PROSOCIAL BEHAVIOUR AS AN ANTIDOTE TO SOCIAL DISCONNECTION: 
EXPLORING THE LINKS BETWEEN PROSOCIAL BEHAVIOUR, LONELINESS, 
AND SOCIAL CONTACT IN DAILY LIFE 

by 

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Abstract

Engaging in prosocial behaviour—voluntary acts to benefit others—may be effective for restoring individuals’ social connections with others. In three studies, I investigated the links between daily loneliness, social contact, and prosocial behaviour. Study 1 examined daily associations between loneliness and prosocial engagement using daily life assessments of 100 middle-aged and older adults in the community. Adults high in chronic loneliness, but not those low in chronic loneliness, exhibited decreased prosocial behaviours on days during which they reported elevated transient loneliness. The findings suggest that chronic loneliness may elicit maladaptive responses to transient loneliness by reducing prosocial engagement. Building on these findings, Studies 2 and 3 investigated whether an intervention designed to increase daily prosocial behaviour would reduce the subjective experience of loneliness and increase the objective number of social contacts among university students (Study 2) and lonely adults in the community (Study 3). In Study 2 (N = 407), the kindness intervention—compared to an active control intervention—increased daily social contact, especially with close others, and reduced daily loneliness for participants who reported high baseline loneliness. In Study 3 (N = 208), participants who completed a modified version of the same kindness intervention showed sustained daily social contact after the intervention, whereas participants who completed an active control intervention showed decreased daily social contact after the intervention. The kindness intervention also reduced daily feelings of loneliness, though not significantly more than the active control intervention. This dissertation contributes to the growing literature on the benefits of prosocial behavior by providing preliminary evidence that it may help to address social disconnection. However, further work will be needed to refine the intervention and confirm the effects documented in these initial studies.
Lay Summary

Prosocial behaviour (any voluntary act aimed at benefitting others) is a common way for people to connect with one another. This dissertation investigates its role in restoring individuals’ social connections. Study 1 indicates that middle-aged and older adults who experience loneliness over an extended period tend to engage less in prosocial actions on days when they feel particularly lonely. These findings highlight the importance of interventions that encourage lonely individuals to engage in opportunities to reconnect. Study 2 suggests that an intervention designed to promote daily acts of kindness reduces daily loneliness and increases the number of daily social interactions among university students. Study 3 further examines the effects of a modified version of the acts of kindness intervention among lonely adults in the community. Taken together, these studies suggest that interventions promoting prosocial behaviour may provide a promising route to address our experiences of loneliness and social isolation.
Preface

This dissertation is based on three different datasets, and all research presented in this dissertation was approved by the UBC Behavioral Research Ethics Board, UBC BREB Number: H12-03117 (Study 1) and H19-02413 (Studies 2 and 3).

Study 1 (Chapter 2) used data from the Health and Intergenerational Activities Research Project (HARP), in collaboration with the Health and Adult Development Lab (PI: Dr. Christiane A. Hoppmann). A version of Chapter 2 has been published as follows: Archer Lee, Y., Lay, J. C., Pauly, T., Graf, P., & Hoppmann, C. A. (2022). The differential roles of chronic and transient loneliness in daily prosocial behavior. Psychology and Aging, 37(5), 614–625. With guidance from Dr. Hoppmann, I served as the primary author of this work, identifying research questions, conducting data analyses, and drafting the manuscript. Dr. Hoppmann supervised the procedure, contributed to the research design and data interpretation, and edited the manuscript. The co-authors, Dr. Jennifer Lay, Dr. Theresa Pauly, and Dr. Peter Graf, were involved in data collection, assisted with data interpretation, and provided feedback for manuscript revisions. Drs. Jennifer Lay, Peter Graf and Christiane Hoppmann were responsible for study conception of the HARP Project.

Study 2 (Chapter 3) used data that I collected from September 2019 to April 2020 (PI: Dr. Frances S. Chen). A version of Chapter 3 is currently under review for publication: Archer Lee, Y., Guo, Y. C., Li, G., & Chen, F. S. (submitted). Prosocial behavior as an antidote to social disconnection: The effects of an acts of kindness intervention on daily social contact and loneliness. With guidance from Dr. Chen, I am the primary author of this work: identifying and formulating research questions, supervising data collection, conducting data analyses, and drafting the manuscript. Dr. Chen supervised the procedure and contributed to the research
design, data interpretation, and manuscript editing. The co-authors, Yingchi Guo and Dr. Gu Li, contributed to data collection, assisted with data analysis and interpretation, and provided feedback for manuscript revisions.

Study 3 (Chapter 4) used data that I collected from July 2022 to April 2023 (PI: Dr. Frances S. Chen). With guidance from Dr. Chen, I am the primary author of this work: identifying and formulating research questions, supervising data collection, conducting data analyses, and drafting the manuscript. Dr. Chen supervised the procedure and contributed to the design of the research, data interpretation, and manuscript editing. The co-authors, Dr. Gu Li and Julia Nakamura, contributed to revising study materials and the study design.
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List of Abbreviations

95% CI  95% Confidence Interval
AAK  Anonymous acts of kindness
AK  Acts of kindness
ANOVA  Analysis of variance
b  Unstandardized regression coefficient
ICC  Intraclass correlation coefficient
M  Mean
MLM  Multilevel modeling
N  Sample size of a total population
n  Sample size of a subset of the population
p  p-value
SD  Standard deviation
SE  Standard error
t  t score
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Chapter 1: Introduction

1.1 The Need for Evidence-Based Interventions for Loneliness and Social Isolation

Researchers and major health authorities have increasingly recognized social disconnection as a public health concern that has broad implications for people’s mental and physical health (J. T. Cacioppo & Cacioppo, 2018; Department for Digital Culture Media and Sport, 2018; Holt-Lunstad, 2017; Holt-Lunstad et al., 2017; World Health Organization, 2021). Social disconnection can include both loneliness and social isolation, which are related yet distinct constructs. Whereas social isolation refers to the objective state of lack of social contact with others, loneliness describes a distressing emotional experience arising from a perceived discrepancy between one’s desired and actual social connection (Perlman & Peplau, 1981). In other words, people can feel lonely in a crowd, and they do not necessarily feel lonely being alone.

Extensive evidence has documented that both loneliness and social isolation are robust risk factors for all-cause mortality and a wide range of physical and mental health issues (for review: J. T. Cacioppo & Cacioppo, 2014; Holt-Lunstad et al., 2010; Ong et al., 2016). Loneliness, in particular, is viewed as a transdiagnostic clinical phenomenon that has a significant impact on a constellation of mental health outcomes (Heinrich & Gullone, 2006; Käll et al., 2020), including depression (J. T. Cacioppo et al., 2010; Jaremka et al., 2014), anxiety (Matthews et al., 2019), suicidal ideation and behavior (Stickley & Koyanagi, 2016), sleep disturbance (Hom et al., 2020) and substance use (Åkerlind & Hörnquist, 1992). In longitudinal studies, loneliness predicts subsequent increases in depressive symptoms (J. T. Cacioppo et al., 2010; Jaremka et al., 2014), and intervening to reduce loneliness by one standard deviation results in a reduction of 0.33 standard deviation in depressive symptoms assessed 1 or 2 years later (VanderWeele. et al.,
These findings suggest that interventions to alleviate loneliness can be effective in treating and preventing depressive symptoms, as well as potentially addressing other associated mental health issues.

However, there remains a lack of effective and accessible interventions to mitigate loneliness and social isolation (Dickens et al., 2011; Gardiner et al., 2018; Masi et al., 2011). Notably, there is a pressing need for brief and low-cost interventions that overcome both systemic barriers (such as costs) and internal barriers (such as unwillingness to seek professional help due to stigma about loneliness) preventing young people from accessing necessary mental health care (Schleider et al., 2020). Given the large gap in evidence on effective interventions, public and community sectors often deliver loneliness intervention programs in communities without adequate empirical evidence of their likely effectiveness (Fried et al., 2020). Another gap remains in theoretical frameworks for interventions (Fried et al., 2020). What are the drivers and underlying mechanisms that create and perpetuate loneliness and isolation? Effective interventions should successfully address the mechanisms underlying the individual’s experience of loneliness and social isolation.

1.2 Social Functions of Loneliness

There are two predominant theories about the functions of loneliness that initially may appear to conflict with each other. First, it has been suggested that loneliness can be adaptive, motivating one to seek connection with others. According to some evolutionary theories, the feeling of loneliness serves as an aversive, yet adaptive, signal alerting a person to attend to, repair, or replace damaged social connections that are essential for cooperation and mutual protection for survival (J. T. Cacioppo et al., 2014). In a similar vein, loneliness has been
described as a “social hunger” that heightens social monitoring, increasing sensitivity to social
cues and opportunities for social reconnection and inclusion (Gardner et al., 2005). In line with
this idea, social reconnection theory suggests that when a person’s need for social connection is
not satisfied (such as after an experience of social exclusion), they seek to reconnect with others,
even strangers, by expressing and acting upon greater interest in making new friends, working
with others, or doing nice things for new interaction partners, in order to restore their sense of
connection (Maner et al., 2007).

However, a second theory and body of research points to mechanisms through which
loneliness is linked to social withdrawal and further isolation. This evolutionary model proposes
that loneliness is linked to a self-preservation motivation that makes one more self-centered and
hypervigilant toward social threats to avoid the perilous consequences of uninhibited social
approach (J. T. Cacioppo et al., 2014, 2017). This self-preservation motivation can lead people to
avoid and withdraw from others. In support of this model, data have shown hypervigilance to
negative social cues among lonely young and middle-aged adults (S. Cacioppo et al., 2015,
2016) and increased self-centeredness among lonely middle-aged and older adults (J. T.
Cacioppo et al., 2017). Hence, this line of research suggests that loneliness is linked with a
motivation to protect oneself from social threats and socially withdraw, which can perpetuate
loneliness and isolation through a vicious cycle (J. T. Cacioppo & Hawkley, 2009).

1.3 Differential Roles of Chronic vs. Transient Loneliness

To reconcile these seemingly contradictory loneliness mechanisms, recent studies have
distinguished between transient and chronic loneliness, and suggested they have differential
implications (Doane & Adam, 2010; van Roekel et al., 2018; Vanhalst et al., 2015). According to
this distinction, transient loneliness may serve as an aversive yet evolutionarily adaptive response, to the extent that it motivates individuals to seek reconnection with others (J. T. Cacioppo et al., 2014). However, when experienced repeatedly or over an extended period of time, loneliness may become maladaptive, leading to a vicious cycle that maintains and aggravates loneliness (Qualter et al., 2015).

For instance, a four-wave (three-year) longitudinal study suggests that only chronically lonely adolescents with stable high loneliness scores for three years were characterized by hypersensitivity to social exclusion (i.e., high levels of negative emotions) and hyposensitivity to social inclusion (i.e., low enthusiasm), as compared to other adolescents who had different loneliness trajectories of increased or decreased loneliness over time (Vanhalst et al., 2015). These findings suggest that when adolescents experience loneliness over an extended period of time, they can start developing a maladaptive pattern of hypersensitivity to negative social outcomes, which then leads to further isolation and loneliness.

Two longitudinal studies have found that chronically lonely middle-aged and older adults tend to increasingly reduce their involvement in social activities and, as a result, find themselves increasingly lonely and isolated over time (Böger & Huxhold, 2018; Power et al., 2019). This suggests that when loneliness becomes chronic, it may no longer serve an adaptive signaling function that motivates efforts to reconnect with others (for example, by engaging in prosocial behaviour), but rather leads an individual to withdraw from or avoid social opportunities in a way that aggravates their loneliness through a vicious cycle.
1.4 **Interventions for Breaking the Vicious Cycle of Chronic Loneliness**

Effective interventions should address the vicious cycle of loneliness and social isolation, between negative social cognitions (such as hypervigilance to social threats) and maladaptive behavioural consequences (such as withdrawal or increased self-focus; Hickin et al., 2021; Masi et al., 2011). Interventions for loneliness have focused on various intervention targets, including increasing opportunities for socialization or social support (e.g., befriending programs), providing social skills training, or addressing cognitive processes (e.g., thought patterns, mindfulness skills; Hickin et al., 2021; Mann et al., 2017; Masi et al., 2011). Notably, one of the frequently used interventions is Cognitive Behavioural Therapy (CBT), which aims to reframe lonely people’s negative interpersonal thoughts, assuming that this cognitive shift will lead to improved social behaviours and reduced loneliness (Hickin et al., 2021; Käll et al., 2020; Mann et al., 2017).

This dissertation adopts a slightly different approach by targeting shifts in participants’ behaviours within their daily social environment, instead of focusing on changes in cognitive processes. Prior research using behavioural activation (BA) has indicated the effectiveness of a behavioural approach that aims to increase rewarding social activities, in mitigating loneliness among homebound older adults (Choi et al., 2020). Extending this line of work, this dissertation centers on prosociality-based intervention that specifically aims to encourage participants’ prosocial behaviour. Prosocial behaviour is defined as a voluntary act taken with the intent of benefitting others rather themselves, encompassing both naturally occurring, spontaneous acts of kindness and planned activities, such as volunteering (Hui et al., 2020; Midlarsky & Kahana, 1994).
An intervention aimed at promoting prosocial behaviour holds great promise on multiple fronts for lonely individuals. Prosocial behaviour, being an innate and ubiquitous action that connects people with each other, has a distinct advantage over other forms of social engagement (such as attending social gatherings). Prosocial behavior can be self-initiated (in contrast with being invited to a social gathering), and therefore it offers individuals a route for proactively create social opportunities. Prosocial behavior generally leads to positive reactions from others (e.g., appreciation) and involves less risk of negative social experiences (e.g., rejection) than other social behaviors. This can help counter the negative social expectations that socially isolated and lonely individuals often hold (Trew & Alden, 2015).

In addition, one of its key differentiating factors from other behavioural approaches is its emphasis on the motivation to benefit another person. Individuals experiencing loneliness and isolation are often seen as being on the receiving end of others’ support. However, studies suggest that being the target of others’ generosity (e.g., receiving monetary gifts) can sometimes backfire, particularly for those with lower perceived status, by making their status salient and causing them to feel pitied or embarrassed (i.e., social identity threat; Sandstrom et al., 2019). In contrast, an intervention that encourages them to partake in actions directed at others – either aimed at alleviating others’ distress or enhancing their happiness – may reorient their focus away from their own social pain and social preservation motives and towards an empowering role that brings a positive impact on others.

1.5 The Benefits of Prosocial Behaviour for Givers’ Health and Well-Being

To date, a number of studies have investigated the effects of prosocial behaviour on givers’ emotional lives and physical health (reviewed in Curry et al., 2018; Hui et al., 2020). Accumulating evidence consistently shows better health and well-being outcomes among people
who are more regularly engaged in prosocial activities, including spending money on others and volunteerism (Aknin, Dunn, Helliwell, et al., 2013; Kim et al., 2020; Klein, 2017; Poulin, 2014). Prospective studies have also shown that regular engagement in prosocial behaviour, such as volunteering or informal helping, buffers against long-term health risks (Hui et al., 2020; Poulin et al., 2013). This line of research suggests that interventions promoting prosocial behaviour may enhance physical and psychological well-being (Curry et al., 2018; Fried et al., 2004). Prior experimental studies have indeed shown that prosocial behaviours, including spending money on others, volunteering, and acts of kindness, have positive effects on givers’ subjective well-being (e.g., Aknin, Dunn, Helliwell, et al., 2013; Dunn et al., 2008; Nelson et al., 2016; Pressman et al., 2015) and also—to a more limited extent—on health-related outcomes (e.g., Nelson-Coffey et al., 2017; Whillans et al., 2016).

1.6 The Effects of Prosocial Behaviour on Social Connection

Although fewer studies have examined the relationship between prosocial behavior and givers’ social lives, some promising initial findings suggest that engaging in prosocial behaviour can have positive effects on social relationships. Beyond the evidence of cross-sectional associations between prosocial engagement and positive social relationship outcomes (e.g., Pilkington et al., 2012), longitudinal evidence supports a directional link between regular engagement in prosocial behaviour (e.g., volunteering) and better subsequent social relationship outcomes, such as attenuated loneliness among recently-widowed older adults (Carr et al., 2018) and more frequent contact with friends among middle-aged and older adults (Kim et al., 2020).

