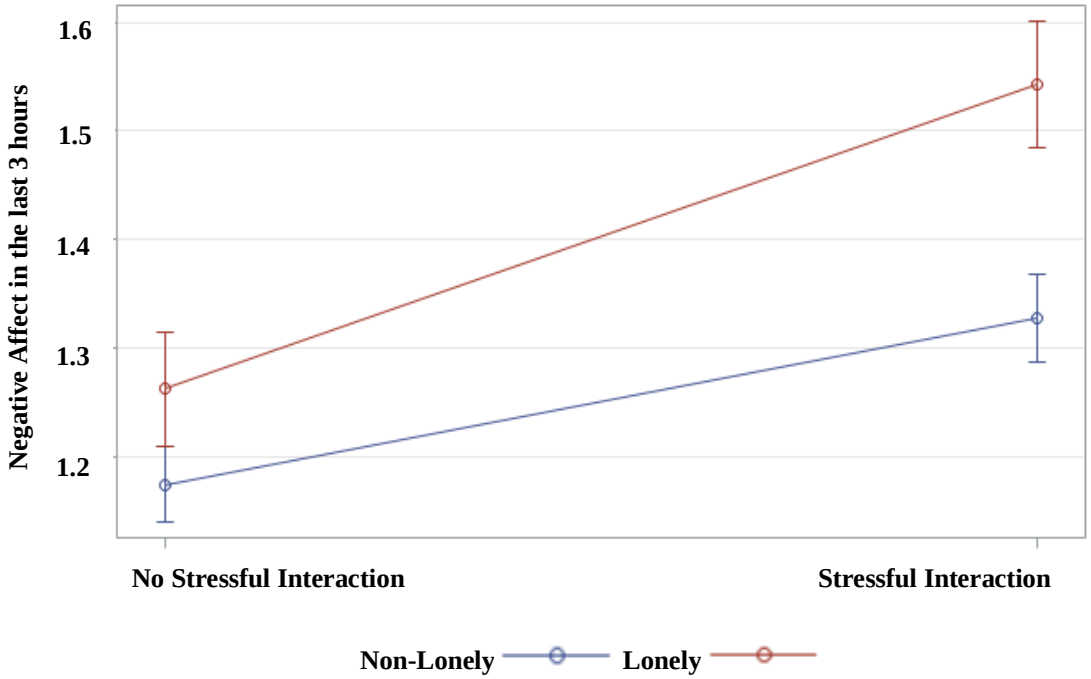

Figure 1.2 Daily negative affect by daily stressful interaction and loneliness.

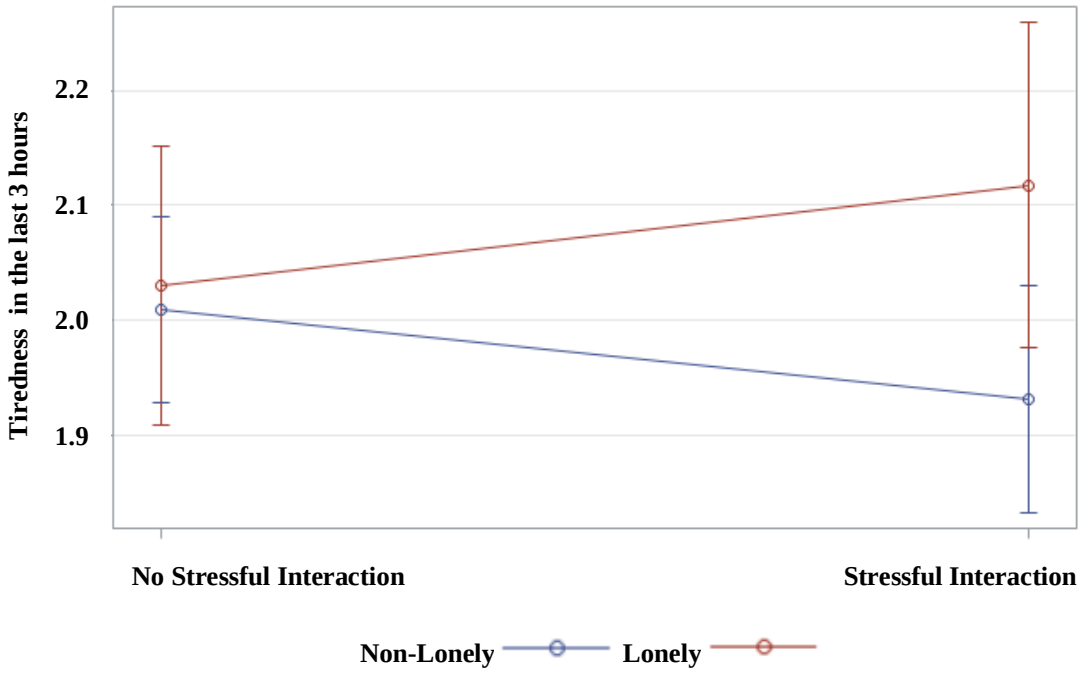

Figure 1.3 Daily negative affect by daily stressful interaction and loneliness.

CHAPTER 3:

The Protective Role of Positive Social Networks for the Daily Well-being of Lonely Individuals

Abstract

Much existing literature has focused on risk factors that make lonely individuals more vulnerable to health and well-being problems. The current study examined protective factors, specifically the potential moderating role that *positive network quality* might have on the daily well-being of lonely older adults when they experience stressful interactions. Participants from the *Daily Experiences and Well-being Study* (DEWS; N=313, M_{age}= 73.94) reported their levels of global loneliness and social network quality (e.g., perceived support from their close social network members). Then, they completed ecological momentary assessments every 3 hours across approximately five to six days. At each 3-hour interval, participants reported if they experienced a stressful social interaction (vs. no stressful interaction) and reported their emotional well-being (positive and negative affect). Multilevel models revealed that when lonely older adults experienced stressful interactions, positive network quality buffered against the adverse effects of social stressors on their daily emotional well-being (positive and negative affect). In contrast, this buffering effect was not observed among non-lonely older adults. Findings highlight a protective asset that may be important for helping lonely older adults maintain daily well-being. These findings may inform future intervention targets aimed at mitigating the adverse effects of stressful daily experiences on lonely older adults' daily well-being.

The Protective Role of Positive Social Networks for the Daily Well-being of Lonely Individuals

Lonely older adults are particularly vulnerable to everyday experiences of stressful interactions (Hawkley & Cacioppo, 2007). Research indicates that *positive network quality* reduces the negative effects of social stressors on well-being (Cohen et al., 1986; Unger & Powell, 1980). Yet, it is unclear whether lonely older adults also experience such benefits when experiencing everyday social stressors. Few studies have examined the buffering role of positive social network for older adults' daily emotional well-being (positive and negative affect). With an estimate of more than 40% of adults 65 and over experiencing loneliness (Perissinotto et al., 2012), coupled with the rapidly aging populations in many countries, identifying the potentially protective role of a positive social network is more important than ever. The current study examines whether having a positive social network quality buffers against lonely older adults' daily experiences of stressful interactions for emotional well-being (positive and negative affect).

Global Loneliness, Daily Stressful Interactions, and Well-being

Loneliness, the subjective perception that one lacks social connections, determines how people perceive and respond to stressful social experiences (Perlman & Peplau, 1981). According to the differential reactivity hypothesis, lonely individuals perceive negative social environments as more threatening and stressful than non-lonely individuals (Cacioppo et al., 2000; Cacioppo et al., 2003; Cacioppo et al., 2006). For example, an ecological momentary assessment (EMA) study found that loneliness is related to greater increases in negative affect when engaging in stressful social interactions (Hawkley et al., 2007). Another EMA study found that lonely individuals perceive their social interactions as more negative, less positive, and more stressful than non-lonely individuals, and report lower ability to meet demands of social partners (Hawkley et al., 2003).

Previous work using the same dataset as the current study found that daily stressful interactions are associated with decreased positive affect for lonely and non-lonely older adults. Further, stressful interactions were particularly costlier for lonely older adults' daily negative affect compared to their non-lonely counterparts (Hong et al., under review). Consistent with the previous study, therefore, we expected to replicate those findings that stressful interactions would be costly for lonely and non-lonely older adults and especially for lonely older adults' daily negative affect.

Global Loneliness, Daily Stressful Interactions, and Well-being: The Protective Role of Positive Social Network Quality

A positive social network may be one protective social asset that reduces lonely individuals' heightened vulnerabilities to daily social stressors. The broaden-and-build theory posits that positive emotions allow people to recover more quickly from stressful experiences (Fredrickson & Levenson, 1998). For example, studies found an "undoing effect" of positive emotions such that increased positive emotion allowed for faster cardiovascular recovery following a negative experience (for a review, see Fredrickson, 2013). Similarly, a daily diary study showed that on days people experienced a stressful event and also reported a higher than average level of positive emotions, they showed a blunted increase in negative emotions (Leger et al., 2019). According to the differential-stress-buffering hypothesis, lonely individuals are more susceptible to the harmful effects of stressful experiences because they lack positive social resources (Cacioppo et al., 2003). Thus, positive emotions related to one's social context may be particularly beneficial for lonely individuals in the face of social stressors. When lonely individuals are able to access and secure a positive social network, these social assets may be even more protective for their well-being than for their non-lonely counterparts.

For example, one lab study found that perceived social support buffered against the adverse effects of standardized laboratory stressors for lonely college students, but not for their non-lonely counterparts. Social support (e.g., group cohesion at university) was related to lower pulse pressure (PP) reactivity (indicating a healthier cardiovascular reactivity) only for lonely college students (O'Donovan & Hughes, 2007). As lonely older adults are more vulnerable to the negative health consequences of stressful experiences that younger adults, identifying the protective role of social network quality for the older adult population is particularly important (Ong et al., 2011). Together, we anticipated that more positive social network quality would mitigate the adverse effects of daily stressful interactions for lonely individuals' daily emotional well-being.

The Current Study

The current study first examined lonely older adults' daily emotional (e.g., positive and negative affect) well-being when having engaged in a stressful social interaction. Consistent with prior findings (Hawkley et al., 2007; Hong et al., under review), we predicted that lonely older adults would be more reactive (have greater decreases in well-being) than non-lonely adults to daily stressful interactions. Then, we examined whether positive network quality buffered against the negative effects of stressful social interactions and whether these effects were stronger among lonely older adults compared to non-lonely adults. The ecological momentary assessment design, where participants completed surveys every 3 hours across approximately five days, allowed us to examine these daily processes. Participants first completed an initial interview and reported global levels of loneliness and positive network quality. Then, participants completed EMAs every 3 hours across approximately five days and reported their experiences of stressful social interactions and levels of emotional well-being. We also adjusted

for participants' negative network quality across all models. This allowed us to examine the unique and independent effect of positive network quality on lonely and non-lonely older adults' experiences of daily stressful interactions.

Method

Sample and Procedures

We used data from the *Daily Experiences and Well-being Study* (DEWS), consisting of 333 community-dwelling older adults residing in the greater Austin, Texas. Inclusion criteria involved being 65 years old and over (*Range* = 65–92, *Mean* = 74.15, *SD* = 6.57), not fully employed, and having no cognitive impartments. We collected data in 2016-2017 and used a stratified sampling procedure to increase the diversity of the sample. Approximately 33% of the sample were ethnic minorities (e.g., Hispanic/Latino, African American), and 55% were females. All procedures for the current study were approved by the University of Texas at Austin Institutional Review Board (2015-02-0123).