Experimental work on prosocial behavior has primarily used an “acts of kindness” intervention designed to increase participants’ prosocial behaviors in their daily environment.
Initial evidence suggests that acts of kindness intervention is effective for improving existing social relationships among different groups of participants, including increasing children’s peer acceptance in their classrooms (Layous et al., 2012) and relationship satisfaction among socially anxious undergraduates (Alden & Trew, 2013). In a study examining the effects of prosocial behavior on cellular aging (telomere length), Fritz et al. (2021) found that healthy community adults who participated in 4-week kindness activities (completing three acts of kindness in a single day, once a week for 4 weeks) reported a reduction in loneliness across time, not immediately after the intervention, but 2 weeks after completion of the intervention. Although promising, the primary aim of this study was not to test the effects of acts of kindness on loneliness; thus, the results require replication. In addition, this study did not examine the intervention’s effect on changes in any objective measures of social contact. An unpublished master’s thesis examining the effect of a kindness intervention on positive relations (Erdinger, 2019) documented an increase in positive relations after a kindness intervention but found no difference between other-directed and self-directed kindness conditions, suggesting that prosocial behaviour intended to benefit others might not be more effective than self-care activities. Overall, more research is necessary to validate these exploratory findings that have been documented to date, and to provide clearer evidence for the effects of engaging in prosocial behavior on people’s subjective experience of loneliness as well as objective measures of their daily social contact.

To my knowledge, no well-controlled study has yet tested the effects of a kindness intervention (or other types of prosocial behaviour) on both objective and subjective indicators of social connection. For instance, we do not know yet whether a kindness intervention is effective in increasing participants’ social interactions after the intervention, which is an important
predictor of future social connectedness (Böger & Huxhold, 2018; Power et al., 2019). In addition, no study has yet examined the effects of an intervention to increase prosocial behaviour on changes in daily social processes using diary assessment, which has been increasingly recognized as methodologically advantageous for sensitively capturing intervention effects on psychosocial processes in daily life (Lindsay et al., 2019; Smyth et al., 2017). To fill these gaps, this dissertation tests whether an acts of kindness intervention that increases daily prosocial behavior is effective for increasing social contact and reducing loneliness in the daily life of university students as well as adults in the broader community who report some degree of loneliness.

1.7 Overview of the Dissertation

In this research program, I conducted a series of studies investigating links between daily loneliness, social contact, and prosocial behaviour. Specifically, I conducted three studies aimed at answering questions pertaining to daily loneliness and prosocial behaviour, as follows:

Research Question 1. How are different time scales of loneliness (chronic and transient) associated with daily prosocial behaviour? (Study 1)

Research Question 2. Is an intervention designed to increase daily prosocial behaviour effective in reducing daily loneliness and increasing daily social contact among university students? (Study 2)

Research Question 3. Is an intervention designed to increase lonely participants’ daily prosocial behaviour, particularly during moments of elevated loneliness, effective at reducing loneliness and increasing social contact among adults in the broader community? (Study 3)
Study 1 Overview (Chapter 2). I aimed to build the theoretical frameworks for the intervention in the following two studies (Study 2 and 3), by observing individuals' daily experience of loneliness and naturally-occurring prosocial engagement in their social environment. Using a community-dwelling sample of middle-aged and older adults, I examined whether transient and chronic loneliness have differential roles in shaping daily social behaviour. I focused specifically on daily prosocial behaviour as a common social connection behaviour. The study used repeated daily life assessments, thereby allowing me to disentangle the between-person effects (chronic loneliness) from the within-person effects of loneliness (transient loneliness) on prosocial behaviour. This study design also maximizes ecological validity by capturing loneliness and prosocial behaviour as participants engage in their typical daily life routines and environments. Specifically, I tested (1) whether elevated transient loneliness is associated with increased prosocial behaviour and (2) whether chronic loneliness weakens the association between transient loneliness and prosocial behaviour. I also conducted post-hoc analyses examining the role of fear of evaluation to understand how daily experiences of loneliness may at times be linked with reduced, rather than increased, prosocial behaviour.

Study 2 Overview (Chapter 3). I examined whether increasing daily prosocial behaviour is effective at reducing daily loneliness and increasing daily social contact in a sample of university students. Specifically, I tested the effects of an acts-of-kindness intervention that participants can easily integrate into their daily routine. In a randomized controlled trial using diary assessment, I examined the effect of a 14-day acts-of-kindness intervention on participants’ objective social contact (i.e., number of social interactions and interaction partners) and their subjective perceptions of social connection (i.e., loneliness and sense of belonging). To test whether direct contact with the recipient(s) is an essential ingredient of the positive effects of the kindness
intervention, I also compared the effects of anonymous acts of kindness involving no contact with the recipients with regular acts of kindness.

**Study 3 Overview** (Chapter 4). Building on the findings from Study 1 and 2, I developed and tested an intervention designed to increase daily prosocial behaviour among lonely community adults. To tailor the intervention to lonely individuals, I incorporated components of the Just-in-Time Adaptive Intervention, which is designed to deliver timely intervention during moments of need (Nahum-Shani et al., 2015, 2018). Based on Study 1 findings suggesting that chronically lonely adults become more vigilant to social threat and are more likely to withdraw from prosocial opportunities on their lonelier days, I designed the intervention to deliver an additional just-in-time intervention to support next-day intervention activities on evenings when participants reported above average loneliness. I assessed the intervention effects on participants’ subjective experience of loneliness and objective social contact (i.e., number of social interactions and interaction partners). To examine longer-term intervention effects, I added a follow-up assessment 1 month after program completion.
Chapter 2: The Differential Roles of Chronic and Transient Loneliness in Daily Prosocial Behaviour

2.1 Introduction

2.1.1 Background

Older adults are often thought to have an elevated risk of loneliness in comparison to younger age groups, in part due to age-related social losses and health problems that limit mobility and social engagement opportunities (Dykstra, 2009; Lang & Carstensen, 1994). Indeed, older adults are more likely to live alone (Kharicha et al., 2007) and to spend a larger proportion of their time alone than younger age groups (Chui et al., 2014; Larson et al., 1985). Of note, a recent meta-analysis that compiled the datasets of different age groups from adolescence to the oldest-old age group (older than 80 years) suggests that older age is not associated with higher trait loneliness (Mund, Freuding, et al., 2020). Nevertheless, loneliness has been associated with a range of physical and mental health problems as well as with increased mortality risk in middle-aged and older adult samples (J. T. Cacioppo & Cacioppo, 2014; Holt-Lunstad et al., 2010; O’Süilleabháin et al., 2019; Ong et al., 2016)

As previously noted, loneliness can activate two conflicting motivations (J. T. Cacioppo et al., 2014). On one hand, loneliness can flag a social deficit and motivate a person to approach others and reconnect with them. On the other hand, loneliness can also increase a self-preservation motivation, resulting in increased self-centeredness and hypervigilance toward social threats, which in turn makes one withdraw from social opportunities (J. T. Cacioppo et al., 2014, 2017). Empirical evidence supports both the approach motivation perspective (e.g., (Gardner et al., 2005) and the withdrawal motivation perspective (e.g., Layden et al., 2018).

To reconcile these seemingly contradictory motivational tendencies, this work unpacks
the time scale of loneliness in shaping social behaviour. Recent studies have highlighted the
distinction between transient and chronic loneliness. Specifically, transient loneliness may be
adaptive to the extent that it motivates individuals to reconnect, whereas chronic loneliness might
be maladaptive, leading a person to respond to social situations in a way that perpetuates their
loneliness and isolation through a vicious cycle (Qualter et al., 2015).

2.1.2 Research Questions

Based on this distinction, the current study examines the differential roles of chronic and
transient loneliness in daily social behaviour using repeated daily life assessments from a sample
of 100 community-dwelling adults aged 50–85 years. This study focuses specifically on the
adults’ daily prosocial behaviour as a potentially effective strategy to approach and affiliate with
others. Participants provided ratings of their current loneliness three times a day for 10 days and
provided information on their prosocial activities throughout the measurement period. Repeated
daily life assessments allowed me to disentangle the between-person effects from the within-
person effects of loneliness (chronic loneliness and transient loneliness, respectively) on
prosocial behaviour, while maximizing ecological validity by capturing loneliness and prosocial
behaviour as participants engaged in their typical daily life routines (Christiane A. Hoppmann &
Riediger, 2009; Smyth et al., 2017). Chronic loneliness was operationally defined as person-
average loneliness levels over a 10-day assessment period, and transient loneliness was captured
by day-to-day variations in loneliness.

Considering that transient loneliness might serve as an adaptive signal motivating
individuals to reconnect (Qualter et al., 2015), I expected that elevated transient loneliness would
be associated with increased prosocial behaviour on a given day (Hypothesis 1). On the other
hand, given that chronic loneliness is often linked to maladaptive patterns of hypersensitivity to
negative social outcomes (Vanhalst et al., 2015) and reduced social engagement (Böger & Huxhold, 2018; Power et al., 2019), I expected that individuals with higher overall levels of loneliness – chronic loneliness – would show weaker daily loneliness–prosocial behaviour associations than individuals with lower overall loneliness levels (Hypothesis 2).

Although not the main focus of this study, I also conducted post-hoc analyses examining the role of fear of negative evaluation to better understand how daily experiences of loneliness may at times be linked with reduced, rather than increased, prosocial behaviour. Previous research has suggested that chronic loneliness is closely related to hypervigilance toward social threats (S. Cacioppo et al., 2015, 2016); such social vigilance might dampen the motivation to reconnect with others (J. T. Cacioppo et al., 2014; Maner et al., 2007). In this study, I examined self-reported fear of negative evaluation as a measure of individuals’ vigilance to negative social outcomes. Building on this literature, I examined whether elevated daily loneliness is associated with same-day elevated fear of evaluation and whether elevated fear of evaluation is associated with same-day reductions in prosocial behaviour. I specifically explored potential time-varying associations between elevated loneliness and fear of evaluation, extending well-established associations between chronic loneliness and trait fear of evaluation found in previous studies using retrospective global assessments of loneliness (e.g., J. T. Cacioppo et al., 2006).

Ultimately, I aimed to build the theoretical frameworks for the intervention in the following two studies (Study 2 and 3), by observing individuals' daily dynamics of loneliness and naturally-occurring prosocial engagement in their social environment.
2.2 Method

2.2.1 Participants

One hundred community-dwelling adults\(^1\) aged 50 years and above from the Metro Vancouver area were recruited through community organizations, posters, referral, and a participant database for a large project on social engagement and well-being. Data pertaining to other aspects of this larger project have been published elsewhere (Lay et al., 2018; Lay, Fung, et al., 2019; Lay, Pauly, et al., 2019; Pauly et al., 2018, 2019). Previous publications from the same dataset showed significant within- and between-person effects, suggesting the data provide sufficient power to examine the targeted associations in the current study.

The sample was on average 67.0 years old (\(SD = 8.7\), range 50-85) and 64\% female. In terms of participants’ ethnic backgrounds, the sample included 58\% East Asian, 38\% European, and 4\% other ethnicity.\(^2\) This sample reflects the racial makeup of Metro Vancouver, where about one-third of the population has an East or Southeast Asian background, with Chinese being the second-largest ethnic group, comprising about one-fifth of population. Seventy-two percent of participants had at least some postsecondary education, and 57\% were in a romantic relationship. Of the 79 participants who reported their annual household income, 53\% earned under Can$40,000 per year, the low-income threshold for a three-person household in Metro Vancouver (Statistics Canada, 2019). Participants received up to CAD$100 or the iPad Mini they

\(^1\) 108 participants were initially recruited. However, only 100 participants were included in the final sample, as eight participants either did not complete the repeated daily life assessments, or their data could not be used due to technical issues with the data collection app.

\(^2\) Notably, two out of 38 European participants identified themselves as having mixed ethnicity (i.e., European and Central Asian), and two out of 58 East Asian participants also identified themselves with an additional qualifier (specifying themselves as Taiwanese or Malaysian Chinese).
used for the study questionnaires. Participants provided informed consent, and the study was ethics-approved by the University of British Columbia Behavioral Research Ethics Board.

2.2.2 Procedure

Data, code for the analysis and study materials are available at: https://doi.org/10.5683/SP3/FOBSGC. The study design, hypotheses, and analytic plan were not pre-registered. The project had four components: a baseline session, a 10-day daily life assessment period, an exit session, and a six-month follow-up session. I describe only the components relevant to the present study (see Lay, Pauly, et al., 2019 for more detail). In the baseline session, participants provided informed consent and information on their background and individual difference variables. Participants also completed training on how to use iPads for the everyday life questionnaires. During the 10-day everyday life assessment period, typically beginning one day after the baseline session, participants were asked to carry their tablet with them throughout each day. The tablet prompted participants three times a day to complete a brief questionnaire about their experiences at the moment, including loneliness ratings (morning, afternoon, evening, with a minimum four-hour interval between questionnaires) using an app customized for older adults (iDialogPad app; Mutz, 2014, University of Cologne, Germany).

Participants were also asked to take photos on their tablet whenever they encountered an opportunity to help someone and whenever they actually engaged in prosocial behaviour (i.e., by helping one or more people). Participants were asked to take photos of objects or scenes (but not people, for their privacy) that would remind them of each situation and facilitate memory reconstruction of that situation, in line with ideas underlying the Daily Reconstruction Method (Kahneman et al., 2004). For example, when opening a door for someone, they could photograph
the door handle. As part of the evening questionnaire, participants were asked to review their photos of prosocial opportunities and prosocial actions from that day, to describe these situations via voice recording or text description, and to answer follow-up questions (data not reported in this paper). Photos have been used in previous research to support recall of daily experiences (Yue et al., 2014) and to capture participants’ lived experiences and everyday behaviour in a minimally intrusive way, including with older adult participants (Mysyuk & Huisman, 2020).

Participants were given a broad definition of prosocial behaviour that included frequently occurring, spontaneous acts of kindness as well as planned prosocial behaviours, such as volunteering (Curry et al., 2018; Hui et al., 2020). To explain to participants what constitutes “helping” or “everyday prosocial behaviour,” our research team made use of an acronym, COVO (“making a Contribution to help Other people or another person that is Voluntary or unpaid, in response to an Opportunity to help that may or may not be acted upon”). Participants reported a wide range of prosocial behaviours, including “holding the door open for someone,” “cooking for family,” “volunteering,” and “donating to a charity.” Participants took a photo whenever they encountered a prosocial opportunity, whether or not they did take an action.

When participants who voluntarily completed daily life assessments beyond the 10-day study period were included, there were an average of 32.0 momentary assessments ($SD = 10.1$). Aggregating participants’ momentary reports for each day (from the morning, afternoon, or evening questionnaire), they provided an average of 11.99 daily reports ($SD = 3.45$, range = 7-29). I only included the days when participants provided at least one momentary loneliness rating. The final analyses included data that participants provided beyond the 10-day study period. However, I ran additional analysis to test whether the main findings change when including only the reports provided during the first 10 days (9.88 daily reports per participant, on
average) and found that the results did not change substantially. The daily reports also included instances in which participants took one or more photos but did not complete the evening questionnaire that asked about the photos taken that day (i.e., reports of prosocial opportunities/actions, \( n = 111 \)).

At the exit session, participants provided feedback. They reported that the 10-day everyday assessment period was typical of their everyday lives (\( M = 3.5 \) on a 5-point scale) and that study participation did not interfere with their everyday routines (\( M = 1.8/5 \)) or change their behaviour (\( M = 1.7/5 \)). To be inclusive of diverse populations, the study team provided the translated version of the study materials in Chinese languages (Mandarin and Cantonese), the second most-used languages in Metro Vancouver. All study materials were translated into simplified Chinese (with traditional Chinese made available upon request), and all translations were verified by independent backward translation. Participants completed the study in English (57%), Mandarin (28%), or Cantonese (15%).

2.2.3 Measures

**Everyday loneliness.** At each beep, participants were asked to report their current loneliness by responding to Russell’s (1996) “I am lonely” item (\( M = 20.81, SD = 18.91 \))^3 using a visual analogue scale ranging from 0 (not at all) to 100 (very much)^4. A day-level measure of transient loneliness was created by averaging the momentary loneliness ratings from each day and a

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^3 Measures of loneliness, prosocial opportunities and actions, and fear of evaluation were averaged (person-level means) when computing descriptive statistics.

^4 For all the multi-level analyses, I rescaled the measures of everyday loneliness and fear of evaluation by dividing them by 10 to fix model convergence issues due to variables being of very different scales.
person-level measure of chronic loneliness was created by computing the person-mean of all momentary loneliness ratings for each individual.

**Daily prosocial opportunities and actions.** Each evening, participants reviewed their photos and answered additional questions. The participant-reported total number of prosocial opportunities, whether acted upon or not, was computed (i.e., *prosocial opportunities*; \( M = 1.54 \) per day, \( SD = 0.90 \)), as was the total number of prosocial opportunities that were acted upon (i.e., *prosocial actions*; \( M = 1.22 \) per day, \( SD = 0.74 \)). Daily prosocial opportunity and prosocial action totals were both positively skewed (skewness = 1.36 and 1.33, respectively). Analyses reported in this article are based on prosocial *actions* rather than prosocial opportunities.

**Additional variables.** Sociodemographic characteristics, including age, sex, education, and ethnicity, were assessed at the baseline session. Sex (1 = female, 0 = male), education (1 = at least some post-secondary education, 0 = no post-secondary education), and ethnicity (1 = European, 0 = all other ethnic groups) were dummy coded. All analyses included this set of control variables. The everyday life assessments also included a measure of fear of evaluation, which required participants to respond to the following item: “I am worried about what other people might think of me” (from Kashdan & Steger, 2006) on a visual analogue scale ranging from 0 (*not at all*) to 100 (*very much*; \( M = 23.3, SD = 21.3 \)). This variable was used for exploratory purposes.

### 2.2.4 Analysis Plan

#### 2.2.4.1 Primary Analyses

Associations between day-level and person-level loneliness and number of daily prosocial actions were examined using multilevel modeling (*lme4* package in *R*; Bates et al., 2015) to
account for daily reports (level 1) being nested within persons (level 2). Multilevel Poisson regression models were fit for the count variable (number of prosocial actions taken by each person on each day; level 1) using the \texttt{glmer} function in the \texttt{lme4} package and maximum likelihood estimation (Laplace approximation).

I first examined the main effects of day-level loneliness (person-centered, level 1) and person-level loneliness (grand-mean-centered, level 2) on number of daily prosocial actions, controlling for socio-demographic covariates, including age, sex, ethnicity, and education level (grand-mean-centered, level 2). Next, I examined whether the cross-level interaction between day-level loneliness and person-level loneliness statistically predicted daily prosocial actions by adding this interaction term to the model.

\begin{align*}
\text{Level 1: } \ln(\text{number of day-level prosocial actions}_{ij}) &= \beta_0 + \beta_1 \text{ (day-level loneliness}_{ij}) + e_{ij} \\
\text{Level 2: } \beta_0 &= \gamma_{00} + \gamma_{01} \text{ (person-level loneliness}_{ij}) + \gamma_{02} \text{ (age}_{ij}) + \gamma_{03} \text{ (sex}_{ij}) + \gamma_{04} \text{ (ethnicity}_{ij}) + \\
& \quad + \gamma_{01} \text{ (education}_{ij}) + u_{0j} \\
\beta_1 &= \gamma_{10} + \gamma_{11} \text{ (person-level loneliness}_{ij}) + u_{1j}
\end{align*}

In an attempt to disentangle the effects of prosocial actions and prosocial opportunities, I ran additional analyses controlled for the total number of prosocial opportunities participants encountered at the day-level (level 1, person-centered) and person-average level (level 2, grand-mean-centered), as well as for sociodemographic variables (level 2, grand-mean-centered). These models will be only reported in the appendix (Appendix Table A.1) rather than as part of my main results due to concerns about multicollinearity, given the high correlation between prosocial actions and opportunities ($r = .91$).
2.2.4.2 Exploratory Analyses

Further exploratory analyses used multilevel models to examine associations between day-level (level 1, person-centered) and person-level (level 2, grand-mean-centered) loneliness and same-day fear of evaluation (level 1), using restricted maximum-likelihood estimation (REML). Then, multilevel Poisson regression models were used to examine associations between day-level (level 1, person-centered) and person-average (level 2, grand-mean-centered) fear of evaluation and same-day number of prosocial actions (level 1), using maximum likelihood estimation (Laplace approximation). The same socio-demographic covariates (age, sex, ethnicity, and education level) were controlled for in both analyses (grand-mean-centered, level 2).

2.3 Results

Table 2.1 presents person-level means, standard deviations, and intercorrelations of study variables and control variables. The number of prosocial opportunities encountered and prosocial actions taken were highly correlated \( r = .91, p < .001 \). Higher overall loneliness was positively associated with fear of evaluation \( r = .66, p < .001 \). Women reported more prosocial actions overall than men \( r = .25, p = .01 \). Having at least some post-secondary education \( r = .32, p = .001 \) and European ethnic backgrounds \( r = .22, p = .03 \) were associated with engaging in more prosocial actions.

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5 Prosocial behaviour was assessed using the end-of-day measure that aggregated what happened throughout the day (i.e., prosocial opportunities and actions). Assuming that prosocial actions can occur in response to emotional states experienced throughout the day (i.e., loneliness and fear of evaluation), I conducted same-day analyses that predicted the number of prosocial behaviours an individual engaged in from their levels of loneliness or fear of evaluation on that day.
### Table 2.1 Person-level means, standard deviations, and intercorrelations of central study variables and control variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
<th>7.</th>
<th>8.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Loneliness (0-100)</td>
<td>.66**</td>
<td>.00</td>
<td>-.05</td>
<td>-.18</td>
<td>-.02</td>
<td>-.14</td>
<td>-.11</td>
<td></td>
</tr>
<tr>
<td>2. Fear of evaluation (0-100)</td>
<td>.06</td>
<td>.00</td>
<td>-.17</td>
<td>.17</td>
<td>-.07</td>
<td>-.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Prosocial opportunities (count)</td>
<td>.91**</td>
<td>-.10</td>
<td>.25*</td>
<td>.28**</td>
<td>.17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Prosocial actions (count)</td>
<td>-.05</td>
<td>.25*</td>
<td>.32**</td>
<td>.22*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Age (years)</td>
<td>-.14</td>
<td>.12</td>
<td>.07</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Sex (female)</td>
<td>.00</td>
<td>.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Education (post-secondary)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.26**</td>
</tr>
<tr>
<td>8. Ethnicity (European)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

### Mean (SD)/%                                   | 20.81 | 23.27 | 1.54  | 1.22  | 67.03 | 64.00 | 72.00 | 38.00 |
|                                                | (18.91)| (21.27)| (0.90)| (0.74)| (8.69)| %     | %     | %     |
| N                                             | 100   | 100   | 100   | 100   | 95    | 100   | 100   | 100   |

*Note. Sex was coded 1 = female, 0 = male; Education was coded 1 = at least some post-secondary education, 0 = no post-secondary education); ethnicity was coded 1 = European, 0 = all other ethnic groups. Daily measures of loneliness, fear of evaluation, and number of prosocial opportunities and prosocial actions were averaged (person-level means). *p < .05, **p < .01.*

### 2.3.1 Chronic and Transient Loneliness and Prosocial Behaviour

I first examined whether higher transient loneliness would be associated with an increased number of prosocial actions on a given day by testing the main effects of day-level and person-average loneliness on prosocial actions. Results show that there were no significant main effects of daily within-person variations in loneliness on the number of prosocial actions \((b = 0.05, SE = 0.03, p = .11)\), nor of person-average loneliness on the number of prosocial actions \((b = 0.0001, SE = 0.0001, p = .10)\).
There was no significant reduction in deviance when comparing the null model to this main effects model (chi-square = 2.99, df = 4, p = .56).

Next, I examined whether chronic loneliness would moderate the relationship between transient loneliness and the number of prosocial actions by examining the cross-level interaction of person-average loneliness with daily loneliness-prosocial action slopes. Results showed that person-average loneliness moderated the relationship between day-level loneliness and number of prosocial actions taken on a given day (b = -0.04, SE = 0.02, z = -2.72, p = .007; see Table 2.2 for full results). Of the socio-demographic covariates, female sex (b = 0.34, SE = 0.12, z = 2.93, p = .003) and having at least some post-secondary education (b = 0.39, SE = 0.13, z = 2.94, p = .003) were associated with taking a greater number of daily prosocial actions, whereas age (b = -0.0007, SE = 0.007, z = -0.11, p = .92) and ethnicity (b = 0.16, SE = 0.12, z = 1.32, p = .19) showed no significant associations with the number of daily prosocial actions. When comparing this full model to the model containing only main effects, there was a statistically significant reduction in deviance (chi-square = 6.83, df = 1, p = .009), suggesting that the addition of the interaction term significantly improved the model fit.
Table 2.2 Day-level and person-average loneliness as predictors of the number of prosocial actions

<table>
<thead>
<tr>
<th></th>
<th>b</th>
<th>SE</th>
<th>z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.49</td>
<td>0.14</td>
<td>-3.54</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Day-level loneliness</td>
<td>0.008</td>
<td>0.04</td>
<td>0.21</td>
<td>.83</td>
</tr>
<tr>
<td>Person-average loneliness</td>
<td>-0.01</td>
<td>0.03</td>
<td>-0.38</td>
<td>.70</td>
</tr>
<tr>
<td>Age</td>
<td>-0.0007</td>
<td>0.007</td>
<td>-0.11</td>
<td>.92</td>
</tr>
<tr>
<td>Sex</td>
<td>0.34</td>
<td>0.12</td>
<td>2.93</td>
<td>.003</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>0.16</td>
<td>0.12</td>
<td>1.32</td>
<td>.19</td>
</tr>
<tr>
<td>Education</td>
<td>0.39</td>
<td>0.13</td>
<td>2.94</td>
<td>.003</td>
</tr>
<tr>
<td>Day-level loneliness × person-average loneliness</td>
<td>-0.04</td>
<td>0.02</td>
<td>-2.72</td>
<td>.007</td>
</tr>
<tr>
<td>Random effects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept variance</td>
<td>0.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loneliness slope variance</td>
<td>0.001</td>
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</tr>
</tbody>
</table>

Note. N = 95, n = 1046 daily reports. Loneliness was originally scored from 0 to 100 and rescaled to produce a score from 0 to 10. Sex coded 1 = female, 0 = male; education coded 1 = at least some post-secondary education, 0 = no post-secondary education; ethnicity coded 1 = European, 0 = all other ethnic groups. There was missing data for age (n = 5), resulting in a final N = 95 for this model.

To unpack the statistically significant cross-level interaction, I calculated simple slopes (Preacher et al., 2003). Results point to daily loneliness-prosocial action associations that were different for individuals with higher chronic loneliness (i.e., 1 SD above the grand-centered mean; \( b = -0.07, SE = 0.03, z = -2.21, p = .03 \)) compared to individuals with lower chronic loneliness (i.e., 1 SD below the grand-centered mean; \( b = 0.09, SE = 0.06, z = 1.43, p = .15 \); see Figure 1 for full results).
Figure 2.1 Simple slopes for significant cross-level interactions between day-level and person-average loneliness

*Note.* The exponential value of the outcome variable was used for this graph on the y axis to enhance interpretability.

When controlling for the number of prosocial behaviour *opportunities* (whether or not they were acted upon), the cross-level interaction between day-level and person-average loneliness remained significant (*b* = -0.04, *SE* = 0.02, *p* = .02; see Table A.1. in Appendix A). When controlling for relationship status, the cross-level interaction between day-level and person-average loneliness remained significant (*b* = -0.04, *SE* = 0.02, *p* = .007; see Table A.2. in Appendix A). This speaks to the robustness of the findings and suggests that the moderating role of chronic loneliness on daily loneliness-prosocial action associations is not explained by between- or within-person variations in prosocial opportunities nor by participants’ relationship status.
2.3.2 Daily Associations between Loneliness, Fear of Evaluation, and Prosocial Behaviour

To explore fear of negative evaluation as a potential reason why daily experience of loneliness may at times be associated with reduced rather than increased prosocial behaviour, I conducted two additional analyses examining time-varying associations between loneliness, fear of evaluation, and prosocial behaviour. In the first analysis, I examined concurrent associations between loneliness and fear of social evaluation. Results showed that both within-person and between-person variations in loneliness were significantly associated with greater fear of evaluation on the same day ($b = 0.25$, $SE = 0.06$, $p < .001$; $b = 0.73$, $SE = 0.09$, $p < .001$, respectively; see Table 2.3 for full results). In my second analysis, I examined daily associations between fear of evaluation and number of prosocial actions. Results showed a negative association between daily variations of fear of evaluation and prosocial behaviour, such that increased fear of evaluation on a given day was significantly associated with taking fewer prosocial actions on that day ($b = -0.07$, $SE = 0.03$, $z = -2.12$, $p = .03$; see Table 2.4).
### Table 2.3 Same-day associations between daily loneliness and fear of evaluation

<table>
<thead>
<tr>
<th></th>
<th>$b$</th>
<th>$SE$</th>
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<th>95% CI</th>
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<td>4.81</td>
<td>[1.10, 2.57]</td>
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<tr>
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<tr>
<td>Person-average loneliness</td>
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<td>8.27</td>
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<tr>
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<td>-0.27</td>
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<td>0.34</td>
<td>2.53</td>
<td>[0.21, 1.53]</td>
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<tr>
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*Note. N = 95, n = 1141 daily reports. Loneliness and fear of evaluation were originally scored from 0 to 100 and rescaled to produce a score from 0 to 10. Sex coded 1 = female, 0 = male; education coded 1 = at least some post-secondary education, 0 = no post-secondary education; ethnicity coded 1 = European, 0 = all other ethnic groups. There was missing data for age ($n = 5$), resulting in a final $N = 95$ for this model.

### Table 2.4 Same-day associations between fear of evaluation and prosocial actions

<table>
<thead>
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*Note. N = 95, n = 1046 daily reports. Fear of evaluation was originallly scored from 0 to 100 and rescaled to produce a score from 0 to 10. Sex coded 1 = female, 0 = male; education coded 1 = at least some post-secondary education, 0 = no post-secondary education; ethnicity coded 1 = European, 0 = all other ethnic groups. There was missing data for age ($n = 5$), resulting in a final $N = 95$ for this model.
2.4 Discussion

The current study examined the differential roles of chronic and transient loneliness in shaping daily prosocial behavior in a sample of middle-aged and older adults. Results indicate that neither transient loneliness nor chronic loneliness alone were associated with the number of prosocial actions taken on a given day; this points to the complexity of the underlying mechanisms. Specifically, findings showed that the association between transient loneliness and daily prosocial behavior depends on individual differences in overall loneliness. This suggests that chronic loneliness may elicit maladaptive responses to transient elevations in loneliness by decreasing prosocial behaviour.

2.4.1 Differential Effects of Chronic and Transient Loneliness

This study examined two competing hypotheses concerning the effects of loneliness on prosocial behaviour: (1) loneliness promotes affiliative behaviors and efforts to reconnect with others, and thus increases prosocial behaviour; and (2) loneliness increases attentiveness to potential social threats and withdrawal tendencies, and thus reduces prosocial behaviour (J. T. Cacioppo et al., 2014; Layden et al., 2018). The findings suggest that the distinction between chronic and transient loneliness is crucial for reconciling these seemingly contradictory perspectives. The current study did not find direct support for -- but also does not contradict -- the idea that acute loneliness is a form of social pain, similar to physical pain, that may motivate actions to keep an individual out of harm’s way (Qualter et al., 2015; Riva et al., 2014; Vanhalst et al., 2015). However, findings of this study highlight that loneliness, when it becomes chronic, may elicit a maladaptive response to this social pain, possibly due to increased social withdrawal tendencies that counteract an individual’s motivation to re-connect with others. These findings
are in line with two previous longitudinal studies showing that older adults’ loneliness is associated with a decrease in social engagement over time, and that this in turn is associated with a subsequent increase in loneliness (Böger & Huxhold, 2018; Power et al., 2019). Persistent loneliness appears to lead individuals to respond to social situations in a way that perpetuates their loneliness through a self-reinforcing loop (J. T. Cacioppo & Hawkley, 2009; Qualter et al., 2015) and this loop could perpetuate the isolation and loneliness of older adults even more (Böger & Huxhold, 2018).

These findings dovetail with previous work on loneliness and hypothalamic-pituitary-adrenal functioning in adolescence (HPA: Doane & Adam, 2010), which also points to differential associations of time-varying versus trait-level loneliness and cortisol profiles. Doane and Adam (2010) show that daily increases in loneliness were associated with greater cortisol awakening responses the following morning. The authors speculate that such increased cortisol awakening responses may give individuals extra energy to meet the anticipated demands of the coming day, in line with the “boost hypothesis” proposed by Adam and colleagues (2006). Higher trait loneliness, in contrast, has been shown to be associated with flattened diurnal cortisol slopes, which may be indicative of losses in HPA functioning and elevated physical and mental health risks (Christiane A. Hoppmann et al., 2018; Miller et al., 2007). In other words, there are multiple indications that the potential adaptive function of temporary loneliness, which could contribute to a person’s ability to deal with challenges and re-engage socially, may be undermined by chronic loneliness.
2.4.2 Loneliness, Fear of Evaluation, and Prosocial Behaviours

Aside from the role of chronic loneliness, I also explored the possibility that fear of negative evaluation may provide insights into how daily experiences of loneliness may dampen, rather than increase, prosocial behaviour. A longitudinal study showed that the reciprocal relationship between loneliness and social disengagement may become even stronger as people get older (Böger & Huxhold, 2018). However, the potential mechanisms underlying this relationship have not been well-studied in older adults. Conceptually, loneliness is thought to lead to hypervigilance aimed at detecting and avoiding potentially hurtful social situations, such as rejection or exclusion (J. T. Cacioppo et al., 2014). Lonely individuals showed elevated sensitivity to social rejection and exclusion in a sample of children (Qualter et al., 2013), stronger motivation to avoid negative social outcomes in a sample of undergraduates (Gable, 2006), and heightened implicit attention to negative social stimuli in samples of young and middle-aged adults (S. Cacioppo et al., 2015, 2016).