Participants first completed a 2-hour face-to-face interview where they provided sociodemographic information (e.g., age, gender, education, ethnic/racial background), information about their social network, and other psychosocial measures of their health that are not included in the current study. Following, participants participated in the EMA portion of the study, where they used a mobile device to answer questionnaires every three hours across approximately five to six days (depending on the day they started to ensure that the study captured both weekend days). Participants were paid $50 for completing the initial interview and another $100 for the EMAs.

Global Interview Measures

Global loneliness. We measured participants' global loneliness using a validated three-item scale from the Health and Retirement Study (Hughes et al., 2004). Participants reported how often in the past 30 days, they felt *that they lacked companionship, left out,* and *isolated from others* from 1 (*Hardly ever),* 2 *(Some of the time) to* 3 *(Often)* ($\alpha = .73$). Consistent with previous research, we categorized participants who reported feeling lonely *Some of the time* or *Often* as lonely (1) and those feeling lonely *hardly ever* as non-lonely (0) (Perissinotto et al., 2012).

Social Network Quality. Participants used the Social Convoy diagram (Antonucci, 1986) to place their social network members in three concentric circles, ranging in different levels of closeness. Then, they reported how "positive" and "negative" their relationships were with each of the ten closest network members. The three positive network quality questions assessed the extent to which participants can: *share their private feelings and concerns*; *rely on (social partner) for help when they have a serious problem*; and *loves and cares for them*. The two negative network quality questionnaires included the extent to which (social partners): *get on your nerves;* and *are critical of them and what they do.* Scores based on a 5-point Likert-type scale from 1 (*not at all)*), 2 (*a little*), 3 (*somewhat*), 4 (*quite a bit*), to 5 (*a great deal)* were averaged separately for positive network quality (*alpha* =.91) and negative network quality (*alpha* =.89). Given the weak association between positive and negative network quality scores ($r = -.17$), we used a "positive network quality" construct to capture the supportive and loving aspects of participants' social relationships, whereas the negative network quality construct was used as a covariate in the analyses.

Covariates. Participants reported their age (*years*), gender (0 = *Female, 1= Male*), marital status (recoded as 0 = *Not Married*, 1 = *Married*), racial/ethnic background (recoded as 0

= *Non-Hispanic White*, 1 = *Ethnic/racial Minority*), work status (recoded as 0 = *Not Working*, 1 = *Working*), living arrangement (recoded as 0 = *Living with Others*, 1 = *Living Alone*), size of social network (*total number of social partners listed in the social network;* SNI*)* and number of medical conditions (recoded into a construct ranging from 0 = *No Medical Condition* to 4 = *Four or More Medical Conditions*; Section B: Health Status in the HRS 1992-2001). Participants also reported their highest level of education which range from: 1 (*No formal education*), 2 (Elementary school), 3 (Some high school), 4 (High school), 5 (*Some college/vocation or trade school*), 6 (*College graduate*), 7 (*Post-college but no additional degree*) to 8 (*Advanced degree*). Based on previous studies, we dichotomized the construct into 0 (*Less than a college degree*) and 1 (*College degree or more*) (Meng et al., 2019).

Participants also indicated how well each item described them: *moody, a person who worries, nervous, calm (*Neuroticism*; alpha* =.75*)* and *outgoing, friendly, lively, active*, and *talkative (*Extraversion*; alpha* =.81*)* on a 5-point Likert-type scale ranging from 1 (*not at all)*) to 5 (*a great deal)*. Scores were averaged separately for neuroticism and extraversion (Midlife in the United States Study; Lachman & Weaver, 1997). To assess depression, participants used the abbreviated 11-item CES-D scale (Kohout et al., 1993) and reported how often they felt each item in the past two weeks (e.g., "*I did not feel like eating, my appetite was poor*," "*I felt that everything I did was an effort*"). Scores based on a 4-point Likert-type scale (1 = Rarely or None of the Time to 4 = *most or all of the time;* $\alpha = .78$). Finally, we also adjusted for negative social network quality (variable described above) and the average number of daily stressful interactions.

Ecological Momentary Assessment Measures

Following the global interview, participants completed EMAs every three hours during the day for five to six days. Data collection occurred on at least three weekdays and two weekend days.

Daily emotional well-being (positive and negative affect). To assess daily positive affect, participants reported how much they felt *proud*, *content*, *loved,* and *calm* in the last three hours (α = .69). For daily negative affect, participants reported how much they felt *nervous/worried*, *irritated*, *bored*, and *sad* (α = .69). Questionnaires for both positive and negative affect were adapted from the questionnaire by Watson et al. (1988), and participants used a 5-point Likert-type scale ranging from 1 (*not at all)* to 5 (*a great deal*). Scores were averaged for each three-hour block, separately for positive and negative affect.

Daily Stressful interactions. Participants indicated whether they engaged in a conversation that *involved anything stressful or unpleasant* in the past three hours, coded as 0 (did not engage in a stressful interaction), or 1 (did engage in a stressful interaction).

Statistical Analyses

Multilevel models in SAS Proc Mixed were used to examine whether global loneliness and positive network quality influenced older adults' daily emotional well-being (positive and negative affect) when having experienced a stressful interaction. Using two separate multilevel models for each outcome (positive and negative affect), we first examined whether global loneliness moderated the associations between daily stressful interactions and daily emotional well-being. Then, we tested whether positive network quality reduced lonely and non-lonely older adults' negative experiences of daily stressful interactions, again, separately for each outcome variable (daily positive and negative affect).

$Daily\ Negative\ Affect_{ti}$ =

$\beta_{0i} + \beta 1(Global\ Lonelinessi) + \beta 2(Daily\ Stressful\ Interaction\text{ti}) +$

$\beta 3(Positive\ Social\ Network\text{i}) +$

$\beta 4(Global\ Loneliness\text{i})(Daily\ Stressful\ Interaction\text{ti}) +$

$\beta 5(Daily\ Stressful\ Interaction\text{ti})(Positive\ Social\ Network\text{i}) +$

$\beta 6(Global\ Loneliness\text{i})(Positive\ Social\ Network\text{i}) +$

$\beta 7(Global\ Loneliness\text{i})(Daily\ Stressful\ Interaction\text{ti})(Positive\ Social\ Network\text{i}) + u0\text{i} +$

e_{bi}

As shown in the simplified version of the three-way interaction above, β_0 represents the intercept of daily negative affect variable; β_1 represents differences in overall levels of negative affect by global loneliness; β_2 represents within-person trajectories of experiencing a stressful social interaction; β_3 indicates an association between positive network quality and overall levels of negative affect. We further included two-way interaction terms between global loneliness, daily stressful interactions, and positive network quality ($\beta_4 - \beta_6$) to examine how lonely and non-lonely older adults may differentially experience daily stressful interactions. Finally, β_7 tested our main hypothesis, the buffering role of positive network quality against daily stressors for lonely and non-lonely older adults. Each model was tested separately for each emotional well-being outcome (positive and negative affect). All models included the following covariates: age, gender, marital status, racial/ethnic background, work status, education, living status, size of the social network, number of medical conditions, personality traits (neuroticism and extraversion), depressive symptoms, negative social network quality, and the average number of daily stressful interactions.

Results

Descriptive Results

Consistent with other studies (including large datasets with national samples of participants; for review, see Ong et al., 2016), approximately 34% of the total sample reported feeling lonely. Lonely older adults reported higher levels daily negative affect ($t(127.52) = 5.90$, $p < 0.001$) and lower levels of daily positive affect ($t(308) = -5.08$, $p < 0.001$). Loneliness was not associated with total number of daily stressful interactions ($t(308) = 1.79$, $p = 0.08$), positive social network quality ($t(310) = -1.45$, $p = 0.15$), age ($t(311) = 0.10$, $p = 0.92$), and total size of social network ($t(311) = -1.21$, $p = 0.22$).

Many sociodemographic varied by global levels of loneliness. Lonely older adults reported higher levels of education ($t(311) = -2.22$, $p = 0.03$) and neuroticism ($t(311) = 5.74$, $p < 0.001$), greater number of chronic health conditions ($t(311) = 2.18$, $p = 0.03$), and more negative social network quality ($t(310) = 3.45$, $p = 0.001$), but lower levels of extraversion ($t(311) = -3.42$, $p = 0.001$). Further, lonely individuals were less likely to be married (X^2 (1) = 254.77, $p < 0.001$), female (X^2 (1) = 39.50, $p < 0.001$), report depression symptoms (X^2 (1) = 1419.77, $p < 0.001$), less likely to work (X^2 (1) = 4.20, $p = 0.04$), and more likely to be a minority (X^2 (1) = 53.31, $p < 0.001$) and live alone (X^2 (1) = 110.68, $p < 0.001$).

Global Loneliness, Positive Social Network Quality, and Daily Stressful Interactions

We first examined main effects in analyses where daily emotional well-being (negative and positive affect) was predicted by global loneliness, positive social network quality, daily stressful interactions in addition to the covariates in separate models (Tables 2.3 & 2.4; Model 1). Consistent with prior research (Hawkley et al., 2007; van Roekel et al., 2014), global loneliness was associated with greater daily negative affect and lower positive affect. Positive social network quality was related to greater daily positive affect, but not daily negative affect, and stressful social interactions were associated with greater negative and lower positive affect.

The Moderating Role of Positive Network Quality in the Relationship between Global Loneliness and Daily Stressful Interactions

Prior to testing our hypotheses regarding the buffering effects of positive experiences, we first examined whether loneliness shaped older adults' experiences of daily stressful interactions (see Tables 2.3 and 2.4; Model 2). Two-way interactions between global loneliness and daily stressful interactions were significant for daily negative affect, but not for daily positive affect and energy. Lonely older adults reported a greater increase in negative affect compared to non-lonely older adults when having experienced a stressful interaction, whereas lonely and non-lonely older adults showed a similar decrease in positive affect.

As hypothesized, three-way interactions between loneliness, positive social network, and daily stressful interactions were significant for daily negative and positive affect (Table 2.3, 2.4, Model 3; Figure 2.1, 2.2). First, positive network quality buffered against daily stressful interactions for lonely individuals' daily negative affect. Simple slope tests revealed that lonely individuals with a more positive network quality reported less increase in daily negative affect (B = 0.12, SE = 0.05, p = 0.01) compared to lonely individuals with a less positive network quality (B = 0.50, SE = 0.07, $p < 0.001$). In fact, lonely and non-lonely individuals with a more positive social network had patterns of negative affect reactivity when having experienced a social stressor that did not vary significantly from one another (Slope difference: B = -0.05, SE = 0.03, p = 0.14) (Table 2.3, Model 3; Figure 2.1).

Results for daily positive affect were consistent with findings for daily negative affect. Lonely individuals with a more positive network quality reported no change in positive affect when having experienced a stressful social interaction (B = 0.08, SE = 0.07, p = 0.28) whereas those with less positive network reported a significant decrease in daily positive affect (B = -

0.46, *SE* = 0.10, $p < 0.001$). Regardless of one's positive network quality, however, non-lonely older adults reported decreased levels of positive affect when having experienced a stressful interaction (less positive network: *B* = -0.10, *SE* = 0.03, *p* = 0.0002; more positive network: *B* = -0.08, *SE* = 0.03, *p* = 0.001). See Table 2.4, Model 3, and Figure 2.2 for the buffering effect of positive network quality against the adverse effects of daily stressful interactions for lonely adults' positive affect.