The findings of this study add to this literature by pointing to time-varying associations between increased loneliness and heightened fear of evaluation on a given day in a sample of middle-aged and older adults. This suggests that on days people feel lonelier than usual they tend to be more vigilant to potential social threats. My exploratory analyses also revealed that people were less likely to engage in prosocial actions on days when they were more fearful than usual about social evaluation. Together, these findings support the potential role of fear of evaluation as a mechanism that is relevant to reduced prosocial engagement on lonelier days such that middle-aged and older adults become more vigilant to the potential for social pain (such as negative social evaluation or rejection) on a lonelier day and come to view prosocial
opportunities as potential sources of further social pain rather than as potential avenues for reaffiliation with others (Maner et al., 2007).

While the current findings cannot establish a causal relationship between the daily experience of loneliness and fear of evaluation, evolutionary theoretical models of loneliness suggest that the chronic and repeated experience of loneliness may increase social vigilance in the longer term (J. T. Cacioppo et al., 2014; Qualter et al., 2015). Future research using measurement bursts and long-term longitudinal data would be able to elucidate the temporal dynamics between repeated daily loneliness experiences and fear of evaluation (or other measures of social vigilance) in the longer term (e.g., J. T. Cacioppo et al., 2017).

2.4.3 **Strengths, Limitations and Future Directions**

A strength of this study is the use of daily life assessments to disentangle the roles of transient and chronic loneliness (i.e., within-person and between-person variations in loneliness) on prosocial behaviour. This design also enables us to capture naturally occurring social experiences and behaviours as participants engage in their typical everyday life routines and environments, thereby maximizing the ecological validity of the study findings. Another strength of this study is the inclusion of a diverse sample. The study sample captures the experiences of middle-aged and older adults from different walks of life, including immigrants (predominantly of East Asian background given the Greater Vancouver study location) and individuals of low socioeconomic status, who are often less well represented in aging research. Although the findings show a significant association between ethnicity and daily prosocial behaviour, I caution against an overinterpretation of findings in light of the fact that a larger proportion of East Asian participants had more recently immigrated to Canada relative to European participants in the
current sample. Participants who are more recent immigrants might encounter language barriers or have relatively smaller local networks hampering their opportunities to engage in prosocial activities. It is also possible that the definition of prosocial behaviours may vary among different cultural and ethnic groups. For instance, in some cultures, people may not consider their informal helping, such as caregiving, as a prosocial behaviour. Future studies are needed to disentangle the effects of ethnicity versus immigration on prosocial behaviour, and explore how prosociality is defined in different cultures.

I also acknowledge several limitations. First, information about everyday prosocial opportunities and actions is based on retrospective self-reports. In line with ideas underlying the Daily Reconstruction Method (DRM) which guides participants to systematically reconstruct their activities and experiences of the preceding day (Kahneman et al., 2004), this study used daily photographs to refresh their memory of the relevant experiences when answering questions at the end of the day. The photo-voice method was intended to reduce retrospective self-report biases given that questionnaire responses that were prompted by photographic cues rely less on retrospection than responses that do not benefit from such memory aids. However, I acknowledge that this method cannot rule out the possibility of self-report biases. Study data are not objective accounts of what happened during the day. For instance, participants may have either underreported the number of prosocial behaviours they engaged in throughout the day (perhaps due to discounting their habitual prosocial behaviours), have underreported the number of prosocial opportunities they did not engage in (as they may be less likely to recognize or recall) or have overreported their prosocial experiences due to demand characteristics (as they knew that prosocial behaviour was the focus of the study).
Future research using larger samples could also test other potential models to explain the relationship between loneliness and prosocial behaviour in daily life. For instance, there may be a non-linear relationship between daily loneliness and prosocial behaviour, such that both very low and very high levels of transient loneliness may be related to reduced engagement in prosocial behaviour. Such a relationship would likely be based on different mechanisms such as a lack of social desire or heightened hypervigilance for social threat for very low and very high levels of loneliness respectively.

Future studies could also examine whether age moderates the relationship between loneliness and prosocial engagement. For instance, the relationship between chronic loneliness and prosocial engagement may grow stronger with increasing age; a study by Böger and Huxhold showed a stronger pathway from loneliness trait to reduced social engagement at older ages (Böger & Huxhold, 2018). Conversely, it is also possible that older adults’ prosocial behaviour may be less influenced by loneliness as the same paper showed a weaker association between loneliness and emotional distress (Böger & Huxhold, 2018). Larger data sets are needed to examine how the relationship between transient and chronic loneliness and prosocial engagement might unfold differently in different age groups.

Future research could also assess prosocial actions using behavioural measures in a controlled laboratory context. Daily life assessments have the strength of capturing a wide range of naturally-occurring prosocial behaviours, given that different individuals may find different ways of engaging prosocially with others - from minimal acts of kindness (e.g., holding the door

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6 I ran an additional analysis to test whether age moderates the interaction between chronic loneliness and transient loneliness. I did not find a significant 3-way interaction ($b = -0.0003$, $SE = 0.002$, $p = .88$). However, I did not include the results in the manuscript because I recognize that the current data may not have been powered to test 3-way interactions.
open for someone), to formal helping (e.g., volunteering). However, this method did not allow us to directly assess whether participants were more willing to respond to prosocial opportunities they encountered in lonelier moments, given that some middle-aged and older adults might not have had enough opportunities to engage in prosocial behaviour (the average number of prosocial opportunities reported was 1.54 per day; $SD = 0.90$). If participants were given opportunities to help or connect with others in a laboratory setting, their social behaviours (to approach or withdraw) in response to transient loneliness may be better understood. For instance, experimental paradigms can be used to assess prosocial behaviour using measures such as engaging in novel social encounters and helping a confederate or donating to charity (e.g., Maner et al., 2007; Twenge et al., 2007; Weinstein & Ryan, 2010), or engaging in cooperative behaviour in a public goods game (e.g., Fowler & Christakis, 2010).

It should also be noted that daily prosocial behaviour as assessed in this study often overlaps with social engagement but the two are distinct to the extent that prosocial behaviour may or may not involve social contact. For instance, a donation to a charity could be made without in-person contact. In the current study, I cannot determine whether the study results would generalize to social engagement. Future research should disentangle these two overlapping yet distinct constructs by assessing both social interaction and prosocial behaviour in daily life. Furthermore, future research should also examine the role of loneliness on engaging in specific social opportunities such as companionship, for example by sharing pleasurable activities with others.

The current findings point to time-varying associations between loneliness and prosocial behaviour in daily life, but they cannot speak to the underlying causal mechanisms. Future experimental research could build on these findings and explore whether experimentally-induced loneliness (e.g., Wildschut et al., 2006) might increase prosocial behaviour in the laboratory, and
whether pre-assessed chronic levels of loneliness may moderate such effects. Future work could also disentangle processes along different timeframes. For instance, measurement burst designs could elucidate how accumulated experiences of loneliness might alter approach and avoidance behaviours associated with momentary loneliness across multiple timescales (e.g., moment-to-moment, year-to-year; C. A. Hoppmann et al., 2020). Combining lab and life promises to address different aspects of the underlying phenomena, thereby maximizing both ecological validity and experimental rigor. Effect sizes for interactions were small (model deviance reduction chi-square = 6.82). Small effect sizes are common in data using daily life assessments as compared to findings from controlled laboratory settings, but they may still be meaningful in foreshadowing key health outcomes (e.g., Piazza et al., 2018).

I also acknowledge that the findings of this study might underrepresent the experience of chronically lonely individuals. In an additional analysis, I tested the associations between the number of daily life assessments participants completed each day and transient and chronic loneliness. I did not find any association between transient loneliness and the daily number of momentary reports, suggesting that missing data seem to be unrelated to participants’ daily fluctuations in loneliness. However, I found that chronically lonelier participants completed fewer daily life assessments on average over the assessment period. These findings suggest that the overall daily experience of chronically lonelier participants might be relatively underrepresented in our findings.

7 To determine whether or not values are missing at random on the loneliness measures, I tested the associations between the number of momentary reports participants completed each day and transient and chronic loneliness. I found that chronic loneliness was associated with fewer momentary reports participants completed on average over the 10-day assessment period ($b = -0.06$, $SE = 0.02$, $p = .01$), whereas transient loneliness was not significantly associated with the number of momentary reports ($b = -0.01$, $SE = 0.02$, $p = .40$).
Furthermore, the current study presents a snapshot of everyday life processes related to loneliness and prosocial behaviour over a 10-day period. Long-term longitudinal outcome tracking would be needed to address how habitually responding to day-to-day loneliness with increased prosocial behaviour may shape longer-term outcomes. Such research could help determine whether increased prosocial engagement is in fact effective in helping individuals restore social connections and reduce loneliness over time.

Future research could also examine whether interventions that promote prosocial behaviour among older adults, such as volunteering (Fried et al., 2004; Jenkinson et al., 2013) or acts of kindness manipulations (Curry et al., 2018), are effective at reducing loneliness. A substantial body of research has revealed emotional and health benefits of prosocial behaviour (Brown et al., 2009; Curry et al., 2018; Poulin & Holman, 2013; Raposa et al., 2016), although some recent studies also suggest potential costs to older adults’ psychological well-being (Bjälkebring et al., 2021; Chi et al., 2021). Engaging in prosocial behaviour could also be an effective strategy for overcoming momentary loneliness by fostering social connection and affiliation (e.g., Carr et al., 2018). Our findings suggest that chronically lonely adults may find it particularly difficult to engage in prosocial opportunities on lonelier days. Future research could explore the potential of interventions that may help chronically lonely individuals seek out and actively engage in prosocial action at times when they are feeling particularly lonely. A recent meta-analysis suggests that older adults show greater altruistic motivations than other age groups (Sparrow et al., 2021). Encouraging older adults to engage in altruistic actions may also reduce social vigilance (such as hypersensitivity to rejection and negative evaluation) and promote a prosocial frame of mind that encourages them to approach and affiliate with others (J. T. Cacioppo & Patrick, 2008).
2.4.4 Conclusion

The results of Study 1 highlight the unique roles of chronic and transient loneliness in influencing prosocial behaviour in real-world contexts of middle-aged and older adults. The findings support the idea that chronic loneliness may elicit maladaptive responses to transient loneliness, such that middle-aged and older adults high, but not low, in chronic loneliness are more likely to withdraw from opportunities to engage in prosocial behaviour on days when loneliness is elevated. The results suggest that chronic loneliness may undermine its potential adaptive function of motivating individuals to reconnect with others when it occurs frequently or over extended periods of time. When individuals are not chronically lonely, an acute increase in loneliness on a given day could better serve its potential adaptive function of prompting social reengagement.

The results of Study 1 suggest the vicious cycle that chronically lonely individuals may experience. In this cycle, in response to elevated loneliness, they become more vigilant to potential negative social outcomes and are more inclined to withdraw from prosocial opportunities, which could have otherwise led to positive interaction experiences. The observed patterns align with theories regarding a negative feedback loop between social vigilance and social withdrawal that perpetuates loneliness (Cacioppo et al., 2014).

Further research is needed to address the practical significance of our findings and the value of designing interventions that help lonely individuals respond to the transient feeling of loneliness by pursuing prosocial opportunities rather than withdrawing from others. Specifically, research is needed to determine whether daily engagement in prosocial behaviour is effective at restoring social connections. In Studies 2 and 3, I will explore this question by testing whether an
intervention designed to increase daily prosocial behaviour can reduce loneliness and promote social contact.
Chapter 3: The Effects of an Intervention Increasing Prosocial Behaviours on Daily Loneliness and Social Contact among University Students

3.1 Introduction

3.1.1 Background

In contrast to the misconception (or stereotype) that loneliness is primarily an issue for older adults, research shows that loneliness is not an exclusive experience of a particular age group but rather a prevalent one from adolescence through old age (Mund, Lüdtke, et al., 2020). Recent evidence even suggests that late adolescents and young adults are at a higher risk for loneliness than other age groups (Lasgaard et al., 2016; Luhmann & Hawkley, 2016; Victor & Yang, 2012). In particular, loneliness and feeling uncertain about their belongingness are common experiences among young people transitioning to new environments, such as a relocating to a new city for college and adjusting to new social networks (Walton & Cohen, 2011; Whillans & Chen, 2018). Mental health problems frequently emerge during late adolescence and young adulthood (Pitman et al., 2018), and data show that young adults experiencing loneliness are more likely to have mental health problems, such as depression, anxiety, and substance abuse (Matthews et al., 2019). Despite the need for early intervention, there is a lack of interventions that specifically target loneliness experiences in adolescents and young adults (Eccles & Qualter, 2021). Notably, there is a pressing need for brief and low-cost interventions that overcome both systemic barriers (such as costs) and internal barriers (such as stigma about loneliness and seeking professional help) preventing young people from accessing necessary mental health care (Schleider et al., 2020).
3.1.2 Research Questions

In this chapter, I aimed to test whether an intervention designed to increase prosocial behaviour in university students is effective at reducing loneliness and increasing social contact. Specifically, I used an acts-of-kindness intervention as an experimental tool in which participants could freely choose, easily integrate, and readily enact prosocial behaviours within their daily routines. Initial evidence suggests that kindness interventions may improve social relationships among different groups, including increased children’s peer acceptance in the classroom (Layous et al., 2012), increased relationship satisfaction among socially anxious undergraduates (Alden & Trew, 2013), and decreased loneliness among healthy community adults (Fritz et al., 2020). However, no well-controlled study has tested the effects of an acts-of-kindness intervention (or intervention increasing any type of prosocial behaviour) on changes in both objective social contact and subjective perceptions of social relationships. In addition, no study has yet used diary assessment to examine intervention effects on changes in daily psychosocial processes. To fill this gap, this study aimed to test the effects of an acts-of-kindness intervention on subjective and objective aspects of social connection in the daily life of university students.

The current study also aimed to identify a central mechanism that drives the potential effects of prosocial engagement. Specifically, I tested whether direct contact with the recipient(s) of the act of kindness is an essential ingredient for improving givers’ daily social connection. Direct contact with a recipient would increase the likelihood that a giver would perceive the positive impact of their actions on the recipient more directly and also feel connected to the recipient, both of which are related to greater emotional rewards for givers (Aknin, Dunn, Sandstrom, et al., 2013; Aknin, Dunn, Whillans, et al., 2013; Inagaki & Orehek, 2017; Lok & Dunn, 2020). Particularly for chronically lonely individuals, positive contact experience with the recipient(s)
may play an important role in countering their negative social expectations and motivation to avoid social interaction (Trew & Alden, 2015). To test this idea, I compared the outcomes of a “regular” kindness intervention condition to an “anonymous” kindness condition in which participants were instructed to perform their acts of kindness anonymously (thereby removing direct contact with the recipient(s)).

In summary, in a randomized controlled trial, I tested the effects of a 14-day acts-of-kindness intervention on participants’ objective daily social contact (i.e., number of social interactions and interaction partners) and their subjective perception of social relationships (i.e., loneliness and sense of belonging) using diary assessment (Lindsay et al., 2019; Smyth et al., 2017). To test whether direct contact with the recipient(s) is an essential ingredient of the intervention, I compared the effects of regular acts of kindness with anonymous acts of kindness involving no contact with the recipients.

Participants were randomly assigned to complete one of the three 14-day interventions: (1) acts of kindness (AK), (2) anonymous acts of kindness (AAK), or (3) active control (i.e., taking a break). Participants completed daily measures of social connection and psychological well-being for three days before and after the intervention. I hypothesized that daily acts of kindness would increase daily social contact and sense of belonging, and decrease loneliness, compared to the control condition. Given the lack of prior research on anonymous acts of kindness, I did not formulate a directional hypothesis about the effects of anonymous acts of kindness compared to the control condition.
3.2 Method

3.2.1 Participants

Undergraduate students at the University of British Columbia were invited to participate in a study about “daily acts and social integration” for course credit. Of the 494 enrolled participants, 407 (83.5% women, 16.2% men, 0.3% non-binary; $M_{age} = 20.7$) came to the laboratory and were randomly assigned to one of three intervention conditions. Our final analyses include all participants with available pre- and post-intervention data ($n = 388$ in diary analyses; $n = 389$ in in-lab survey analyses). See Figure 3.1 for a CONSORT flowchart.

![Figure 3.1 CONSORT flowchart](chart.png)
3.2.2 Procedure

The study design and expected outcomes were pre-registered\(^8\) and the preregistration, data, study materials, and analysis code are available at: https://osf.io/b374j/?view_only=4ad548aba61e40f5b48a34ad347f9c5f). All participants were contacted via email to provide consent and complete a pre-intervention diary assessment for three days before their first lab visit. During the first lab visit, participants first completed a survey questionnaire that included global measures of loneliness, psychological well-being, and perceptions of others. Participants were then randomly assigned to one of the three interventions: to perform acts of kindness (AK condition, \(n = 134\)), to perform anonymous acts of kindness (AAK condition, \(n = 135\)), or to take a short break each day (active control condition, \(n = 138\)). Participants were asked to perform their assigned activities daily for the next 14 days, starting the next day. At the end of each day, they were asked to report what (if any) intervention-relevant activities they had performed, and—for participants in the AK and AAK conditions—their relationship with any recipients (a close other, acquaintance, or stranger). Immediately after completing the 14-day intervention, participants were asked to complete a post-intervention diary assessment for 3 days, followed by returning to the laboratory to complete post-intervention self-report global measures. See Figure 3.2, for a graphical representation of the study procedure.

\(^8\) This preregistration includes a second hypothesis regarding the intervention’s effects on decreasing self-focus. As this dissertation focuses on the intervention’s effects on daily social connection, the details and analyses for this hypothesis are not included in this chapter. However, they can be provided upon request.
Figure 3.2 Study procedure

Note. The green colour coding indicates diary assessments at pre- and post-intervention. The blue colour coding indicates global assessment at pre- and post-intervention.

3.2.3 Interventions

All participants were instructed to perform at least one act per day for 14 days based on their intervention condition. During the first lab visit, they received detailed instructions (see Appendix B.1 for full instructions), along with several examples of the type of acts that they could perform for their assigned intervention. Participants in the AK or AAK conditions were all given a pamphlet detailing the definition of acts of kindness (acts that aim to benefit others) and an explanation of two types of kind acts: making someone happy (e.g., giving a surprise gift) and acting compassionately to a person in distress (e.g., checking in with someone needing emotional support; see Appendix B.2 for the full list). Participants were then instructed to perform acts of kindness in one of the two categories for the following week, and in the other category for the second week (order randomized). All instructions for the AK and AAK conditions were the same except that AAK participants were asked to perform their acts of kindness anonymously. Examples of anonymous acts of kindness included leaving an anonymous thank-you note or making an anonymous donation online (see Appendix B.3 for the full list).

Participants in the control condition were instructed to take a short break each day. To match the structure of the control condition with the other two conditions, they were instructed to take a
break by doing activities falling into two different categories, for one week each (order randomized): *having fun* (e.g., listen to a song; watching a funny video) and *relaxing and resting* (e.g., going on a walk; having a cup of tea; see Appendix B.4 for the full list).

To enhance participant engagement in the intervention activities (Ekers et al., 2014), participants were asked to plan some of the activities relevant to their intervention (either acts of kindness or breaks) that they could engage in during the intervention period. They were instructed to spend at least five minutes brainstorming and writing down five specific acts that they could incorporate into their day for each week. All planning was done on the pamphlets, which they were asked to carry with them throughout the intervention.

### 3.2.4 Measures

The primary outcomes assessing social contact, loneliness, and sense of belonging were measured for 3 days pre-intervention and for 3 days post-intervention, using daily diary assessments. The pre-intervention diary assessments were administered online on 2 weekdays plus 1 weekend day (Thursday–Saturday or Sunday–Tuesday; (Lindsay et al., 2019) before the first lab visit. Post-intervention diary assessments assessed the same variables; because they were scheduled for the 3 days directly following participants’ completion of the 14-day intervention, they also fell on 2 weekdays and 1 weekend day. Diary survey links were sent by email at 8:00 p.m. each day and remained active for the next 5 hours. In addition, participants also completed global measures of loneliness and other measures (e.g., subjective well-being) in the laboratory.

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9 Diary-assessed subjective well-being outcomes were included in the data to address secondary questions. However, since this dissertation focuses on the intervention’s effects on daily social connection, this chapter does not include the details of the well-being outcomes.
before and after the intervention, and daily records on intervention activities during the 14-day intervention period.

3.2.4.1 Pre- and Post-intervention Diary Assessment

**Objective Social Contact.** On the 3 evenings directly before and after the 14-day intervention period, participants were asked to report their total number of social interactions and total number of interaction partners for that day. Social interaction was defined as back-and-forth communication lasting for at least three minutes, including in-person, phone, and online conversations (Lindsay et al., 2019). Number of total social interactions was assessed with a single item (“How many social interactions did you have today?”). Number of interaction partners was measured with a single item (“How many different people did you interact with today?”) for three types of social ties: strong ties (“someone who you are close to and can confide in”), weak ties (i.e., “someone you are not very close to and unlikely to confide in”), and strangers (i.e., “someone you have never spoken to before”; Sandstrom & Dunn, 2014).

**Subjective perception of loneliness and sense of belonging.** Participants’ daily experience of loneliness was assessed with three items adapted from a loneliness scale (Hughes et al., 2004; “Overall today, to what extent did you feel the following? e.g., I felt like I lacked companionship”). All items were evaluated on a 7-point scale (1 = Not at all - 7 = Very much). I averaged scores on these three items to create a single composite measure assessing daily loneliness (Cronbach’s $\alpha = .89$; $M = 2.21$, $SD = 1.32$).

---

10 Some individuals reported a very large number of interactions (e.g., for total interactions, 150-463). I winsorized responses more than $3 \text{SD}$ from the mean by replacing them with the next largest value within the range of $3 \text{SD}$ from the mean (Whillans et al., 2017). While retaining outliers did not substantially change the direction of effects, some results became nonsignificant.
Daily sense of belonging was assessed using the average of two items (“I felt close to people”; “I felt like I belonged to a community (like a social group, school, or neighborhood)”) adapted from a social connectedness scale (Lee et al., 2001). The Cronbach’s alpha for these two items was 0.89. Both items were evaluated on a 7-point Likert scale (1 = Not at all - 7 = Very much; $M = 4.94$, $SD = 1.47$).

### 3.2.4.2 Pre- and Post-intervention Global Assessment

**Baseline Trait Loneliness.** Baseline trait loneliness was measured during participants’ first lab visit using an eight-item version of the UCLA Loneliness Scale (e.g., “There is no one I can turn to”; ULS-8, Russell et al., 1980). Items were rated on a 4-point scale ranging from 1 (Never) to 4 (Often). Trait loneliness was calculated by averaging responses on the eight items, with the mean score being 2.05 ($SD = 0.68$). The Cronbach’s alpha for the eight items was 0.66.

In addition, global measures of psychological well-being (positive and negative affect, life satisfaction, and meaning in life) were assessed during the lab visits both before and after the intervention. These measures were not included in the dissertation.

### 3.2.4.3 Daily Survey of Intervention Activities

During the 14-day intervention period, each participant was asked to complete a short daily survey on their intervention activities they had performed at the end of each day. Based on their daily reports, participants’ intervention adherence and details about their intervention were assessed. On average, participants filled out 13.05 daily reports ($SD = 2.33$) and reported engaging in a total of 10.11 intervention activities ($SD = 2.98$) over the 14-day period.
Participants’ intervention experience in the regular and the anonymous acts of kindness conditions were also assessed.

**Number of Acts of Kindness Performed and Relationship with the Recipients.** Participants were asked to report whether or not they performed their intervention activity that day (e.g., “Did you perform an act of kindness today?”). The total number of days participants performed acts of kindness (out of 14 days) was then calculated. Participants also reported their relationship with their recipients – whether they were strong ties (“someone who you are close to and can confide in”), weak ties (“someone you are not very close to and unlikely to confide in”), or strangers (“someone you have never spoken to before”). The proportion of kindness acts performed toward each relationship type was calculated.

**Perceived Effortfulness.** Participants’ perception of the effortfulness of completing each act of kindness was assessed using a single item (“How effortful did the act feel to you?”), on a 7-point scale (1 = *Not at all* to 7 = *Very much*).

**Perceived Effectiveness.** Participants’ belief about the effectiveness of each act of kindness was assessed with two items – one assessing the effectiveness of the act in increasing the recipient’s happiness (“To what extent do you think this act was effective in increasing the recipient’s happiness?”) and the other assessing the effectiveness of the act in decreasing the recipient’s distress (“To what extent do you think this act was effective in decreasing the recipient’s difficulties?”). Responses ranged from 1 (*Not at all*) to 7 (*Very much*).
3.2.5 Analysis Plan

3.2.5.1 Preliminary Analyses

I first tested whether there were condition differences in demographics and baseline characteristics using Chi-squared tests ($\chi^2$ tests for categorical variables) and Analyses of Variance (ANOVA for continuous variables).

3.2.5.2 Primary Analyses

I first describe and justify the deviations from my preregistered analysis plan in my primary analyses. I initially preregistered a plan to conduct a repeated-measures ANOVA to compare the effect of condition on diary-assessed social outcomes (total interactions, interaction partners, loneliness, and sense of belonging) before and after the intervention. However, after preregistration, I discovered that two covariates were closely linked to all diary-assessed outcomes: whether the reports were collected before or after COVID-19 pandemic restrictions were imposed (specifically, I found increased loneliness and decreased number of weak-tie and stranger interaction partners at post-pandemic) and which day of the week participants completed the report (specifically, I found increased loneliness on Saturday, and decreased numbers of weak-tie interaction partners during the weekdays). Additionally, there was an unexpectedly high amount of missing data, which undermines the power of repeated-measured ANOVA.

To accommodate these covariates and maximize the utility of our data, I conducted multilevel modeling with observations clustered within participants. Specifically, I tested time (pre- or post-intervention) × condition (AK, AAK, or control) interactions for diary-assessed outcomes (including social behaviours, loneliness, and sense of belonging) using multilevel
modeling (lme4 package in R; Bates et al., 2015) with restricted maximum likelihood estimation. The general analysis model, which was adapted from Lindsay et al. (2019), is shown below:

\[
\gamma_b = \gamma_{0e} + \gamma_{1e}(AAK_i) + \gamma_{2e}(Control_i) + \gamma_{10}(Post_r) + \gamma_{11}(AAK_i) \times (Post_r) + \gamma_{12}(Control_i) \times (Post_r) + \gamma_{20}(Covid) + \gamma_{30}(Monday_i) + \gamma_{21}(Tuesday_i) + \gamma_{22}(Wednesday_i) + \gamma_{23}(Thursday_i) + \gamma_{20}(Friday_i) + \gamma_{30}(Saturday_i) + u_b + r_i
\]

with \(\gamma_{0i}\) denoting the fixed component of intercept for the reference group (Control condition) at pre-intervention, and \(\gamma_{1i}\) reflecting the time \(\times\) condition interactions. For all analyses, I controlled for the day of week (with Sunday as a reference group) and whether the diary reports were collected before or after the COVID-19 pandemic. Time (pre- or post-intervention), day of week, and COVID-19 (pre or post) were modeled at Level 1, whereas intervention condition was modeled at Level 2. \(u_{0i}\) and \(r_{0i}\) represented within- and between-participant error, respectively. To unpack significant time \(\times\) condition interactions (if any), I additionally calculated simple slopes for participants in different conditions (Hughes & Team, 2020; Long, 2019).

### 3.2.5.3 Exploratory Analysis 1: Moderating Role of Trait Loneliness

After testing the preregistered, primary hypotheses, I additionally ran a follow-up analysis to test whether the intervention effect for daily-assessed loneliness varied depending on participants’ baseline trait loneliness. I tested the three-way interaction of time (pre- or post-

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11On March 16, 2020, the university halted in-person research due to concerns about the spread of COVID-19. I continued data collection for participants already in the intervention period or who had completed it by moving their post-intervention sessions online. Given the potential impacts of pandemic-related changes, I controlled for “post-pandemic” (1 = data collected on/after March 16, 2020, 0 = before). 229 participants completed either the intervention or post-intervention assessments after this date.
intervention), condition (AAK, AK or control), and trait loneliness (continuous) using the following model:

\[
\text{DailyLoneliness}_n = \gamma_{00} + \gamma_{01}(\text{AAK}_n) + \gamma_{02}(\text{Control}_n) + \gamma_{03}(\text{TraitLoneliness}) + \gamma_{10}(\text{Post}_n) \\
+ \gamma_{11}(\text{AAK}_n) \times (\text{Post}_n) \times (\text{TraitLoneliness}) + \gamma_{12}(\text{Control}_n) \times (\text{Post}_n) \times (\text{TraitLoneliness}) \\
+ \gamma_{20}(\text{Covid}) + \gamma_{30}(\text{Monday}_n) + \gamma_{40}(\text{Tuesday}_n) + \gamma_{50}(\text{Wednesday}_n) + \gamma_{60}(\text{Thursday}_n) + \gamma_{70}(\text{Friday}_n) + \gamma_{80}(\text{Saturday}_n) + u_n + r_n
\]

Simple slopes were calculated to probe the nature of the interaction for individuals who reported higher (i.e., 1 SD above the average) and lower levels of trait loneliness (i.e., 1 SD below the average).

3.2.5.4 Preregistered Analyses

For transparency, I also conducted the preregistered repeated-measures ANOVA, testing time (pre or post-intervention) × condition (AK, AAK or control) interactions. To examine whether trait levels of loneliness would moderate the effects, I also tested the three-way interaction of time (pre or post-intervention), condition (AAK, AK or control), and trait loneliness (continuous) using a repeated-measures ANOVA.

3.2.5.5 Exploratory Analysis 2: Comparison between Regular versus Anonymous Acts of Kindness

I additionally conducted post-hoc analyses to compare participants’ intervention experiences in the regular versus anonymous of acts of kindness conditions using their daily records within each intervention period. Specifically, using independent samples t-tests, I examined whether there were differences between the two conditions in the total number of acts performed,
perceived effortfulness, proportion of kind acts towards close versus distant others (weak ties and strangers), and perceived effectiveness of the acts of kindness.

3.3 Results

3.3.1 Preliminary Analyses

There were no condition differences on major demographic characteristics, including age, gender, and ethnicity (see Table 3.1 for details). There were no baseline condition differences in the primary social outcomes (i.e., diary-assessed number of total interactions, number of interaction partners, loneliness and sense of belonging).