Discussion

The current study examined whether having a positive social network buffered against lonely and non-lonely older adults' daily experiences of stressful interactions. We found that daily stressful interactions were more harmful to lonely older adults' negative, but not positive, affect. In addition, results confirmed the hypothesized protective role of positive network quality on daily emotional well-being (positive and negative affect) when lonely older adults reported experiencing a stressful social interaction. This buffering effect of positive social networks was not present among non-lonely older adults. Together, the current findings suggest that the availability of a positive social network is particularly important for lonely older adults' daily emotional well-being.

Loneliness and Daily Stressful Interactions: Daily Emotional and Physical Well-being

Replicating previous finding, loneliness was related to a greater increase in negative affect when having experienced a stressful interaction (Cacioppo & Hawkley, 2009; Hong et al, under review). Our findings are consistent with the differential reactivity hypothesis, which states that loneliness is associated with increased stress reactivity to negative experiences (Cacioppo et al., 2000; Cacioppo et al., 2003; Cacioppo et al., 2006). In contrast, lonely and non-lonely older adults did not differ in their experiences of daily positive affect following stressful

interactions, which supports existing research that positive and negative affect are related, yet, independent components of emotional well-being (Diener & Emmons, 1984).

Is a Positive Social Network Protective against Daily Social Stressors for Lonely and Non-lonely Older Adults?

As anticipated, positive social network quality buffered against daily stressful interactions for lonely older adults' daily emotional well-being; this buffering effect was not present among non-lonely older adults. Importantly, the buffering effects of positive social networks varied for each dimension of lonely older adults' daily emotional well-being (negative and positive affect). A more positive network was related to a blunted increase in lonely older adults' daily negative affect. When considering daily positive affect, however, having a more positive social network allowed lonely older adults to maintain their levels of daily positive affect, indicated by no change in positive affect following a stressful interaction.

Our findings provide further support for the protective role that a positive social network quality plays for lonely older adults' well-being. The current results are in line with theories that view positive emotions as an important asset that can be utilized when overcoming and adapting to stressful experiences (Fredrickson, 2013). The broaden-and-build theory contends that positive emotions provide resources that allow people to better adapt to negative experiences (Fredrickson & Levenson, 1998). Further, the differential-stress-buffering hypothesis contends that loneliness is associated with worse health outcomes due to the perceived lack of supportive and positive social relationships (Cacioppo et al., 2003). Thus, having a positive network, influencing the availability of positive social emotions, may be a particularly important resource for lonely older adults to successfully navigate everyday social stressors.

Lonely individuals, characterized as those who constantly perceive that they lack social connections, who are able to identify positive aspects of their social network may be able to better navigate daily stressful experiences. For non-lonely older adults, however, positive social resources may be dispersed across many different aspects of their lives (e.g., current positive social network, positive memories about past relationships, the anticipation of creating more positive relationships in the future). Thus, a positive social network may not be the only social resource or an indispensable asset for non-lonely individuals as they navigate daily stressful interactions. This may explain the absence of buffering effect among non-lonely older adults.

Future Directions and Limitations

We recognize several limitations in the current study. First, the correlational nature of the current study does not allow us to conclude causal relationships between stressful interactions, positive social network quality, and daily emotional well-being. Thus, future research should also examine the bidirectional relationship between our main variables of interest and employ a longitudinal study design. Although older adults' experiences of social interactions and daily well-being were captured every three hours, more frequent assessments would provide a more comprehensive picture of the role of stressful interactions, positive network in older adults' experiences of daily well-being.

In sum, the current study identified positive social network quality as an important social resource that allows lonely older adults to better navigate stressful social environments. Our findings also highlight that positive social resources may function differently for each dimension of daily well-being outcomes. A more positive social network quality allowed lonely older adults experience *less* negative affect but helped them to *maintain* their levels of positive affect. In

contrast to common belief, lonely individuals may also be resilient in times of stress if given sufficient social resources.

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Table 2.1

Correlations Among All Variables of Interest

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Age	-															
2	Gender (ref=Female)	0.015	-														
3	Education	-0.072	.172**	-													
4	Marital Status (ref=Not married)	-.206**	.383**	.147**	-												
5	Chronic Conditions	.281**	-0.106	-.242**	-.170**	-											
6	Working (ref = Not Working)	-.124*	-0.007	0.032	0.038	0.014	-										
7	Network Size	-0.024	-.161**	0.079	-0.054	-0.042	0.109	-									
8	Living Alone (ref= Not alone)	.166**	-.183**	-0.007	-.629**	.160**	-0.035	0.026	-								
9	Minority (ref = Not Minority)	-.123*	-0.001	-.361**	0.007	0.077	-0.054	0.015	-.148**	-							
10	Neuroticism	-.125*	0.019	-0.085	.150**	.111*	-0.018	-0.085	-0.101	.143*	-						
11	Extraversion	-0.070	0.058	-0.001	0.028	-.123*	0.097	.333**	-0.051	0.065	-.161**	-					
12	Depression	0.012	-0.028	-.265**	-0.092	.239**	-0.068	-.135*	0.101	.249**	.462**	-.248**	-				
13	Positive Network Quality	-0.087	-0.069	0.064	-0.101	-0.098	-0.071	.226**	.119*	-0.051	-.138*	.149**	-.159**	-			
14	Negative Network Quality	-.133*	.124*	-.244**	.170**	0.091	-0.014	-0.002	-.123*	.338**	.246**	0.033	.371**	-.131*	-		
15	Avg. Numb Stress Int.	-0.109	-0.084	0.083	0.013	0.011	-0.033	0.065	-0.078	-0.060	.165**	0.005	.219**	-0.016	.145*	-	
16	Loneliness	0.007	-0.007	-.136*	-.155**	0.087	-0.012	-0.107	.171**	.135*	.311**	-.204**	.618**	-0.090	.200**	.167**	-

Note. ** Correlation is significant at the 0.01 level. * Correlation is significant at the 0.05 level (2-tailed).

Table 2.2

Descriptive Characteristics of Participants (N=313)

Characteristics	***Mean***	***SD***
Age	73.72	6.31
Number of Chronic Conditions	2.35	1.45
Neuroticism	2.43	0.68
Extraversion	3.68	0.82
Total Number of Social Network Members	20.41	10.37
Depression	16.46	4.7
Negative Social Network	1.66	0.55
Positive Social Network	3.62	0.63
Avg Number of Daily Stressful Interactions	3.73	3.56
	Proportion	
Global Loneliness (ref= Non-lonely)	34%	
Education (ref = less than college education)	86.30%	
Gender (ref= Male)	55.60%	
Work Status (ref= Not working)	11.90%	
Living Status (ref= Not living with others)	34.60%	
Marital Status (ref= Not married)	57.40%	
Minority (ref= Not minority)	29.10%	

Table 2.3

Multilevel Models Predicting Daily Negative Affect by Daily Stressful Interaction, Positive Social Network, and Loneliness

Variable	**Daily Negative Affect**		
	Model 1	*Model 2*	*Model 3*
Intercept	1.49 (0.11)**	1.76 (0.16)**	1.98 (0.18)**
Age	0 (0)	0.002 (0)	0.003 (0)
Gender (ref=male)	0.02 (0.03)	0.02 (0.03)	0.02 (0.03)
Education	0 (0.01)	-0.002 (0.01)	-0.002 (0.01)
Marital Status (ref=Not married)	-0.04 (0.04)	-0.04 (0.04)	-0.04 (0.04)
Minority (ref = Not Minority)	0.01 (0.03)	0.01 (0.03)	0.01 (0.03)
Work Status (ref = Not Working)	-0.04 (0.04)	-0.04 (0.04)	-0.04 (0.04)
Neuroticism	0.11 (0.02)**	0.11 (0.02)**	0.11 (0.02)**
Extraversion	-0.04 (0.02)*	-0.05 (0.02)*	-0.05 (0.02)*
Numb of Chronic Conditions	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
Depression (ref=Not depressed)	0.09 (0.03)*	0.1 (0.03)*	0.1 (0.03)*
Total Network Size	0 (0)	-0.001 (0)	-0.001 (0)
Living Alone (ref= Not living alone)	-0.05 (0.04)	-0.05 (0.04)	-0.05 (0.04)
Negative Social Network	0.04 (0.12)	0.03 (0.12)	0.02 (0.12)
Avg Number of Daily Stressful Interactions	0.38 (0.08)**	0.37 (0.08)**	0.36 (0.08)**
Positive Social Network Quality	0.002 (0.02)	-0.06 (0.04)	-0.12 (0.04)*
Daily Stressful Interaction (ref=No Stress Int)	0.19 (0.01)**	-0.32 (0.06)**	-0.61 (0.1)**
Loneliness (ref= Non-lonely)	0.12 (0.03)*	-0.47 (0.17)*	-0.8 (0.2)**
Pos Social Network*Daily Stress Int		0.01 (0.02)	0.1 (0.03)*
Pos Social Network* Lonely		0.07 (0.05)	0.16 (0.05)*
Daily Stress Int* Lonely		0.13 (0.02)**	0.55 (0.12)**
Pos Social Network*Daily Stress Int* Lonely			-0.12 (0.03)*

Note. $p<.05$, * $p<.001$**. Standard Errors are indicated by the parentheses.

Table 2.4

Multilevel Models Predicting Daily Negative Affect by Daily Stressful Interaction, Positive Social Network, and Loneliness

Variable	**Daily Positive Affect**		
	Model 1	*Model 2*	*Model 3*
Intercept	2.66 (0.29)**	2.5 (0.41)**	2.23 (0.43)**
Age	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
Gender (ref=male)	-0.05 (0.08)	-0.05 (0.08)	-0.05 (0.08)
Education	-0.02 (0.03)	-0.02 (0.03)	-0.02 (0.03)
Marital Status (ref=Not married)	0.16 (0.1)	0.16 (0.1)	0.16 (0.1)
Minority (ref = Not Minority)	0.03 (0.09)	0.03 (0.09)	0.03 (0.09)
Work Status (ref = Not Working)	-0.21 (0.11)	-0.21 (0.11)	-0.21 (0.11)
Neuroticism	-0.09 (0.06)	-0.09 (0.06)	-0.09 (0.06)
Extraversion	0.23 (0.05)**	0.23 (0.05)**	0.23 (0.05)**
Numb of Chronic Conditions	0.04 (0.03)	0.03 (0.03)	0.04 (0.03)
Depression (ref=Not depressed)	-0.14 (0.09)	-0.14 (0.09)	-0.14 (0.09)
Total Network Size	0.01 (0)	0.01 (0)	0.01 (0)
Living Alone (ref= Not living alone)	-0.12 (0.1)	-0.11 (0.1)	-0.11 (0.1)
Negative Social Network	-0.38 (0.31)	-0.38 (0.31)	-0.38 (0.31)
Avg Number of Daily Stressful Int	-0.36 (0.2)	-0.36 (0.2)	-0.35 (0.2)
Positive Social Network Quality	0.19 (0.06)*	0.23 (0.1)*	0.31 (0.11)*
Daily Stressful Interaction (ref= No Stress Int)	-0.11 (0.02)**	0.36 (0.09)**	0.73 (0.16)**
Loneliness (ref= Non-Lonely)	-0.14 (0.09)	0.13 (0.44)	0.54 (0.47)
Pos Social Network*Daily Stress Int		-0.06 (0.02)*	-0.16 (0.04)*
Pos Social Network* Lonely		0.02 (0.12)	-0.1 (0.13)
Daily Stress Int* Lonely		-0.05 (0.03)	-0.59 (0.19)*
Pos Social Network*Daily Stress Int* Lonely			0.15 (0.05)*

Note. $p<.05$, * $p<.001$**. Standard Errors are indicated by the parentheses.

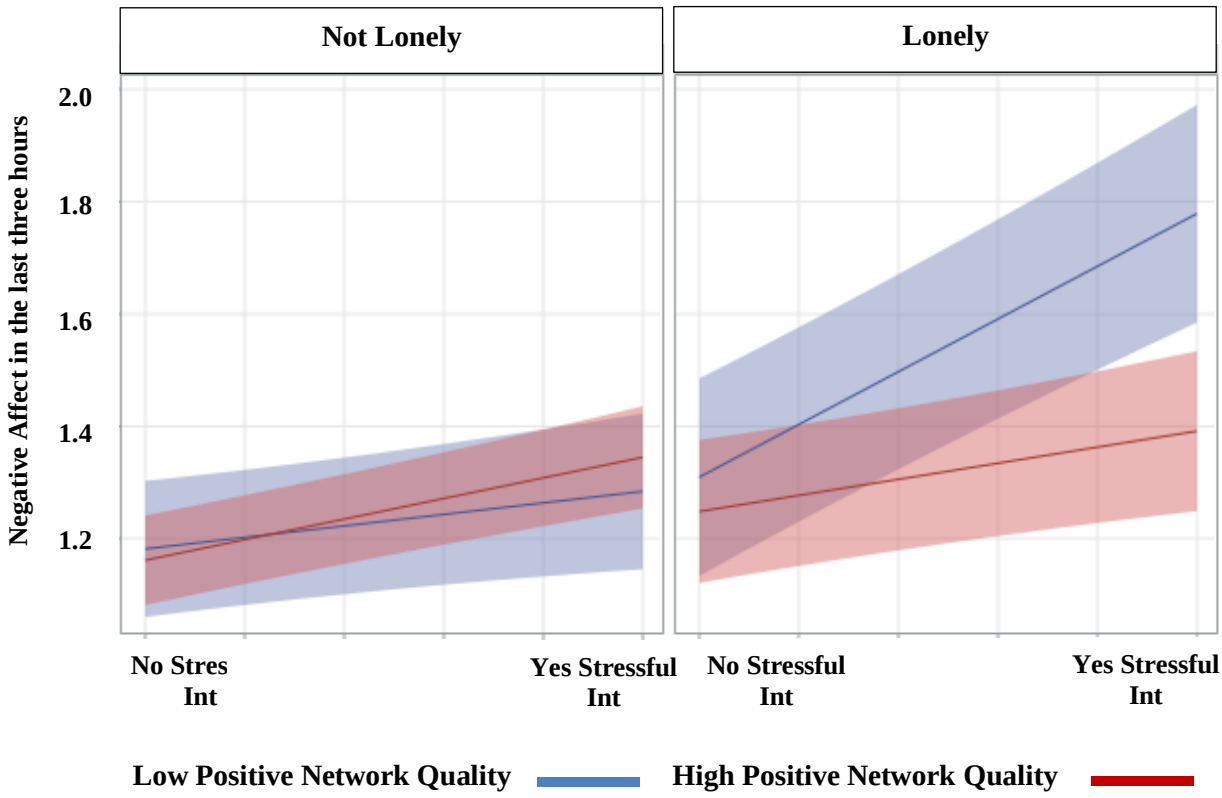

Figure 2.1. Multilevel Models Predicting Daily Negative Affect by Loneliness, Positive Social Network Quality and Daily Stressful Interaction.

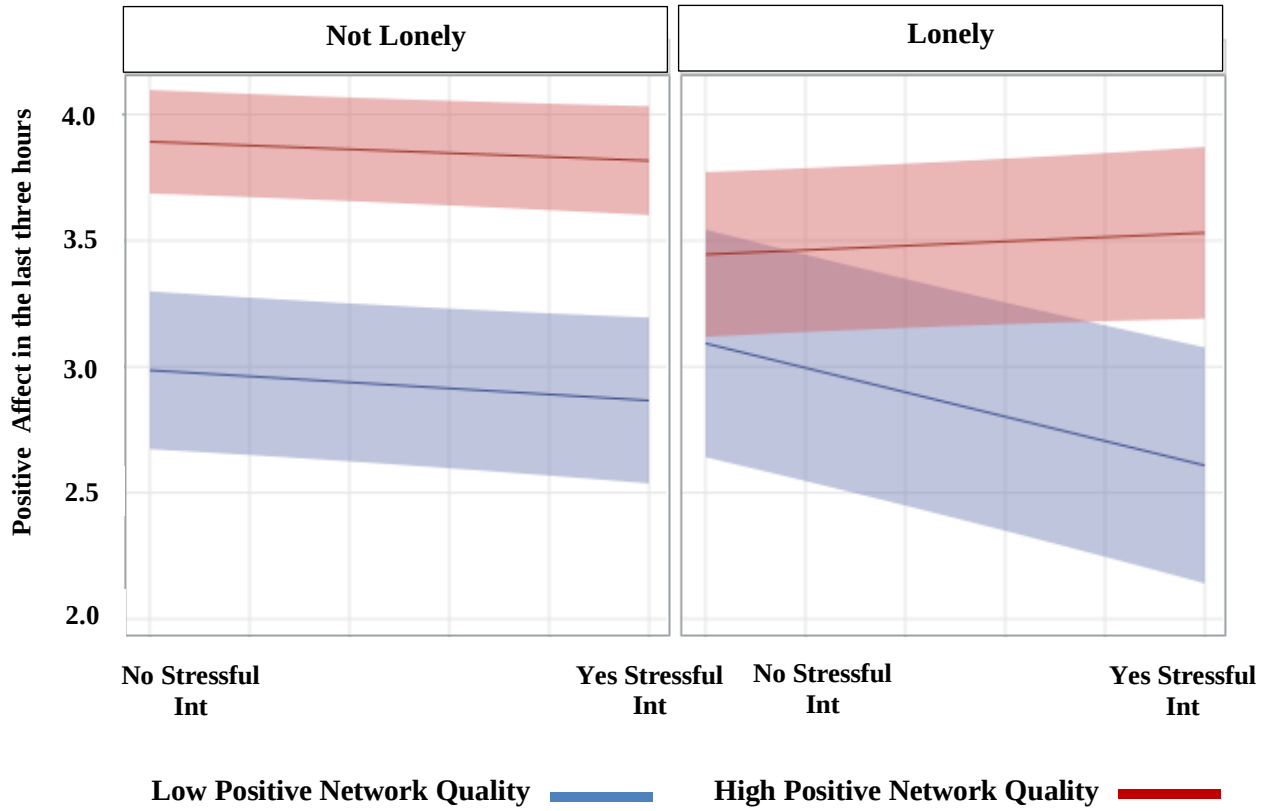

Figure 2.2. Multilevel Models Predicting Daily Positive Affect by Loneliness, Positive Social Network Quality and Daily Stressful Interaction.

CHAPTER 4:

Loneliness and Daily Stress*:* The Protective Role of Daily Positive Events

Abstract

Lonely individuals are particularly vulnerable to stressful daily experiences. A range of positive factors may mitigate these negative effects, especially positive events. Furthermore, positive events that are social in nature may be particularly beneficial in buffering the harmful effects of daily stressors for lonely individuals. The current study examined if experiencing a positive event (e.g., positive experience at work, positive interpersonal interactions) on the same day as a stressor helps lonely individuals maintain their daily emotional well-being and whether the effects vary depending on whether the positive event included social interaction. The current study combined data from the Midlife in the United States Survey (MIDUS II), and the National Study of Daily Experiences (NSDE II). Participants first completed a self-administered questionnaire that assessed their global levels of loneliness. A subset of the participants (N=2,022, M_{age}= 56.24) also completed approximately eight days of daily interviews and reported their *daily* experiences of stressful events, positive events (social and non-social), and emotional well-being (negative and positive affect). On days lonely individuals reported a stressor, experiencing a positive event reduced their experiences of daily negative affect. Furthermore, only daily *social* positive event (involving a positive interpersonal interaction) was protective against daily stressors, whereas non-social positive event did not show such an effect. This buffering effect of daily positive events was not observed among non-lonely individuals or for maintaining positive affect on stressor days. Findings suggest that daily positive social events are important for reducing lonely individuals' negative affect on days they experience a stressor.

Loneliness and Daily Stress: The Protective Role of Daily Positive Events

Lonely individuals often perceive a greater number of daily stressors and react more negatively to the stressors they encounter compared to non-lonely individuals (Doane & Thurston, 2014; Hawkley et al., 2003; Hawkley & Cacioppo, 2007; van Roekel et al., 2014; van Roekel et al., 2015). Although growing evidence suggests that daily positive events buffer against daily stressors, no research has examined whether these effects extend to people who are lonely, or whether the effects are similar among lonely and non-lonely individuals (Charles et al., 2010; Sin & Almeida, 2018). In addition, the buffering effects may vary depending on whether the positive events are social or non-social in nature. The current study examines the protective role of different types of daily positive events (social and non-social) for lonely individual's emotional well-being (negative and positive affect) on days they experience a stressor.

Loneliness and Daily Stressful Events

Global loneliness (a longer feeling of loneliness than state loneliness) is defined as the subjective perception that one lack social connections, and shapes how individuals perceive daily experiences (Perlman & Peplau, 1981; van Roekel et al., 2014). According to the differential reactivity theory, feeling lonely motivates people to improve or develop new relationships, which then makes them more sensitive and hypervigilant to their environments (Cacioppo & Hawkley, 2009; Cacioppo et al., 2003). Thus, lonely individuals are often characterized as being more reactive and vulnerable to stressful experiences than their non-lonely counterparts (Cacioppo & Hawkley, 2009). For example, lonely individuals report a greater increase in negative affect and decrease in positive affect when experiencing a stressor compared to non-lonely individuals (Hawkley et al., 2007; van Roekel et al., 2014). Similarly, loneliness is associated with increased memory of negative social exchanges (Cacioppo et al., 2006; Eronen & Nurmi, 1999; Jones et

al., 1981). Although some evidence indicates a weak association between loneliness and heightened sensitivity to stressors, a large number of studies have documented lonely individuals' increased susceptibility to the consequences of social stressors (Cacioppo et al., 2003; Wolf & Davis, 2014). In line with previous research, daily stressors may be particularly costly for lonely individuals' daily emotional well-being than for non-lonely individuals.