Table 3.2 presents means, standard deviations, and intercorrelations of study variables and control variables. Daily levels of loneliness and belongingness were correlated with the number of total social interactions, strong-tie interaction partners, and weak-tie interaction partners, but not with the number of stranger interaction partners. Day of week was associated with the number of weak-tie interaction partners and loneliness. COVID-19 was correlated with fewer numbers of weak-tie and stranger interaction partners.
Table 3.1 Demographic characteristics and preintervention differences on key variables

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Full Sample (N = 407)</th>
<th>AK (n = 134)</th>
<th>AAK (n = 135)</th>
<th>Control (n = 138)</th>
<th>Condition Difference Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>20.72 (2.85)</td>
<td>20.62 (2.47)</td>
<td>21.01 (3.63)</td>
<td>20.54 (2.27)</td>
<td>F(2, 403) = 1.07</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>χ²(2) = 2.41</td>
</tr>
<tr>
<td>Men</td>
<td>66 (16.22%)</td>
<td>25 (18.66%)</td>
<td>24 (17.78%)</td>
<td>17 (12.32%)</td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>340 (83.53%)</td>
<td>109 (81.34%)</td>
<td>110 (81.48%)</td>
<td>121 (87.68%)</td>
<td></td>
</tr>
<tr>
<td>Non-binary</td>
<td>1 (0.25%)</td>
<td>0 (0%)</td>
<td>1 (0.74%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>χ²(14) = 9.51</td>
</tr>
<tr>
<td>East Asian</td>
<td>153 (37.59%)</td>
<td>49 (36.57%)</td>
<td>48 (35.56%)</td>
<td>56 (40.58%)</td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>110 (27.03%)</td>
<td>39 (29.1%)</td>
<td>40 (29.63%)</td>
<td>31 (22.46%)</td>
<td></td>
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<tr>
<td>South Asian</td>
<td>53 (13.02%)</td>
<td>20 (14.93%)</td>
<td>12 (8.89%)</td>
<td>21 (15.22%)</td>
<td></td>
</tr>
<tr>
<td>Southeast Asian</td>
<td>32 (7.86%)</td>
<td>6 (4.48%)</td>
<td>14 (10.37%)</td>
<td>12 (8.7%)</td>
<td></td>
</tr>
<tr>
<td>Middle Eastern</td>
<td>23 (5.65%)</td>
<td>9 (6.72%)</td>
<td>8 (5.93%)</td>
<td>6 (4.35%)</td>
<td></td>
</tr>
<tr>
<td>African</td>
<td>5 (1.23%)</td>
<td>1 (0.75%)</td>
<td>2 (1.48%)</td>
<td>2 (1.45%)</td>
<td></td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>5 (1.23%)</td>
<td>2 (1.49%)</td>
<td>1 (0.74%)</td>
<td>2 (1.45%)</td>
<td></td>
</tr>
<tr>
<td>Other/Mixed</td>
<td>25 (6.14%)</td>
<td>8 (5.97%)</td>
<td>9 (6.67%)</td>
<td>8 (5.8%)</td>
<td></td>
</tr>
<tr>
<td>Prefer Not to Answer</td>
<td>1 (0.25%)</td>
<td>0 (0%)</td>
<td>1 (0.74%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>Primary Social Outcomes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total social interactions</td>
<td>10.85 (11.72)</td>
<td>11.06 (12.50)</td>
<td>9.52 (8.27)</td>
<td>11.87 (13.42)</td>
<td>F(2, 385) = 1.69</td>
</tr>
<tr>
<td>Unique strong-tie partners</td>
<td>4.06 (3.47)</td>
<td>4.17 (4.26)</td>
<td>3.91 (2.79)</td>
<td>4.10 (3.18)</td>
<td>F(2, 385) = 0.23</td>
</tr>
<tr>
<td>Unique weak-tie partners</td>
<td>3.21 (3.96)</td>
<td>3.02 (4.04)</td>
<td>3.13 (3.42)</td>
<td>3.45 (4.33)</td>
<td>F(2, 385) = 0.65</td>
</tr>
<tr>
<td>Unique stranger-partners</td>
<td>1.55 (4.53)</td>
<td>1.43 (3.27)</td>
<td>1.46 (5.35)</td>
<td>1.75 (4.76)</td>
<td>F(2, 385) = 0.49</td>
</tr>
<tr>
<td>Diary-assessed loneliness (1-7)</td>
<td>2.23 (1.35)</td>
<td>2.39 (1.49)</td>
<td>2.24 (1.30)</td>
<td>2.07 (1.23)</td>
<td>F(2, 385) = 2.63</td>
</tr>
<tr>
<td>Diary-assessed belongingness (1-7)</td>
<td>4.94 (1.45)</td>
<td>4.84 (1.50)</td>
<td>4.93 (1.47)</td>
<td>5.04 (1.40)</td>
<td>F(2, 385) = 0.96</td>
</tr>
</tbody>
</table>

Note. Data are reported as means (SD) or counts (%). All ps > .05
Table 3.2. Means, standard deviations, and intercorrelations of diary-assessed study variables and control variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
<th>7.</th>
<th>8.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number of interactions</td>
<td>.39***</td>
<td>.48***</td>
<td>.50***</td>
<td>-.05*</td>
<td>.14***</td>
<td>.00</td>
<td>-.03</td>
<td></td>
</tr>
<tr>
<td>2. Strong-tie interaction partners</td>
<td>.19***</td>
<td>.05*</td>
<td>-.13***</td>
<td>.27***</td>
<td>-.03</td>
<td>.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Weak-tie interaction partners</td>
<td>.20***</td>
<td>-.05*</td>
<td>.14***</td>
<td>-.08***</td>
<td>-.12***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Stranger interaction partners</td>
<td>.00</td>
<td>.02</td>
<td>-.02</td>
<td>-.06**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Loneliness</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>-.51***</td>
<td>-.05*</td>
<td>.03</td>
<td></td>
</tr>
<tr>
<td>6. Belongingness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.03</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>7. Day of Week</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td>8. Covid-19</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

*Mean (SD)*/ %

<table>
<thead>
<tr>
<th></th>
<th>11.09</th>
<th>4.14</th>
<th>3.05</th>
<th>1.45</th>
<th>2.21</th>
<th>4.94</th>
<th>11.71%</th>
<th>5.99%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(12.84)</td>
<td>(3.53)</td>
<td>(4.15)</td>
<td>(4.31)</td>
<td>(1.32)</td>
<td>(1.47)</td>
<td>11.71%</td>
<td>5.99%</td>
</tr>
<tr>
<td>N</td>
<td>2147</td>
<td>2146</td>
<td>2118</td>
<td>2091</td>
<td>2145</td>
<td>2146</td>
<td>2152</td>
<td>2152</td>
</tr>
</tbody>
</table>

*Note. N = 388, n = 2091-2152 for daily reports. Day of week coded 0 = Sunday, 1 = all other days. COVID-19 coded 0 = prior to March 16, 2020, 1 = after March 16, 2020. *p < .05. **p < .01. ***p < .001
3.3.2 Intervention Effects on Daily Social Contact and Loneliness

I predicted that the acts of kindness (AK) intervention would increase daily social interactions and number of interaction partners, decrease loneliness, and increase sense of belonging compared with the active control condition. I also tested whether anonymous acts of kindness (AAK) would have equivalent effects (See Table 3.3 and Table 3.4).

Diary analyses showed that the AK intervention increased the number of daily social interactions compared to the control intervention but not the AAK intervention. There was a significant time × condition effect on total number of daily social interactions (AK vs. Control: \( b = 2.33, SE = 0.95, t(2132) = 2.46, p = .014 \); AAK vs. Control: \( b = 1.07, SE = 0.95, t(2132) = 1.13, p = .260 \)). When comparing the time × condition interaction model to the model containing only main effects, there was a statistically significant reduction in deviance (chi-square = 6.07, \( df = 2, p = .048 \)), suggesting that the addition of the interaction term significantly improved model fit. When calculating simple slopes, I found a significant increase after intervention in the AK condition (\( b = 1.78, SE = 0.70, t(2132) = 2.55, p = .011 \)) but not in the AAK (\( b = 0.52, SE = 0.70, t(2132) = 0.75, p = .455 \)) or control (\( b = -0.55, SE = 0.67, t(2132) = -0.82, p = .414 \)) conditions (see Figure 3.3).

I also analyzed the total number of unique individuals with whom each participant interacted daily. There was a significant time × condition effect on the number of unique strong-tie interaction partners (AK vs. Control: \( b = 0.77, SE = 0.26, t(2131) = 2.93, p = .003 \); AAK vs. Control: \( b = 0.15, SE = 0.26, t(2131) = 0.56, p = .573 \); Figure 3.3). When comparing the time × condition interaction model to the model containing only main effects, there was a statistically significant reduction in deviance (chi-square = 9.51, \( df = 2, p = .009 \)). In simple slope analyses, I found that there was a significant increase after intervention in the AK condition (\( b = 0.54, SE = \)
0.19, \( t(2131) = 2.81, p = .005 \) but not in the AAK (\( b = -0.08, SE = 0.19, t = -0.40, p = .693 \)) or control (\( b = -0.23, SE = 0.19, t(2131) = -1.21, p = .227 \)) conditions. However, I did not observe a significant time \( \times \) condition effect on the number of unique weak-tie interaction partners (AK vs. Control: \( b = 0.16, SE = 0.37, t(2103) = 0.42, p = .674 \); AAK vs. Control: \( b = -0.37, SE = 0.37, t(2103) = -1.00, p = .320 \)) or stranger interaction partners (AK vs. Control: \( b = 0.31, SE = 0.41, t(2076) = 0.76, p = .448 \); AAK vs. Control: \( b = 0.60, SE = 0.41, t(2076) = 1.47, p = .142 \)). When comparing the time \( \times \) condition interaction model to the model containing only main effects, the reduction in deviance was not significant for either weak-tie interaction partners (chi-square = 2.05, \( df = 2, p = .360 \)) or stranger interaction partners (chi-square = 2.17, \( df = 2, p = .338 \)).

I did not find evidence that the intervention affected participants’ loneliness or sense of belonging. Specifically, I did not observe a significant time \( \times \) condition effect on daily level of loneliness (AK vs Control: \( b = -0.07, SE = 0.11, t(2130) = -0.69, p = .490 \); AAK vs Control: \( b = 0.08, SE = 0.11, t(2130) = 0.77, p = .443 \)) or daily level of sense of belonging (AK vs Control: \( b = -0.06, SE = 0.12, t(2131) = -0.49, p = .621 \); AAK vs Control: \( b = -0.07, SE = 0.12, t(2131) = -0.62, p = .538 \); see Table 3.4 for details). When comparing the time \( \times \) condition interaction model to the model containing only main effects, the reduction in deviance was not significant for either loneliness (chi-square = 2.04, \( df = 2, p = .360 \)) or sense of belonging (chi-square = 0.43, \( df = 2, p = .806 \)).
Table 3.3. Multilevel mixed effects linear model results for daily social contact

<table>
<thead>
<tr>
<th></th>
<th>Number of Interactions</th>
<th></th>
<th>Strong-tie Interaction Partners</th>
<th></th>
<th>Weak-tie Interaction Partners</th>
<th></th>
<th>Stranger Interaction Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$b$ (SE)</td>
<td>$t(2132)$</td>
<td>$b$ (SE)</td>
<td>$t(2131)$</td>
<td>$b$ (SE)</td>
<td>$t(2103)$</td>
<td>$b$ (SE)</td>
</tr>
<tr>
<td>Intercept</td>
<td>11.81 (1.22)</td>
<td>9.72***</td>
<td>3.89 (0.33)</td>
<td>11.89***</td>
<td>2.45 (0.36)</td>
<td>6.83***</td>
<td>1.57 (0.37)</td>
</tr>
<tr>
<td>Time (Pre vs. Post)</td>
<td>-0.55 (0.67)</td>
<td>-0.82</td>
<td>-0.23 (0.19)</td>
<td>-1.21</td>
<td>-0.08 (0.26)</td>
<td>-0.30</td>
<td>-0.37 (0.29)</td>
</tr>
<tr>
<td>Condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AK vs. Control</td>
<td>-0.90 (1.34)</td>
<td>-0.67</td>
<td>0.05 (0.36)</td>
<td>0.14</td>
<td>-0.46 (0.37)</td>
<td>-1.25</td>
<td>-0.35 (0.38)</td>
</tr>
<tr>
<td>AAK vs. Control</td>
<td>-2.36 (1.35)</td>
<td>-1.76</td>
<td>-0.2 (0.36)</td>
<td>-0.56</td>
<td>-0.3 (0.37)</td>
<td>-0.8</td>
<td>-0.34 (0.39)</td>
</tr>
<tr>
<td>Condition × Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>AK vs. Control × Time</td>
<td>2.33 (0.95)</td>
<td>2.46*</td>
<td>0.77 (0.26)</td>
<td>2.93**</td>
<td>0.16 (0.37)</td>
<td>0.42</td>
<td>0.31 (0.41)</td>
</tr>
<tr>
<td>AAK vs. Control × Time</td>
<td>1.07 (0.95)</td>
<td>1.13</td>
<td>0.15 (0.26)</td>
<td>0.56</td>
<td>-0.37 (0.37)</td>
<td>-1.0</td>
<td>0.60 (0.41)</td>
</tr>
<tr>
<td>Covid (γ20)</td>
<td>-1.55 (1.10)</td>
<td>-1.41</td>
<td>0.22 (0.30)</td>
<td>0.73</td>
<td>-1.8 (0.41)</td>
<td>-4.41***</td>
<td>-1.3 (0.45)</td>
</tr>
<tr>
<td>Day of Week</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monday</td>
<td>1.43 (0.80)</td>
<td>1.80</td>
<td>0.19 (0.22)</td>
<td>0.87</td>
<td>1.67 (0.31)</td>
<td>5.39***</td>
<td>0.02 (0.34)</td>
</tr>
<tr>
<td>Tuesday</td>
<td>0.97 (0.81)</td>
<td>1.20</td>
<td>0.08 (0.22)</td>
<td>0.36</td>
<td>1.1 (0.32)</td>
<td>3.47**</td>
<td>0.03 (0.35)</td>
</tr>
<tr>
<td>Wednesday</td>
<td>1.39 (5.64)</td>
<td>0.25</td>
<td>0.3 (1.57)</td>
<td>0.19</td>
<td>0.36 (2.16)</td>
<td>0.17</td>
<td>0.16 (2.38)</td>
</tr>
<tr>
<td>Thursday</td>
<td>0.05 (1.15)</td>
<td>0.04</td>
<td>0.36 (0.31)</td>
<td>1.16</td>
<td>1.2 (0.35)</td>
<td>3.41**</td>
<td>0.24 (0.37)</td>
</tr>
<tr>
<td>Friday</td>
<td>0.25 (1.15)</td>
<td>0.22</td>
<td>0.47 (0.31)</td>
<td>1.52</td>
<td>1.29 (0.35)</td>
<td>3.67***</td>
<td>0.44 (0.37)</td>
</tr>
<tr>
<td>Saturday</td>
<td>-0.66 (1.15)</td>
<td>-0.57</td>
<td>0.14 (0.31)</td>
<td>0.44</td>
<td>0.67 (0.35)</td>
<td>1.92</td>
<td>0.41 (0.37)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>95% CI</th>
<th>Estimate</th>
<th>95% CI</th>
<th>Estimate</th>
<th>95% CI</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within-subject error (rti)</td>
<td>8.94</td>
<td>(8.66, 9.22)</td>
<td>2.49</td>
<td>(2.40, 2.58)</td>
<td>3.48</td>
<td>(3.36, 3.60)</td>
<td>3.81</td>
</tr>
<tr>
<td>Between-subject error (μ0i)</td>
<td>9.42</td>
<td>(8.70, 10.26)</td>
<td>2.49</td>
<td>(2.30, 2.71)</td>
<td>2.15</td>
<td>(1.93, 2.37)</td>
<td>2.06</td>
</tr>
</tbody>
</table>

|                          | ICC                    | .53                   | .50                             | .27                   | .22                             |

Notes: $N = 388, n = 2147$ for daily reports; using all available data and controlling for day of week and time of beginning of pandemic. Reference group: Time: pre-intervention; Condition: Control; Day of week: Sunday. COVID-19 coded 1 = after March 16, 2020, 0 = prior to March 16, 2020; ICC = Intraclass correlation coefficient. *$p < .05$, **$p < .01$, ***$p < .001$. 57
Table 3.4. Multilevel mixed effects linear model results for daily loneliness and belongingness

<table>
<thead>
<tr>
<th></th>
<th>Loneliness</th>
<th></th>
<th></th>
<th>Belongingness</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(b) ((SE))</td>
<td>(t(2130))</td>
<td></td>
<td>(b) ((SE))</td>
<td>(t(2131))</td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>1.94 (0.12)</td>
<td>16.11***</td>
<td></td>
<td>5.16 (0.13)</td>
<td>38.4***</td>
<td></td>
</tr>
<tr>
<td>Time (Pre vs. Post)</td>
<td>-0.03 (0.08)</td>
<td>-0.43</td>
<td>0.03 (0.08)</td>
<td>0.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AK vs. Control</td>
<td>0.28 (0.13)</td>
<td>2.18*</td>
<td>-0.20 (0.14)</td>
<td>-1.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AAK vs. Control</td>
<td>0.10 (0.13)</td>
<td>0.77</td>
<td>-0.09 (0.15)</td>
<td>-0.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition × Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AK vs. Control × Pre vs. Post</td>
<td>-0.07 (0.11)</td>
<td>-0.69</td>
<td>-0.06 (0.12)</td>
<td>-0.49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AAK vs. Control × Pre vs. Post</td>
<td>0.08 (0.11)</td>
<td>0.77</td>
<td>-0.07 (0.12)</td>
<td>-0.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Covid ((T_{20}))</td>
<td>0.38 (0.12)</td>
<td>3.15**</td>
<td>0.00 (0.13)</td>
<td>-0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day of Week</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monday</td>
<td>0.18 (0.09)</td>
<td>1.95</td>
<td>-0.12 (0.10)</td>
<td>-1.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tuesday</td>
<td>0.14 (0.09)</td>
<td>1.57</td>
<td>-0.17 (0.10)</td>
<td>-1.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wednesday</td>
<td>0.47 (0.64)</td>
<td>0.73</td>
<td>-0.93 (0.69)</td>
<td>-1.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thursday</td>
<td>0.10 (0.12)</td>
<td>0.85</td>
<td>-0.03 (0.13)</td>
<td>-0.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Friday</td>
<td>0.10 (0.12)</td>
<td>0.89</td>
<td>-0.09 (0.13)</td>
<td>-0.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saturday</td>
<td>0.24 (0.12)</td>
<td>2.05*</td>
<td>-0.27 (0.13)</td>
<td>-2.08*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>95% CI</th>
<th>Estimate</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within-subject error (r_0)</td>
<td>1.02</td>
<td>(0.98, 1.05)</td>
<td>1.10</td>
<td>(1.06, 1.14)</td>
</tr>
<tr>
<td>Between-subject error (\mu_0)</td>
<td>0.85</td>
<td>(0.78, 0.93)</td>
<td>0.97</td>
<td>(0.88, 1.06)</td>
</tr>
</tbody>
</table>

\(ICC\) .41 .44

Note. \(N = 388\), \(n = 2146\) for daily reports; using all available data and controlling for day of week and time of beginning of pandemic. Reference group: Time: pre-intervention; Condition: Control; Day of week: Sunday. COVID-19 coded 1 = after March 16, 2020, 0 = prior to March 16, 2020. *\(p < .05\), **\(p < .01\), ***\(p < .001\).
Figure 3.3. Simple slopes for significant time × condition effects

Note. Significant increases are indicated for the number of social interactions and the number of strong-tie interaction partners in the Kindness condition.

*p < .05. **p < .01
3.3.3 Moderating Role of Trait Loneliness on Intervention Effects

Given the unexpected nonsignificant effect of acts of kindness on diary-assessed loneliness, I conducted an exploratory follow-up analysis to examine whether trait levels of loneliness would moderate the effects. Specifically, because average trait loneliness scores in the sample were relatively low (\( M = 2.05, SD = 0.68 \), on a 4-point scale), I speculated that the regular acts of kindness intervention might only buffer daily loneliness in participants who reported higher-than-average baseline levels of trait loneliness. Indeed, I found significant three-way interactions among time, condition, and baseline trait loneliness (AK vs Control: \( b = -0.36, SE = 0.16, t(2078) = -2.28, p = .023 \); AAK vs Control: \( b = 0.26, SE = 0.16, t(2078) = 1.55, p = .12 \)).

When comparing the full three-way interaction model to the model containing two-way interaction terms, there was a statistically significant reduction in deviance (\( \chi^2 = 13.52, df = 2, p = .001 \)), suggesting that the addition of the interaction term significantly improved model fit.

To estimate the size of the effects of the intervention for high and low lonely individuals, I calculated simple slopes. Results showed that the time \( \times \) condition effect was significant for individuals who reported high trait levels of loneliness (i.e., 1 \( SD \) or more above the mean, average loneliness score of 2.73 or above), such that lonelier individuals in the AK condition—but not the other two conditions—showed a significant decrease in diary-assessed loneliness (simple slope for AK condition = -0.36, \( SE = 0.11, t(2078) = -3.41, p = .001 \)). There was no significant time \( \times \) condition effect for individuals who reported lower trait loneliness (i.e., 1 \( SD \) below the mean, average loneliness score 1.38 or below; Figure 3.4 and Table 3.5).

\(^{13}\) I additionally tested whether trait levels of loneliness would moderate the intervention effect on diary-assessed sense of belonging, but did not find any significant three-way interactions among time, condition, and baseline trait loneliness (AK vs Control: \( b = -0.05, SE = 0.17, p = .75 \); AAK vs Control: \( b = -0.16, SE = 0.18, p = .39 \)).
Table 3.5. Simple effects for the interaction between trait loneliness and interventions on daily loneliness across time

<table>
<thead>
<tr>
<th></th>
<th>AK</th>
<th></th>
<th></th>
<th>AAK</th>
<th></th>
<th></th>
<th>Control</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( b ) (SE)</td>
<td>( t ) (2078)</td>
<td>( p )</td>
<td>( b ) (SE)</td>
<td>( t ) (2078)</td>
<td>( p )</td>
<td>( b ) (SE)</td>
<td>( t ) (2078)</td>
<td>( p )</td>
</tr>
<tr>
<td>Low Trait Loneliness (-1 SD)</td>
<td>0.18 (0.11)</td>
<td>1.58</td>
<td>.113</td>
<td>-0.07 (0.11)</td>
<td>-0.62</td>
<td>.535</td>
<td>-0.02 (0.10)</td>
<td>-0.16</td>
<td>.870</td>
</tr>
<tr>
<td>Average Trait Loneliness (Mean)</td>
<td>-0.09 (0.08)</td>
<td>-1.13</td>
<td>.259</td>
<td>0.07 (0.08)</td>
<td>0.89</td>
<td>.375</td>
<td>-0.05 (0.08)</td>
<td>-0.61</td>
<td>.539</td>
</tr>
<tr>
<td>High Trait Loneliness (+1 SD)</td>
<td>-0.36 (0.11)</td>
<td>-3.41</td>
<td>.001**</td>
<td>0.21 (0.12)</td>
<td>1.80</td>
<td>.072</td>
<td>-0.08 (0.11)</td>
<td>-0.72</td>
<td>.473</td>
</tr>
</tbody>
</table>

\(*p < .01.\)
Figure 3.4. Three-way interaction plot for high and low trait loneliness

*Note.* The left panel shows the two-way interaction of time and condition for participants with low trait loneliness, while the right panel shows the two-way interaction for participants with high trait loneliness. A significant decrease in daily loneliness was observed in the Kindness condition among participants with high trait loneliness.

**p < .01.**
3.3.4 Preregistered Analyses of Intervention Effects

Using a repeated-measures ANOVA, I did not observe a significant time × condition effect on the total number of daily social interactions \((F(2, 2139) = 1.16, p = .31)\). For the total number of unique interaction partners, there was a marginally significant time × condition effect on the number of unique strong-tie interaction partners, \((F(2, 2138) = 2.82, p = .06)\). I did not observe a significant time × condition effect on the number of unique weak-tie interaction partners \((F(2, 2110) = 0.44, p = .64)\) or stranger interaction partners \((F(2, 2083) = 0.97, p = .38)\). I did not observe a significant time × condition effect on diary-assessed loneliness \((F(2, 2137) = 0.53, p = .74)\), or sense of belonging \((F(2, 2138) = 0.17, p = .85)\).

However, I found significant three-way interactions among time, condition, and baseline trait loneliness \((F(2, 2085) = 5.20, p = .006)\). I calculated simple slopes in order to estimate the size of the intervention effects for high- and low-lonely individuals. Results showed that lonelier individuals (i.e., 1  SD or more above the mean, average loneliness score of 2.73 or above) in the AK condition (but not the other two conditions) showed a significant decrease in diary-assessed loneliness \((t = -4.99, p < .001)\).

In summary, using repeated-measures ANOVA, instead of multilevel modeling, did not substantially change the direction of effects, but some of the results became either non-significant (for the total number of interactions) or marginally significant (for the number of unique strong-tie interaction partners). This difference might be due to the high amount of missing data (missing daily reports) undermining the power of repeated-measures ANOVA as well as the different estimation methods (repeated-measures ANOVA, ordinary least square vs. multilevel modeling, maximum likelihood).
3.3.5 Comparison of Intervention Experiences between Regular versus Anonymous Acts of Kindness

I additionally conducted post-hoc analyses to compare participants’ intervention experiences in the regular versus anonymous of acts of kindness conditions using their daily records within each intervention period (see Table 3.6 for details).

I first tested the possibility that anonymous acts of kindness may be more effortful to perform and participants were therefore less compliant to intervention activities, which I reasoned could have reduced the intervention effects. There was no significant difference in the perceived effortfulness of performing kind acts (mean difference: 0.04, p = .83) or in the number of reports participants completed during the intervention period (mean difference: 0.12, p = .66) between the AK and the AAK conditions. However, participants in the AK condition performed a greater number of kind acts compared to participants in the AAK condition (mean difference: 0.89, p = .02).

I also tested whether participants in the AAK condition, on average, performed their anonymous kind acts more toward distant others (rather than close others), which could also decrease the positive effects of the AAK intervention, given that stronger effects of prosocial behaviour are observed when the kind act is performed toward close others (Aknin et al., 2011; Whillans et al., 2016). To test this, I compared the proportion of kind acts performed toward close others and the proportion of kind acts performed toward distant others (strangers and acquaintances) between the AK and the AAK conditions. Results showed that participants in the AAK condition performed more kind acts toward strangers (mean difference: 0.33, p < .001), whereas participants in the AK condition performed more kind acts for close others (mean difference: 0.29, p < .001) and acquaintances (mean difference: 0.05, p = .03).
Lastly, I tested whether participants in the AK condition perceived their acts of kindness to be more effective than participants in the AAK condition perceived their acts to be. Participants in the AK condition perceived their kindness acts to be more effective in increasing happiness (mean difference: 0.36, $t = 2.11$, $p = .04$) and decreasing stress (mean difference: 0.54, $t = 2.73$, $p = .007$) for their recipients, compared to participants’ perceptions in the AAK condition (See Table 3.6 for details).

Table 3.6. Comparison of intervention experiences in the AK and AAK conditions

<table>
<thead>
<tr>
<th></th>
<th>AK ($n = 133$)</th>
<th>AAK ($n = 133$)</th>
<th>$t$-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of reports</td>
<td>12.49 (2.02)</td>
<td>12.37 (2.39)</td>
<td>$t = 0.44$, $p = .66$</td>
</tr>
<tr>
<td>Number of kind acts performed</td>
<td>9.89 (2.75)</td>
<td>9.00 (3.21)</td>
<td>$t = -2.44$, $p = .02$</td>
</tr>
<tr>
<td>Perceived effortfulness</td>
<td>4.62 (1.66)</td>
<td>4.57 (1.69)</td>
<td>$t = 0.21$, $p = .83$</td>
</tr>
<tr>
<td>Proportion of kind acts for strong ties</td>
<td>0.65 (0.21)</td>
<td>0.36 (0.29)</td>
<td>$t = 9.20$, $p &lt; .001$</td>
</tr>
<tr>
<td>Proportion of kind acts for weak ties</td>
<td>0.20 (0.18)</td>
<td>0.15 (0.16)</td>
<td>$t = 2.23$, $p = .03$</td>
</tr>
<tr>
<td>Proportion of kind acts for strangers</td>
<td>0.16 (0.16)</td>
<td>0.49 (0.29)</td>
<td>$t = -11.53$, $p &lt; .001$</td>
</tr>
<tr>
<td>Perceived effectiveness: Increasing happiness</td>
<td>7.09 (1.31)</td>
<td>6.73 (1.48)</td>
<td>$t = 2.11$, $p = .04$</td>
</tr>
<tr>
<td>Perceived effectiveness: Decreasing stress</td>
<td>5.83 (1.50)</td>
<td>5.28 (1.73)</td>
<td>$t = 2.73$, $p = .007$</td>
</tr>
</tbody>
</table>

Note. Data are reported as means (SD).
3.4 Discussion

In a preregistered, randomized controlled trial, I found that a 14-day prosocial engagement intervention increased participants’ daily social contact after the intervention period. In addition, my exploratory analyses suggest that engaging in prosocial behavior may reduce daily feelings of loneliness for chronically lonely individuals. I did not find equivalent effects when participants engaged in prosocial behavior anonymously, suggesting that direct contact with the recipient(s) may be an essential mechanism underlying positive social and emotional effects of prosocial engagement.

3.4.1 Intervention Effects on Increasing Daily Social Contact

This intervention designed to promote daily prosocial engagement increased participants’ daily social interactions even after the end of the intervention, compared to the active control condition. A lasting change in daily social behavior even after the end of the intervention may potentially prolong the positive effects of engaging in prosocial activities by building and strengthening participants’ long-term social relationships. In particular, this intervention increased the number of unique close others with whom participants interacted on a daily basis (rather than strangers or acquaintances), suggesting that it might have primarily enhanced close relationships. However, the lack of effect of this intervention on the number of unique acquaintances or strangers with whom participants interacted, could have been due at least in part to measurement error or noise in daily self-reports of interactions with weak social ties. To obtain more accurate estimates of interactions with weaker social ties in future work, participants could be asked to carry a tally counter and count each interaction with non-close others (Sandstrom & Dunn, 2014).
There are several potential underlying mechanisms. First, prosocial engagement during the intervention might have strengthened participants’ connections with their recipients, potentially leading to more frequent interactions with the same people afterwards. It is also possible that the intervention created a habit in participants. For instance, in another study in which participants were prompted to have repeated conversations with strangers, the participants noticed more opportunities to talk to strangers after the week-long intervention ended (Sandstrom et al., 2022). As such, after being prompted to repeatedly engage in prosocial behaviors for 2 weeks, participants might have noticed more opportunities for prosocial behaviors in their surroundings even after the intervention period, which could lead to more interactions with the recipients. Further research will be needed to determine whether participants continue to interact with the previous recipients of their prosocial behaviors and/or whether they continue to engage more in prosocial behavior even after the intervention ends.

3.4.2 Loneliness-Reducing Effects for the Chronically Lonely

My pre-registered hypothesis that the kindness intervention would decrease participants’ loneliness and increase sense of belonging across the entire sample was not supported by the current study results. Given the correlation between daily social contact and perceived social connection (e.g., Sandstrom and Dunn, 2014), these nonsignificant findings appear inconsistent with the findings that the kindness intervention increased daily social interactions. After noting that the mean trait loneliness in our sample was only 2.05 on a 4-point scale, I speculated that there might have been a floor effect for participants who had a low baseline level of loneliness. The post-hoc analysis indeed showed that the kindness intervention significantly reduced diary-
assessed loneliness only for participants who reported high baseline loneliness (23.1% reduction in loneliness scores).

Acting prosocially is a common way to reconnect with others when one’s social needs are unmet (e.g., Maner et al., 2007). For example, prior longitudinal findings suggest that volunteering can buffer the increase in loneliness that occurs immediately following the loss of a spouse (Carr et al., 2018). My findings are consistent with and extend these findings by showing that engaging in prosocial behavior could effectively mitigate perceived isolation among those who were formerly feeling disconnected. Chronically lonely individuals are often more sensitive to potential social threats, such as rejection and criticism, which hinders their social engagement and aggravates their sense of loneliness (J. T. Cacioppo & Hawkley, 2009). Prosocial activities and the associated experience of positive social contact might be effective in countering negative social expectations and reinforcing approach and engagement with others instead of avoidance (Alden & Trew, 2013; Trew & Alden, 2015). Future research is needed to examine if prolonged engagement in prosocial behavior could alter negative social cognitions that chronically lonely individuals tend to have, which could lead to more positive longer-term effects on their social relationships.

I did not find evidence that the kindness intervention increased daily sense of belonging, regardless of participants’ baseline trait loneliness levels. The follow-up analyses showed that participants in the acts of kindness condition performed more than half of their kind acts (64.5%) toward close others, as opposed to acquaintances (19.6%) or strangers (15.9%; see Table 3.6). Thus, engagement in prosocial behavior directed at close others may promote daily contact and connection with those close others, but may not necessarily promote a sense of belonging to a larger social group or community. Future research is necessary to determine whether engagement
in prosocial behavior that is specifically targeted toward non-close others in the same social
group (e.g., school, workplace, or neighbourhood) can promote participants’ overall sense of
belonging to those social groups. Alternatively, it is possible that while this kindness intervention
is effective at mitigating the perceived lack of connection of chronically lonely individuals, it is
not necessarily effective for promoting their general sense of social connectedness and
belongingness. Loneliness and sense of belonging are related yet distinct dimensions (Walton &
Brady, 2017); thus, mitigating loneliness may not always overlap with increasing sense of
belonging in a certain social context (Walton & Brady, 2017). However, given that recent
findings have pointed to the unique contributions that feelings of belonging have on young
adults’ mental health beyond loneliness (Dutcher et al., 2022), future research could examine the
conditions under which a kindness intervention (or engaging in prosocial behavior more broadly)
can be effective at promoting young adults’ sense of belonging in specific social contexts such as
universities.

3.4.3 Why Are Anonymous Acts of Kindness Not as Effective as Acts of Kindness?

In my analysis, anonymous acts of kindness involving no direct contact with the recipient(s)
were not as effective at improving daily social connection, suggesting that direct contact with the
recipient(s) may be an essential ingredient for positive effects. Direct contact with recipients
provides participants with opportunities to perceive the impact of their action more directly (even
through minimal feedback such as a smile) and to feel a sense of connection with the
recipient(s), leading to a greater emotional reward (Aknin, Dunn, Sandstrom, et al., 2013; Aknin,
Dunn, Whillans, et al., 2013; Inagaki & Orehek, 2017; Lok & Dunn, 2020). The follow-up
analyses indeed demonstrated that participants in the anonymous condition perceived their
actions to be less effective in reducing the distress and also less effective in increasing the happiness of the recipient(s) (See Table 3.6).