Loneliness and Daily Stressors: The Buffering Role of Daily Positive Events

Daily positive events are naturally occurring pleasant experiences, such as having a desirable event at work, and engaging in a pleasant social interaction, and may be one asset that offsets the harmful effects of daily stressful experiences (Sin et al., 2015; Sin et al., 2017; Zautra et al., 2005). A growing number of studies find a "buffering effect" of positive experiences, such that the adverse effects of negative experiences are mitigated by positive experiences (Finan et al., 2010; Zautra et al., 2005). For example, a greater experience of positive affect is associated with faster blood pressure recovery following a laboratory-based emotional stressor (Fredrickson & Levenson, 1998; Fredrickson et al., 2000; Tugade et al., 2004). Similarly, a daily diary study found that experiencing a higher than average level of positive emotion on a stressful day was associated with a blunted increase in daily negative affect (Leger et al., 2019).

No research to date has examined whether the mitigating influence of daily positive events occurs among lonely individuals, but findings from several studies provide support for such a hypothesis. One cross-sectional study found that positive life events reduce lonely individuals' likelihood of experiencing depression, hopelessness, and suicidal behaviors (Chang et al., 2015). Another study revealed that positive events weaken the associations between trait characteristics (e.g., attributional style) and negative well-being outcomes (Needles & Abramson, 1990). The evolutionary theory of loneliness posits that lonely individuals are more vigilant and easily

influenced by their environments than non-lonely individuals (Cacioppo et al., 2006). This allows lonely individuals to be more hypervigilant to stressors, which helps them avoid potential threats. The increased sensitivity, however, may also help lonely individuals to recognize, appreciate and value positive experiences more than non-lonely individuals (Longua et al., 2009; van Roekel et al., 2014; van Roekel et al., 2016; Wolf & Davis, 2014).

Indeed, studies showed that lonely individuals are more reactive and benefit more from positive experiences than non-lonely individuals. For example, one daily dairy study found that lonely individuals showed a greater increase in emotional well-being following a positive experience than their non-lonely peers (Russell, Bergeman, & Scott, 2012). A similar pattern was found among college students experiencing depression. Students reporting more depressive symptoms benefited more from positive events than those reporting fewer depressive symptoms (Nezlek & Allen, 2006). Researchers suggest that one reason why loneliness and depression may be associated with greater reactivity to positive events may be because these individuals anticipate a greater number of negative and fewer positive events such that when positive events do occur, they have a stronger impact (Nezlek & Allen, 2006; Russell, Bergeman, & Scott, 2012). Thus, daily positive events may be particularly important for lonely adults' daily emotional well-being as they experience daily stressors.

Positive daily social events. Positive daily experiences that involve pleasant social exchanges may have the greatest buffering effects for lonely individuals. The differential stress-buffering hypothesis posits that lonely individuals are characterized as being more sensitive and vulnerable to stressors because they lack the social resources and the support that may protect them against stressors (Cacioppo et al., 2003). Thus, when lonely individuals are able to identify and secure positive social resources, these assets might be particularly beneficial for their well-

being during stressful times. For instance, one experience sampling study found that compared to non-lonely adolescents, lonely adolescents experience a greater decrease in negative affect when engaging in positive social interactions (van Roekel et al., 2014). Similarly, a daily diary study indicates that global loneliness moderates the association between daily positive events and enjoyment. Lonely individuals report a greater increase in enjoyment on days they experience a positive interpersonal event than their non-lonely individuals (Wolf & Davis, 2014). Based on existing literature, we may expect a stronger buffering effect of daily positive social events against daily stressors for lonely individual's emotional well-being than for non-lonely individuals.

Together, we hypothesized that daily positive events would be particularly protective against daily stressors for lonely individuals given that they are more hypervigilant to their environments and less likely to anticipate positive events than their non-lonely counterparts (Cacioppo et al., 2006; Nezlek & Allen, 2006; Russell et al., 2012). Further, loneliness is associated with an exaggerated and often biased perception that one lacks social relationships but a stronger desire and need for social connection (Cacioppo et al., 2003). Thus, we expect that the buffering effect would be more pronounced for daily positive events that involve interpersonal interactions (vs. non-social positive events).

The Current Study

The present study first examined emotional well-being (daily negative and positive affect) on days people experienced a stressor compared to a no-stressor day for both lonely and non-lonely adults, as well as whether those who are lonely will vary in their stressor-related affect (loneliness x stressor interaction). Then, we examined the buffering effects of different types of daily positive events (social and non-social) on days lonely individuals reported a stressor (vs.

no-stressor day), and how these buffering effects varied between lonely and non-lonely adults. Daily diary interviews across approximately eight days assessed lonely and non-lonely individuals' daily experiences of stressors, positive events (social and non-social), and levels of negative and positive affect. We hypothesized that consistent with prior research (Hawkley et al., 2007; van Roekel et al., 2014, 2015, 2016), loneliness would be associated with lower levels of emotional well-being (i.e., higher negative affect and lower positive affect) on days people experienced a stressor. Further, we hypothesized that experiencing a daily positive event would buffer the effects of daily stressors and would be particularly protective for lonely individuals compared to their non-lonely counterparts. Finally, we predicted that daily social positive events (e.g., involving positive interpersonal interaction) would be more protective against daily stressors than non-social positive events.

Method

Participants and Procedure

Participants were a subset of participants from the second wave of the Midlife in the United States Survey (MIDUS II), a national sample of English-speaking, non-institutionalized U.S. adults. MIDUS II participants completed an initial telephone interview and a self-administered questionnaire, which included measures of sociodemographic information, physical health, and global loneliness. Of the MIDUS II participants, 2022 individuals completed the National Study of Daily Experiences (NSDEII). Across approximately eight days, participants reported their daily experiences of stressful and positive events, and emotions (i.e., positive and negative affect) (Almeida et al., 2009). Participants ranged in age from 33-84 (M_{age}= 56.24) and were predominantly White (84%), female (57%), with approximately 48% of individuals having a college degree. See Table 1 for a sample description. Data collection protocols for both studies

were approved by the Educational and Social/Behavioral Science and Health Sciences Institution Review Boards at the University of Wisconsin-Madison and the Pennsylvania State University.

Initial Interview Questions Measured in MIDUS II

Global loneliness. Participants indicated how much of the time during the *past 30 days* they felt lonely on a five-point scale (1= *all the time*, 2=*most of the time*, 3=*some of the time*, 4=*a little of the time*, and 5= *none of the time*). Using the same coding system as previous research, we created a binary variable of the single-item loneliness scale (Nersesian, 2017; Routasalo et al., 2006;), Participants who reported a score between 1 (*All the time*) through 4 (*A little of the time*) were categorized as "lonely" (1) on this one-item, whereas those reporting a score of 5 (*None of the time)* were categorized as "Non-lonely" (0) due to the severe skewness of the continuous variable.

Covariates. Participants reported their age, gender (0=*female*; 1= *male*), marital status (0=*not married*; 1= *married*), highest level of education (1 = *no school/some grade school*; 2= *eight grade/junior high school*; 3 = *some high school*; 4=*GED*; 5=*graduated from high school*; 6 = *1-2 years of college, no degree yet*; 7 = *3 or more years of college, no degree yet*; 8 = *graduated from 2-year college; 9=graduated form a 4- or 5-year college, or bachelor's degree; 10= some graduate school; 11=master's degree; 12=Ph.D., ED.D., MD, DDS, or other professional degree*), and number of chronic conditions, ranging from 0 to 5 or more. Participants also indicated their race/ethnicity (1 = *White*; 2= *Black and/or African American*; 3 = *Native American or Alaska Native Aleutian Islander*; 4=*Asian*; 5=*Native Hawaiian or Pacific Islander*; 6 = *Other),* which was recoded into a dichotomous variable due to more than 83% of individuals identifying as white (0= *Non-white*; 1= *White*). Personality traits including neuroticism (*moody, worrying, nervous,* and *calm*-reverse coded) and extraversion (*outgoing,*

friendly, lively, active, and *talkative*) were assessed by asking participants to rate the extent to which each of eight self-descriptive adjective described them on a five-point scale anchored from 1 (*all the time)* to 5 (*none of the time)*; Neuroticism *alpha* = .75, Extraversion *alpha* = .77 (Mroczek & Almeida, 2004).

For depression, participants first had to indicate that during the last 12 months, they had felt "*sad, blue, or depressed*" for two weeks or more in a row most or all of the time for every day. They then had to endorse experiencing four additional symptoms during that period, such as a change in appetite or feelings of worthlessness to be classified as currently or recently having depression (1) or not (0). (For a detailed description, see Kessler et al., 1998; Wang et al., 2000).

In addition, we also adjusted for the mean score of the total number of daily stressors and daily positive events experienced across the week to reflect the average levels of stressors and positive events. Similarly, trait negative affect (average score of how much of the time during the past 30 days participants felt *afraid*, *jittery*, *irritable*, *ashamed*, and *upset; alpha* = .82) was included as a covariate in the analyses that examined daily negative affect as an outcome variable. Likewise, trait positive affect (average score of how much of the time during the past 30 days participants felt *enthusiastic*, *attentive*, *proud*, and *active; alpha* = .87) was included as a covariate in models examining daily positive affect as an outcome.

Daily Diary Questions Measured in NSDE II

Approximately six months after the telephone interview and a self-administered questionnaire, participants reported their daily experiences, including the number of daily stressors, positive events, and emotional well-being (negative and positive affect) across eight consecutive days.

Daily emotional well-being: Negative and positive affect. Scales developed for the MIDUS II study assessed daily emotional experiences (Kessler et al. 2002; Mroczek & Kolarz, 1998). For negative affect, participants were asked how much of the time today they felt *nervous, worthless, hopeless, lonely, afraid, jittery, irritable, ashamed, upset, angry, frustrated, restless or fidgety, that everything was an effort,* and *so sad nothing could cheer you up*. For positive affect, participants reported how much of the time today they felt *good spirits, cheerful, extremely happy, calm, satisfied, full of life, close to others, like you belong, enthusiastic, attentive, proud, active,* and *confident.* Participants rated each emotional experience on a five-point scale (0= *none of the time*, 1=*a little of the time*, 2=*some of the time*, 3=*most of the time,* and 4= *all of the time*) and responses were averaged separately for each valence to produce a daily negative affect score (*alpha* = .84) and a daily positive affect score (*alpha* =.94). For the purpose of the current paper, we excluded participants' ratings of daily *loneliness* when calculating the mean score of daily negative affect.

Daily stressors. The Daily Inventory of Stressful Events was used to assess the occurrence of daily stressors (Almeida et al., 2002). Across the eight days, participants indicated whether they experienced any of the following stressors in the last 24 hours: (1) *argument or disagreement,* (2) *almost had an argument but decided to let it pass,* (3) *stressful event at work or school,* (4) *stressful event at home,* (5) *discrimination,* (6) *stressor that happened to a close friend or relative,* and (7) any other *stressful event*. A dichotomous variable was then created to capture the experience of at least one daily stressor (1 = *experienced a stressor today*) or no daily stressor (0 = *stressor-free day*).

Daily positive events. Participants indicated whether they had experienced the following positive events in the past 24 hours: (1) *positive interpersonal interaction*, (2) *positive experience*

at work, school, or at a volunteer position, (3) *positive experience at home*, (4) *positive event experienced by a close social partner*, and (5) *any other positive event*. Three dichotomous variables were created to capture the occurrence of: 1) any positive event (1= *occurrence of any positive event*, 0= *no positive event*); 2) positive interpersonal interaction (1= *occurrence of a positive event involving an interpersonal interaction*, 0= *occurrence of a positive event but indicated NO to experiencing a positive interpersonal positive event or no positive event*); and 3) positive non-interpersonal event (1= *occurrence of a positive event but indicated NO to experiencing a positive interpersonal positive event*, 0= *occurrence of a positive interpersonal event or no positive event*) (Charles et al., 2010; Sin et al., 2017; Sin et al., 2015).

Statistical Analyses

Separate multilevel models in SAS (Proc Mixed) were used to test whether loneliness moderated the associations between daily stressors, daily positive events, and daily emotional well-being (separately for negative and positive affect). We first tested our hypothesis for daily negative affect by examining whether interactions between daily stressors and daily positive events for daily negative affect varied by global loneliness. We further examined the buffering effect of the different types of daily positive events: 1) positive event involving interpersonal interaction, 2) positive event not involving interpersonal interaction. A 2-level model captured associations between daily negative events, daily positive events, and daily negative affect at level-1, which were nested within each participant at level-2. The same set of analyses were then conducted for daily positive affect. All models included the covariates described above and were included at level 2.

Results

Descriptive Results

Table 3.1 provides correlations among all variables of interest and Table 3.2 summarizes means and proportions of all variables by global levels of loneliness. Of the total sample, approximately 30% of participants reported feeling lonely at least a little of the time (N = 608) in the last 30 days, a percentage consistent with other large studies assessing loneliness (for review see Ong et al., 2016). Lonely individuals, compared to non-lonely, reported more daily stressors (t(1107.10) = 5.43, p < 0.001), and fewer total daily positive events (both social and non-social together: t(1750) = -2.71, p = 0.007), fewer daily positive social events (t(1750) = -3.55, p < 0.001), but more daily positive non-social events (t(1051) = 1.98, p = .05). On average, lonely individuals reported lower levels of daily positive affect (t(1077.54) = -11.71, p < 0.001) and higher levels of daily negative affect (t(814.61) = 9.77, p < 0.001).

Many sociodemographic characteristics also varied by overall levels of loneliness. Loneliness was associated with younger age (t(1750) = -3.07, p = 0.002), greater number of chronic health conditions (t(1138.35) = 8.14, p < 0.001), higher levels of neuroticism (t(1740) = 13.03, p < 0.001) and depression (t(770.88) = 8.52, p < 0.001), and lower levels of extraversion (t(1740) = -6.28, p < 0.001). Lonely individuals were also less likely to be married (X^2 (1) = 121.82, p < .001), and female (X^2 (1) = 30, p < .001). However, loneliness was not significantly associated with either educational level (t(1746) = -1.15, p = 0.25) or ethnicity (X^2 (1) = 0.40, p = .53).

Daily Negative Affect and the Role of Global Loneliness, Daily Stressful Interactions, Daily Positive Events

In the first model, we examined the main effects to see whether loneliness was related to higher levels of daily negative affect after daily stressor occurrence, daily positive events, and covariates were included in the model. Results indicated that only daily stressor occurrence

significantly predicted higher levels of daily negative affect (Table 3.3, Table 3.4; Model 1.1). We then examined the two-way interactions to test whether loneliness was related to greater affective reactivity to daily stressors or positive events. A significant interaction between loneliness and daily stressors indicated that lonely individuals reported higher levels of daily negative affect on days they experienced a stressor compared to non-lonely individuals. In contrast, no interactions between loneliness and positive interactions were significant (all types of positive events together, social, and non-social; Table 3.3 & 3.4, Model 2). Finally, we examined the hypotheses regarding whether daily positive events buffered the effects of daily stressors on daily negative affect. A significant three-way interaction revealed that on days lonely individuals reported a stressor, experiencing a positive event was associated with an attenuated increase in daily negative affect (simple slope difference test $F(1, 312) = 20.18$, $p < .001$). In contrast, non-lonely individuals showed a similar increase in negative affect on days they experienced a stressor regardless of whether they experienced a positive event or not (simple slope difference test $F(1, 312) = 0.59$, $p = 0.44$). (Table 3.3, Model 3, Figure 3.1).

We then examined the protective role of social versus non-social daily positive events for daily negative affect (Table 3.4). We examined the effects of *social* and *non-social* events separately. A significant three-way interaction between loneliness, daily stressors, and daily positive *social* events revealed that for lonely adults, experiencing a daily positive *social* event attenuated the increase in daily negative affect on days they experienced a stressor (simple slope difference test $F(1, 404) = 20.71$, $p < .001$). In contrast, no buffering effect was observed for non-lonely adults. When we place each of these three-way interactions together in a final model, the results held for positive social events while controlling for the effects of positive non-social events (simple slope difference test $F(1, 404) = 0.60$, $p = 0.44$). (Table 3.4, Model 3; Figure 3.2),

but the three-way interaction between loneliness, daily stressors, and *daily positive non-social events* was not significant (Table 3.4, Model 3; Figure 3.3).

Daily Positive Affect and the Role of Global Loneliness, Daily Stressful Interactions, Daily Positive Events

As we did for daily negative affect, we first examined the main effects of global loneliness, daily stressors, and daily positive events (both social and non-social together, only social, and only non-social) on daily positive affect. All main variables of interest except for non-social positive events were significantly associated with daily positive affect. Global loneliness and daily stressors were related to lower positive affect, and any positive event (social and non-social) and positive social events were related to higher levels of positive affect (Table 3.3 and Table 3.4: Model 1.2). Then, we examined whether loneliness was related to greater reactivity to both daily stressors and daily positive events (both social and non-social). Two-way interactions between global loneliness and all variables of interest were not significant for daily positive affect (daily stressors: b = -0.02, SE = 0.02, p = 0.28, all positive events: b = 0.03, SE = 0.02, p = 0.15, positive social event: b = 0.03, SE = 0.02, p = 0.10, and non-social positive events: b = 0.01, SE = 0.03, p = 0.83). Finally, the three-way interaction between global loneliness, daily stressors, and daily positive events (both social and non-social) was not significant (b = -0.06, SE = 0.04, p = 0.12). The three-way interactions between global loneliness and either daily positive social or non-social events revealed no significant results (positive social: b = -0.05, SE = 0.04, p = 0.11; positive non-social: b = -0.06, SE = 0.04, p = 0.39).

Discussion

Extensive research indicates that lonely older adults are particularly vulnerable to daily stressful experiences (Hawkley et al., 2003; Hawkley & Cacioppo, 2007; van Roekel et al.,

2014). The current study examined the extent to which lonely individuals' negative experiences of daily stressors can be mitigated by daily positive events. We first examined lonely and non-lonely individuals' daily emotional well-being (daily negative and positive affect) on days they experienced a stressor compared to a non-stressor day. Findings revealed that lonely adults showed a greater increase in negative affect on days they experienced a stressor compared to non-lonely individuals. Next, we examined whether daily positive events mitigated the harmful effects of daily stressors on lonely individuals' emotional well-being. Results indicated that daily positive events buffered the negative effects of daily stressful events on lonely individuals' negative affect, but not for non-lonely individuals. In particular, only daily positive *social* events (e.g., pleasant interpersonal interaction) were protective against the negative effects of stressful effects. Results identify daily positive social events as protective assets that might be important for reducing lonely individuals' negative affect on a stressful day.

Loneliness, Daily Stressors, Daily Positive Events, and Daily Negative Affect

Consistent with previous research, lonely individuals showed a greater increase in negative affect on days they reported experiencing a stressor compared to non-lonely individuals (Cacioppo & Hawkley, 2009; Cacioppo et al., 2003). Findings support differential reactivity theory, which contends that loneliness is associated with exaggerated reactivity to stressful experiences (Cacioppo & Hawkley, 2009; Cacioppo et al., 2003). In line with our hypothesis, daily positive events mitigated the adverse effects of daily stressors for lonely people's negative affect. Yet, this protective role of daily positive events was not observed among non-lonely individuals. The evolutionary theory of loneliness indicates that loneliness functions as a source of motivation for individuals to behave and think in ways that will enhance the quality of their social contexts (Cacioppo et al., 2006). Lonely individuals, therefore, may be more motivated

and incentivized than non-lonely individuals to both recognize positive experiences and benefit from them (van Roekel et al., 2014, van Roekel et al., 2016, Wolf & Davis, 2014). As a result, loneliness may be related to heightened reactivity to positive experiences, similar to their increased attentiveness to stressors. Our findings are consistent with those from an experience sampling study that found that lonely individuals reported a greater decline in negative affect and an increase in positive affect when engaging in a positive social interaction (van Roekel et al., 2016). In particular, we found that only *positive daily social events* were more protective against daily stressors for lonely individuals' negative affect. The differential stress-buffering hypothesis contends that lonely individuals are more vulnerable to stressors because they perceive a lack of positive social relationships (Cacioppo et al., 2003). Thus, when social needs are met, the presence of a positive social resource may have a stronger impact on lonely individuals' well-being than for non-lonely individuals. Importantly, findings remained even after adjusting for global levels of depression and negative affect, neuroticism, and the mean score of daily negative affect.

Loneliness, Daily Stressors, Daily Positive Events, and Daily Positive Affect

In contrast to our findings for daily negative affect, loneliness did not moderate the association between stressful events and daily positive affect. Further, daily positive events (both social and non-social together, only social, only non-social) showed no association with lonely or non-lonely older individuals' experiences of daily stressors. Both lonely and non-lonely individuals reported lower levels of positive affect on days they experienced a stressor, regardless of their experiences of positive events.

The two-factor theories of psychological well-being posit that positive and negative affect are distinct and independent constructs such that they are often predicted by different

factors (e.g., life events). Thus, daily stressors may be particularly important determinants of lonely individuals' daily negative affect but not positive affect (e.g., Diener, 1984; Lawton,1983; Zautra & Reich, 1983). Further, loneliness accompanies negative and self-defeating cognitive biases such as anxiety, frustration, insecurity, and anger. These maladaptive thoughts and emotions are further reinforced with prolonged experiences of loneliness (Hawkley et al., 2003; Hawkley et al., 2009). The strong association between loneliness and a range of negative emotions and cognitions, therefore, may explain why loneliness was only related to daily negative affect but not positive affect.

Health Implications

The results of the current findings have significant health implications. Increased reactivity to stressors (negative emotional reactivity) is associated with worse health behaviors (e.g., sleep) and well-being outcomes (Leger et al., 2018; Piazza et al., 2012). A daily diary using the same data as the current study, for example, found that greater emotional reactivity to daily stressors was related to increased risk of experiencing a chronic physical health condition ten years later. This may explain why loneliness is associated with increased risk of a range of emotional and physical health outcomes, including reduced sleep quality, Alzheimer's disease, stroke, morbidity, and premature mortality (Ong et al., 2018).

Further, loneliness is strongly related to a wide range of negative biases, including negative affect, depression, anxiety, and anger (Hawkley & Cacioppo, 2009). For example, loneliness is a stronger predictor of depression than physical illnesses or disability (Alpass & Neville, 2003). Further, these negative emotions and cognitions are independent risk factors for negative health outcomes. Thus, combined with the harmful effects of other irrational beliefs, loneliness is a particularly a harmful threat to both psychological and physical well-being. Not

surprisingly, loneliness also has high financial and economic costs. In 2017, annual Medicare costs of loneliness were estimated at $6.7 billion. Thus, identifying protective factors against the negative health consequences of loneliness will also reduce a significant amount of health care costs (Flowers et al., 2017).

Future Directions and Limitations

Our study had several limitations. First, although we used a daily diary study design, reports of stressors, positive events, and emotional well-being (negative and positive affect) were retrospective in nature, all asking people to reflect on the day's events. As a result, only the most important events and emotional experiences may have been reported, whereas more minor and mundane experiences may have been forgotten by the end of the day. Similarly, the current study lacks temporal specificity as experiences of positive and negative events and emotional experiences were reported at the same time (at the end of each day). A longer daily diary design may have provided a more comprehensive understanding of people's daily lives and well-being. Existing studies indicate that eight daily diary days sufficiently capture accurate intra-individual variability (Piazza et al., 2012), but nonetheless, future research should take additional measurements throughout the day and utilize a more extended daily diary design.

Further, global loneliness was assessed with a single-item questionnaire. A recent study by AARP among adults 45 and older, however, revealed a high association between a single-item questionnaire of loneliness and the well-validated and widely accepted UCLA Loneliness scale ($r=.735$, $p <.001$; AARP, 2010). Although the use of a one-item questionnaire is common across many population-based and large-scale studies, a more comprehensive assessment tool should be used to increase both the sensitivity and accuracy of the construct measurement (Nersesian, 2017; Routasalo et al., 2006).

Conclusion

An extensive literature indicates lonely individuals' increased susceptibility to the adverse effects of stressors and has established a number of factors to account for reasons why loneliness is associated with an array of negative mental and physical health outcomes. Identifying potential protective resources is, therefore, vital to this vulnerable group of individuals. Results suggest that *daily positive social interactions* help lonely individuals maintain their emotional well-being on stressful days. Findings may suggest an important target for interventions and policies aimed at increasing lonely individuals' daily well-being.

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Table 3.1

Correlations Among All Variables of Interest

		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Age	-												
2	Gender (ref=Male)	-0.022	-											
3	Education	-.128**	-.102**	-										
4	married (ref=Not Married)	-.071**	-.137**	.050*	-									
5	Race (ref = Not White)	0.034	0.002	0.039	.076**	-								
6	Neuroticism	-.220**	.120**	-.087**	-.057*	0.003	-							
7	Extraversion	.062**	.083**	-0.033	-0.008	-.073**	-.242**	-						
8	Depression	-.130**	.107**	-0.043	-.105**	0.021	.281**	-.117**	-					
9	Avg. Numb Daily Stress	-.229**	.092**	.202**	0.018	0.032	.167**	-0.032	.150**	-				
10	Avg. Numb Daily Pos Events	-0.004	.081**	.250**	0.019	0.021	-.073**	.171**	-.063**	.431**	-			
11	Avg. Numb Daily Pos Social	.064**	.080**	.198**	-0.009	.051*	-.085**	.132**	-.068**	.260**	.771**	-		
12	Avg. Numb Daily Pos Non-Social	0.004	-.076**	-0.011	0.013	0.014	-0.018	-0.012	-0.004	-0.001	0.006	-.312**	-	
13	Loneliness	-.079**	.149**	-.067**	-.291**	-0.027	.354**	-.159**	.346**	.173**	-.058*	-.077**	0.039	-

Note. ** Correlation is significant at the 0.01 level. * Correlation is significant at the 0.05 level (2-tailed).

Table 3.2

Descriptive Characteristics of Participants by Levels of Loneliness (N=2002)

Characteristics	**Non-Lonely (*N*= 1144)**	**Lonely (*N*= 608)**
Age	57.25 (12.07)	55.38 (12.26)
Education	7.45 (2.50)	7.30 (2.48)
Number of Chronic Conditions	1.91 (1.63)	2.62 (1.80)
Neuroticism	1.90 (0.58)	2.28 (0.63)
Extraversion	3.19 (0.55)	3.01 (0.59)
Depression (ref=Not depressed)	4.80%	19.70%
Female	51.80%	65.50%
Marital Status (ref=Not married)	80.80%	56.00%
Caucasian (ref= Not Caucasian)	93.10%	92.20%
Daily Stressful Event, % of days	37% (26%)	46% (27%)
Daily Positive Event, % of days	72% (27%)	70% (27%)
Daily Positive Social Event, % of days	64% (28%)	60% (28%)
Daily Positive Non-Social Event, % of days	8% (12%)	10% (14%)
Daily Interviews Completed	7.51 (1.07)	7.32 (1.37)

Table 3.3

Multilevel Models Predicting Daily Negative and Positive Affect by Daily Stressor, Daily Positive Event, and Loneliness

Variable	**Daily Negative Affect**			**Daily Positive Affect**
	Model 1.1	*Model 2*	*Model 3*	*Model 1.2*
Intercept	0.3 (0.02)**	0.32 (0.02)**	0.31 (0.02)**	2.46 (0.07)**
Age	0.001 (0)	0 (0)	0.001 (0)	0.002 (0.001)
Gender (ref=male)	0 (0.01)	0 (0.01)	-0.004 (0.009)	0.06 (0.03)*
Education	-0.003 (0.002)	0 (0)*	-0.004 (0.002)	-0.02 (0.01)*
Marital Status (ref=Not married)	-0.02 (0.01)*	-0.02 (0.01)*	-0.02 (0.01)*	0.02 (0.03)
Number of Chronic Conditions	0.002 (0.003)	0 (0)	0.002 (0.003)	-0.02 (0.01)*
Race (ref = Not White)	0.01 (0.02)	0.01 (0.02)	0.01 (0.02)	0.06 (0.05)
Neuroticism	0.02 (0.01)*	0.02 (0.01)*	0.02 (0.01)*	-0.11 (0.03)**
Extraversion	-0.004 (0.01)	0 (0.01)	-0.004 (0.01)	0.14 (0.03)**
Depression (ref=Not depressed)	0.09 (0.02)**	0.08 (0.02)**	0.08 (0.02)**	-0.08 (0.05)
Avg Number of Daily Stressors	0.15 (0.01)**	0.15 (0.01)**	0.15 (0.01)**	-0.3 (0.03)**
Avg Number of Daily Pos Events	-0.03 (0.01)*	-0.03 (0.01)*	-0.03 (0.01)*	0.1 (0.02)**
Trait Negative Affect	0.13 (0.01)**	0.13 (0.01)**	0.13 (0.01)**	-0.03 (0.04)
Trait Positive Affect	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	0.33 (0.02)
Daily Stress (ref=No Stress)	0.17 (0)**	-0.2 (0.01)**	-0.19 (0.01)**	-0.14 (0.01)**
Daily Pos Event (ref=No Pos Event)	0.001 (0.01)	0.02 (0.01)*	0.05 (0.01)*	0.08 (0.01)**
Global Loneliness (ref= Non-lonely)	-0.001 (0.01)	-0.03 (0.01)*	-0.02 (0.01)*	-0.07 (0.03)*
Daily Stress*Daily Pos Event		-0.03 (0.01)*	-0.07 (0.02)**	
Daily Stress*Lonely		0.06 (0.01)**	0.05 (0.01)**	
Daily Pos Event*Lonely		-0.01 (0.01)	-0.04 (0.02)*	
Daily Stress*Daily Pos Event*Lonely			0.06 (0.02)*	

Note. $p<.05$, * $p<.001$**. Standard Errors are indicated by the parentheses.

Table 3.4

Multilevel Models Predicting Daily Negative and Positive Affect by Daily Stressor, Daily Positive Social Event, and Loneliness

Variable	**Daily Negative Affect**			**Daily Positive Affect**
	Model 1.1	*Model 2*	*Model 3*	*Model 1.2*
Intercept	0.31 (0.02)**	0.31 (0.03)**	0.29 (0.03)**	2.49 (0.07)**
Age	0.001 (0)	0.001 (0)	0 (0)	0.002 (0.001)
Gender (ref=male)	-0.004 (0.01)	-0.004 (0.01)	0 (0.01)	0.06 (0.03)*
Education	-0.003 (0.002)	-0.003 (0)	0 (0)	-0.02 (0.01)*
Marital Status (ref=Not married)	-0.02 (0.01)*	-0.02 (0.01)*	-0.02 (0.01)*	0.02 (0.03)
Number of Chronic Conditions	0.002 (0.003)	0.002 (0)	0 (0)	-0.02 (0.01)*
Race (ref = Not White)	0.01 (0.02)	0.01 (0.02)	0.01 (0.02)	0.06 (0.05)
Neuroticism	0.02 (0.01)*	0.02 (0.01)*	0.02 (0.01)*	-0.11 (0.03)**
Extraversion	-0.004 (0.01)	-0.004 (0.01)	0 (0.01)	0.14 (0.03)**
Depression (ref=Not depressed)	0.09 (0.02)**	0.08 (0.02)**	0.08 (0.02)**	-0.08 (0.05)
Avg Number of Daily Stressors	0.15 (0.01)**	0.15 (0.01)**	0.15 (0.01)**	-0.3 (0.03)**
Avg Number of Daily Positive Events	-0.03 (0.01)*	-0.03 (0.01)*	-0.03 (0.01)*	0.09 (0.02)**
Trait Negative Affect	0.13 (0.01)**	0.13 (0.01)**	0.13 (0.01)**	-0.03 (0.04)
Trait Positive Affect	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	0.33 (0.02)
Daily Stress (ref=No Stress)	0.17 (0)**	-0.17 (0.02)**	-0.13 (0.03)**	-0.14 (0.01)**
Daily Pos Soc Event (ref=No Pos Soc)	-0.001 (0.005)	0.03 (0.01)*	0.05 (0.01)**	0.09 (0.01)**
Daily Pos Non-soc Event (ref=No Pos Non-soc)	0.01 (0.01)	0.002 (0.02)	0.02 (0.02)	0.02 (0.01)
Global Loneliness (ref= Non-lonely)	-0.001 (0.01)	-0.04 (0.02)*	0 (0.03)	-0.07 (0.03)*
Daily Stress*Daily Pos Soc Event		-0.03 (0.01)*	-0.07 (0.02)**	
Daily Stress*Daily Non-soc Event		-0.03 (0.02)	-0.06 (0.03)*	
Daily Pos Soc Event* Lonely		-0.01 (0.01)	-0.05 (0.02)*	
Daily Non-soc Event* Lonely		0.01 (0.02)	-0.02 (0.03)	
Daily Stress* Lonely		0.06 (0.01)**	-0.01 (0.03)	
Daily Stress*Daily Non-soc*Lonely			0.05 (0.03)	
Daily Stress*Daily Soc*Lonely			0.06 (0.02)*	

Note. $p<.05$, * $p<.001$**. Standard Errors are indicated by the parentheses.

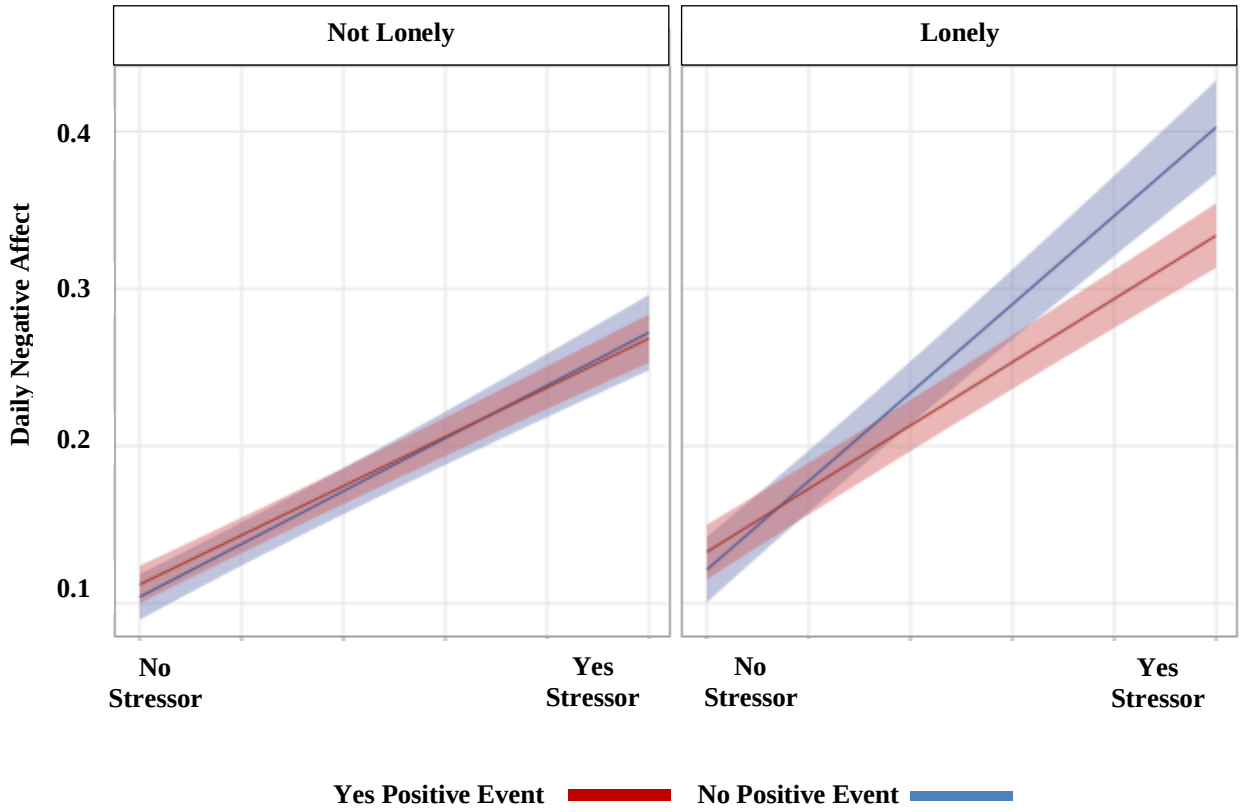

Figure 3.1. Multilevel Models Predicting Daily Negative Affect by Loneliness, Daily Stressor and Daily Positive Event (Social and Non-social Positive Event)

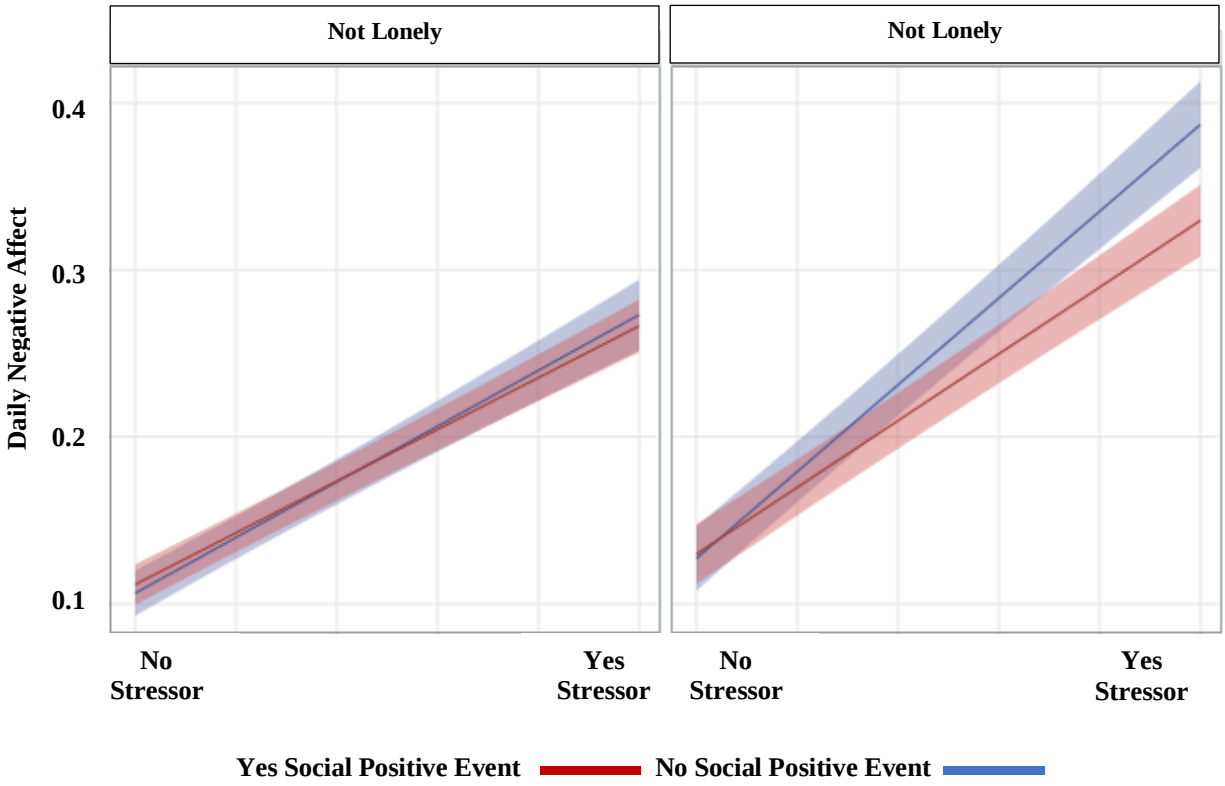

Figure 3.2. Multilevel Models Predicting Daily Negative Affect by Loneliness, Daily Stressor and Daily Positive Social Event

Epilogue

A mounting body of research suggests that loneliness is related to a wide range of detrimental health outcomes, including premature mortality, cognitive declines, inability to carry out basic activities of living, and depression (for reviews, see Hawkley & Cacioppo, 2010; Ong et al., 2016). The adverse effects of loneliness are far-reaching and so pervasive that we see their effects in our *daily* well-being (Chui et al., 2014; Hawkley & Cacioppo, 2007). Indeed, loneliness makes it particularly challenging for individuals to navigate stressful experiences. Even minor everyday stressors are particularly costly for lonely individuals' daily well-being (Hawkley & Cacioppo, 2007). Although concerted efforts by researchers have established important associations between loneliness and increased susceptibility to daily stressors, less is known about the protective factors that could help lonely individuals build resilience to navigate daily stressful experiences better. This dissertation addressed important gaps in the literature by identifying factors that may be protective for lonely individuals' daily well-being against everyday experiences of stressors.

The first study employed an ecological momentary assessment (EMA) design to examine how loneliness and daily social contexts may be related to both emotional (positive and negative affect) and physical well-being (energy and tiredness). Results showed that loneliness and daily social contexts are related to both emotional and physical well-being. For lonely older adults, being with others (vs. being alone) was a pleasant but also a costly emotional experience (increased positive affect and energy, and increased negative affect), whereas being with others was solely a positive experience for non-lonely older adults (higher positive affect and energy). Consistent with previous research, lonely older adults were more susceptible to the negative effects of stressful interactions than non-lonely older adults (Hawkley & Cacioppo, 2007). In

fact, stressful interaction was related to less tiredness for non-lonely older adults. Such findings revealed even a bigger discrepancy between how lonely and non-lonely individuals perceive daily stressors than what has been previously known. Findings from the first study showed the important role of loneliness in determining how individuals experience daily stressors and established a strong rationale for the need to identify protective factors that may mitigate the adverse effects of daily stressors.

Based on findings from the first study, the second study examined whether positive social network quality may be protective against daily stressors for lonely and non-lonely older adults' emotional well-being. Results revealed that a more positive social network quality buffered against daily stressor only for lonely older adults' emotional well-being (positive and negative affect), but not for non-lonely individuals. This study identified a structural social resource that may be particularly helpful for lonely older adults as they navigate daily social stressors.

The last study of this dissertation examined daily positive events as a protective asset against daily stressors for lonely and non-lonely individuals. Using a daily diary study design, a wider age range was examined to ensure the generalizability of the findings across middle age and into older adulthood. Consistent with findings from the second study, results revealed a protective role of a daily positive event against daily stressors. Experiencing a positive event on a stressor day helped individuals feel less negative affect, and this buffering effect was more evident among lonely individuals. Notably, only daily positive events involving a pleasant social interaction (involving a social component) showed a protective effect.

Together, results from the three studies indicate that protective factors such as positive social networks and positive events are important sources of resilience against daily stressors for lonely individuals. Importantly, results showed that *social* resources may be the most critical

source of resilience against daily stressors, especially for lonely individuals. Positive social network quality was protective for lonely individuals, but not for non-lonely, and daily positive events were more protective for lonely individuals than for those non-lonely. Based on current findings, future work should further examine the specific aspects of positive social resources that may be most protective for lonely individuals. For instance, research indicates that social relationships are beneficial when individuals are involved in both "providing" and "receiving" support (Rook, 1987). Thus, reciprocity in one's social resources can be a specific target of intervention if identified to confer the most benefits against daily stressors for lonely individuals (e.g., a positive social network that allows for both the provision and receipt of support and positive social event that involves reciprocity).

A major strength of this dissertation is the use of both ecological momentary assessment and daily diary study designs. As participants of the study reported their daily experiences and emotional well-being at hourly (every 3-hours) and daily intervals, we were able to more accurately capture their experiences in closer time proximity. Thus, compared to cross-sectional study designs, these methods are less susceptible to self-report or memory biases and allow for higher data integrity. Given lonely individuals' tendency to perceive and remember their experiences as more negative than non-lonely individuals (stronger negativity bias compared to non-lonely individuals), these rigorous methodologies may be especially important for our goal of better understanding lonely individuals' daily experiences and well-being. Further, lonely individuals' everyday vulnerabilities and needs are specific to particular contexts and environments. Thus, EMA and daily diary study designs allow us to examine participants' emotional and physical well-being across a variety of daily situations.

The purpose of this dissertation is to contribute innovative and robust knowledge to the growing field of loneliness, daily stressors, and well-being. Equally important goal, however, is to initiate and advance our conversations about expanding our focus to identify protective assets for lonely individual's daily well-being, which in turn, shape long-term health. So far, much of research on loneliness and well-being has focused on identifying potential risk factors and vulnerabilities of loneliness, which has significantly enriched our understanding of loneliness. Alongside this important research, however, identifying factors that foster resilience among lonely individuals may bring about even greater success in reducing lonely individuals' susceptibilities to their everyday environment. This dissertation revealed that, when equipped with sufficient social resources, lonely individuals' daily vulnerabilities could be reduced or even removed completely.

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