The follow-up analyses also showed that participants in the anonymous acts of kindness condition performed a higher proportion of their kind acts toward strangers (49.2%) than did participants in the non-anonymous acts of kindness condition (15.9%; Table 3.6). Engaging in prosocial behavior directed toward close others rather than non-close others, with whom they are less likely to interact with in the future, is also suggested to lead to a greater happiness in givers (Aknin et al., 2011). The difference in the recipients of acts of kindness may also account for some of the differences observed in the effects of anonymous versus regular acts of kindness.

3.4.4 Strengths, Limitations, and Future Directions

To my knowledge, this is the first experiment to test the effect of acts of kindness (or engagement in prosocial behavior more broadly) on daily social connection changes using diary assessment. Lindsay and colleagues (2019) showed that their intervention (mindfulness training) effects were more sensitively captured by diary assessment than global assessment of loneliness and social contact, in line with research that has identified discrepancies between daily experiences and global evaluations of experiences (Kahneman, 2011).

I also acknowledge several limitations of the study. A sample of undergraduate students may not be representative of the general population, consisting of people from different walks of life, and especially of socially isolated or marginalized populations. Future research is needed to test the effectiveness of this intervention for different populations in communities, particularly those in the periphery of networks.
To test whether direct contact with the recipient(s) is an essential ingredient for the intervention effects, I compared the effects of regular acts of kindness with those of anonymous acts of kindness. However, it should be noted that regular acts of kindness do not necessarily involve direct contact with the recipients (e.g., a non-anonymous online donation), and this study did not directly assess participants’ direct contact with recipients. A well-controlled future study would be necessary to clarify the mechanisms driving the observed differences between anonymous and non-anonymous prosocial behavior.

Further research will also be needed to examine the mechanisms underlying the intervention’s effects. For instance, while the current study assessed social relationship outcomes only before and after the intervention period, future studies could also examine social relationship outcomes during the intervention period. This would allow for examining how the prosocial behaviors that participants engage in are associated with their social outcomes on the same day, such as whether people have more interactions with others and feel more connected on the days on which they engage in the instructed prosocial behaviors.

The current study did not include any follow-up assessments. Future research will be needed to test whether the short-term changes found in this research would be sustained—or even compounded—over extended periods of time. I speculate that continued engagement in prosocial behavior may lead to broader social relationship benefits by prompting enduring positive shifts in actors’ social perceptions and more active daily social behaviors. Future longitudinal research is needed to confirm whether two-week intervention can lead to the sustained changes in social cognitions and social relationships.
3.4.5 Conclusion

Despite the increasing recognition of social connection as a public health priority, effective evidence-based interventions that can mitigate both loneliness (i.e., perceived isolation) and lack of social contact (i.e., objective isolation) remain scarce. This study provides a promising route to address these public health concerns by supporting the effectiveness of an acts of kindness intervention in promoting daily social connections. Prosocial behavior intended to benefit another person is an essential ingredient for a cooperative and harmonious society (Hui et al., 2020). The findings extend the growing literature on a wide range of benefits of prosocial behavior by demonstrating that it could also be an effective component of a self-delivered and low-cost intervention that promotes social contact and mitigates loneliness.

While this study shows promising results among university students, further testing is needed to determine whether this kindness intervention would be effective in the general population. The result of our exploratory analysis suggests that the kindness intervention was effective in reducing daily loneliness in chronically lonely individuals. This suggests that prosocial behaviour interventions may be well suited for helping lonely populations restore their social connections. In Study 3, I aim to test whether this intervention promoting daily prosocial behaviour is effective for members of the broader community reporting a high baseline level of loneliness.
Chapter 4: The Effects of an Intervention Increasing Daily Prosocial Behaviours among Lonely Community Adults

4.1 Introduction

4.1.1 Overall Aim and Research Questions

In this study, I tested whether an intervention that increases daily prosocial behaviour is effective in decreasing loneliness and increasing social contact among lonely community adults. To tailor the intervention for lonely participants, I adapted the components of an emerging intervention design, the Just-in-Time Adaptive Intervention (JITA), which delivers timely support during moments of need. Furthermore, I evaluated the intervention's effects across different timeframes (immediate and longer-term) and explored a potential mechanism by examining changes in participants' interpersonal perceptions before versus after the intervention.

4.1.2 The Effects of Delivering the Right Support at the Right Time

Advancements in mobile technology have increased interest in JITAIs in the context of behavioural health interventions designed to provide “timely” intervention. JITAIs account for the fact that individuals’ needs change rapidly in their natural environments (Nahum-Shani et al., 2015, 2018). Based on time-varying information (e.g., mood, location, or social interactions), JITAIs aim to deliver intervention components when a person is most in need (in a vulnerable state) and receptive (for a review, see Nahum-Shani et al., 2017). For instance, a JITAI for smoking cessation might involve delivering intervention messages when participants report experiencing risk factors for smoking relapse, such as smoking urges, emotional distress, and cigarette availability (Hébert et al., 2018). JITAIs have been increasingly used for a wide range of behavioral health interventions, including for smoking (Hébert et al., 2018; Naughton et al., 2021), alcohol overconsumption (Coughlin et al., 2021), physical activity (Adams et al., 2013;
More recently, JITAI s have been applied to mental health interventions, including for depression (Everitt et al., 2021).

As this approach is relatively new, evidence for its efficacy is quite limited, yet promising. Initial evidence suggests that tailoring the timing of an intervention’s delivery can improve its efficacy, beyond providing a comparable static intervention. One proof-of-concept study using a stress-management intervention compared the efficacy of just-in-time (JIT) intervention reminders (delivered when participants reported high stress or negative affect) with randomly scheduled ones (Smyth & Heron, 2016). The authors found that participants who received the JIT reminders experienced better intervention outcomes (including fewer stressors, lower negative affect, less alcohol consumption, and better sleep quality). Another intervention study for smoking cessation also provided preliminary findings that intervention messages tailored to participants’ psychological states (i.e., smoking urges, stress) were more effective in reducing those triggers compared to non-tailored messages (Hébert et al., 2018).

Within the framework of JITAI s, the goal of the acts of kindness intervention is to increase participants’ social contact and decrease their loneliness after the intervention period (distal outcomes; intervention effectiveness). To achieve this goal, the intervention aims to increase participants’ engagement in daily prosocial behaviours during the intervention period as a psychological lever (proximal outcome; see Figure 4.1 for details).
Based on this framework, I adapted and developed strategies to tailor the acts of kindness intervention for lonely participants (see details in Interventions below). To facilitate participants’ behaviour change (i.e., proximal outcome), I first identified common psychological barriers experienced by lonely individuals, such as negative social expectations and social vigilance, that may reduce their engagement in prosocial behaviours. I then incorporated intervention components to address these barriers and promote desired changes in behaviour and cognition.

To address negative expectations regarding how others would respond to their prosocial acts, I implemented a “saying-is-believing” exercise, which helps participants internalize the intervention message (Aronson et al., 2002; Higgins & Rholes, 1978; Walton & Cohen, 2011). In the context of the acts of kindness intervention, the intervention message emphasized the positive impacts of engaging in prosocial behaviours that are often underestimated. I also incorporated “implementation intentions,” which are effective in supporting goal-directed behaviour change, especially when individuals face challenges in altering their behaviour (Gollwitzer, 1999; Sheeran et al., 2013; Wieber et al., 2015).

Second, I integrated just-in-time intervention support to deliver timely support during participants’ vulnerable states (see Figure 4.2 for details). The findings from Study 1 suggest that
individuals experiencing chronic loneliness may encounter more psychological barriers on their lonelier days, increasing their susceptibility to a vicious cycle of loneliness, social vigilance, and social withdrawal. Therefore, it is crucial to intervene, particularly during periods of elevated loneliness that represent their vulnerable states.

Participants’ state of vulnerability was assessed every evening. When participants reported loneliness levels above their personal average in the evening, I delivered a brief intervention (“booster exercise”) to facilitate their engagement in prosocial behaviours the following day. Specifically, I employed implementation intentions as the just-in-time intervention option, which guided them in creating a concrete plan for the next day’s intervention activities using an “if-then-why” format (i.e., “If I encounter situation X, then I will initiate action Y, because of Z”). However, participants were not informed of this decision rule and were told that the booster exercise would be provided on random evenings (see Figure 4.2).

- Distal outcome: decreased daily loneliness and increased daily social contact after the intervention
- Proximal outcome: daily prosocial behaviour
- Decision point (Timescale): every day
- State of vulnerability: when participants report experiencing loneliness “more than usual” during the day
- Intervention option: implementation intentions for the following-day intervention activity
- Decision rule: If participants report “more than usual” daily loneliness in the evening survey, they will be asked to do an “implementation intentions” exercise.

**Figure 4.2. JITAI framework for Kindness Intervention design**

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To ensure that prior-day loneliness rating is a reliable predictor of loneliness the following day, I conducted additional analysis using the data from Study 1. The results showed that elevated levels of loneliness on the prior day were significantly associated with next-day loneliness, even after adjusting for the person-average loneliness ($b = 0.06, SE = 0.03, t = 2.05, p = .04$). These additional findings provide support for the use of prior-day assessments in detecting participants’ vulnerable states.
4.1.3 The Effects of the Kindness Intervention Targeting Lonely Community Adults

Study 2 showed promising findings regarding the effectiveness of the kindness intervention among undergraduate students. Given that the Study 2 findings suggest that this intervention might be particularly effective for lonely participants, Study 3 tested the effects of the kindness intervention in adults in the broader community who report above-average loneliness. I also asked participants to complete a follow-up survey 1 month after program completion to test the time scale of intervention effects: whether effects that are observable immediately after the intervention ends will last after a month elapses or, conversely, whether the intervention may have “sleeper” effects that take longer to emerge (as observed in Fritz et al. (2021)’s exploratory analyses).

In this study, I also explored whether this kindness intervention had an effect on changes in participants’ interpersonal perceptions following the intervention, as a potential mechanism underlying the intervention’s effects. Theories of loneliness have pointed to hypervigilance to social threats as key mechanisms underlying chronic loneliness and social withdrawal (e.g., Cacioppo & Hawkley, 2009). Therefore, effective interventions for loneliness should target these maladaptive, negative social cognitions (Hickin et al., 2021; Masi et al., 2011). In this study, I specifically assessed changes in participants’ snap judgements of strangers’ traits. Recent research on interpersonal perception has shown that people quickly form trait impressions of individuals, even from brief exposure to their faces (Andrew H. Chwe & Freeman, 2023). Especially for chronically lonely individuals who tend to be hypervigilant to social threat cues (S. Cacioppo et al., 2015, 2016), snap judgments of others’ traits, such as perceiving them to be warm and trustworthy rather than hostile and untrustworthy, could play a crucial role in decisions to engage or withdraw from social opportunities.
I expected that prosocial engagement would have positive effects on interpersonal perceptions, for two likely reasons. One likely reason is projection, where individuals tend to overperceive similar emotions, goals, and behaviours in targets by projecting their own psychological states (Kawada et al., 2004; Niedenthal et al., 2000; Peters & Overall, 2020). A prosociality-based intervention that activates participants’ prosocial motivation and behaviours may lead participants to perceive similar goals and emotions when making judgements about the target, such as perceiving the target as warmer or more generous. Second, the experience of positive interactions during prosocial engagement may foster more positive social expectations and counter negative perceptions of others.

4.2 Methods

4.2.1 Participants

I recruited 208 community adults (70.5% women, 26.1% men, 3.4% non-binary; \(M_{age} = 43.5\)) through Facebook advertisements and email advertisements in collaboration with a local community organization (United Way British Columbia), to participate in a project titled “Community Wellness Program.” Eligible participants were English-speaking mobile electronic device owners who scored (>= 7) on the three-item Loneliness Scale (reflecting higher-than-average loneliness; Hughes et al., 2004).

The preregistered recruitment strategy aimed to recruit as many participants as possible from October 2022 to April 2023, with a minimum sample size of 200 required to proceed with the analyses. Based on the simulation-based power analysis (Arend & Schäfer, 2019), assuming medium to large Intraclass Correlation Coefficients (ICC), and medium-sized standardized random slope variances, the final sample size (208 participants at Level 2, 6 measurement points
per participant at Level 1) yields a 80% power to detect a minimum standardized effect size
of .11 for Level 1 direct effects (i.e., Time (pre- or post-intervention)), a minimum standardized
effect size of .22 - .24 for Level 2 direct effects (i.e., Condition (kindness or control)), and a
minimum standardized effect size of .34 for cross-level interactions (i.e., Time × Condition
interaction; see Tables 5, 6, 7 in Arend & Schäfer, 2019 for details).

4.2.2 Procedure

The study design and expected outcomes were pre-registered
(https://osf.io/j86n5/?view_only=7522c3a932064d619b0c6d15839e97). In this randomized
controlled trial, participants were prescreened for eligibility through an online survey. The
overall procedure was similar to that of Study 2 (see Figure 4.3). Enrolled participants first
completed pre-intervention diary assessments for three consecutive days before their first lab
visit. During their first virtual lab session, they completed a survey questionnaire (including
measures of baseline social networks and loneliness) and were randomly assigned to either
perform acts of kindness (Kindness condition, n = 105) or take a break each day (active control
condition, n = 103) for 2 weeks.

The first lab visit included intervention activities, including a saying-is-believing exercise
(Aronson et al., 2002; Higgins & Rholes, 1978; Walton & Cohen, 2011) and implementation
intentions (Gollwitzer, 1999; Sheeran et al., 2013). Participants then completed 2 weeks of at-
home intervention activities and the post-intervention 3-day diary assessments. In their second
virtual lab session, participants completed a post-intervention survey questionnaire. Participants
were recontacted 1 month after the program ends to complete a follow-up survey, after which
they were debriefed and compensated for their participation. See *Figure C.1* for a CONSORT flowchart.

![Flowchart](image)

**Figure 4.3. Study procedure**

*Note.* The green colour coding indicates diary assessments at pre- and post-intervention. The blue colour coding indicates global assessment at three timepoints: pre-intervention, post-intervention, and 1-month follow up.

The intervention procedure followed that of Study 2, with the exception of the changes and additions described in this chapter. During participants’ first virtual lab session, the saying-is-believing exercise was included to help them internalize the intervention message by getting them to advocate a particular attitude in their own words (Aronson et al., 2002; Higgins & Rholes, 1978; Walton & Cohen, 2011). In the kindness condition, participants first read the stories of three individuals who each shared a personal experience of receiving someone else’s acts of kindness and how it impacted their daily life. Participants were then asked to write a short essay about the value of acts of kindness and encouraged to share their own experiences (“Now, we would love to hear your story and thoughts! Why do you think that acts of kindness could be more meaningful and impactful to receivers than what people often assume?”). In the control condition, participants read the stories of three individuals who shared a personal experience of engaging in daily breaks and how it impacted their daily life. Control participants were also asked to write a short essay about the value of taking breaks and were encouraged to share their
own experiences (“Now, we would love to hear your thoughts! Why do you think that taking a short break could bring more benefits than what people often assume?”).

Next, to increase the likelihood that participants would translate their intervention goals into actions, they were asked to make an activity plan for the next 2 weeks using implementation intentions (Gollwitzer, 1999; Sheeran et al., 2013). Specifically, they were asked to visualize the next 2 weeks and to plan when, where, and how they would initiate their intervention activities (i.e., kindness; taking a break; e.g., “Please specify (1) when, (2) where, (3) to whom, and (4) what acts of kindness you would like to perform”). Participants were also encouraged to specify circumstances that might inhibit their intervention activities (such as distractions, habitual behaviour, or temptation to avoid social interaction) and make “If-then” plans (i.e., “If situation A arises (anticipated situation), then I will initiate action Y (goal-directed behaviour”)”). Participants were given a physical copy of a workbook in which they wrote down their plans, to serve as a reminder for them during the 2 weeks. During this lab session, participants were informed that they would be asked to complete a brief survey every evening about their daily experiences. Participants were also told that they would receive an extra “booster” exercise on some “random” evenings to support their intervention activities.

At the end of each day, participants were asked to report how many (if any) and which intervention-relevant activities they performed. In the case of the kindness condition, they were asked to classify the recipient(s) using the categories of close other, acquaintance, or stranger. I added a question assessing their current mood states (“How much did you feel each of the following moods today?”; happy, calm, tired, nervous, lonely; 1 = less than usual, 2 = as usual, 3 = more than usual). If their response to the loneliness rating was 3 (more than usual), participants were guided to create implementation intentions for the next day. Specifically, they
were asked to visualize their next day and make a concrete plan for the act of kindness they would perform that day. They were also asked to identify potential barriers they might encounter (e.g., “If I don’t feel like interacting with anyone,”) and make an action plan (“then I will motivate myself by reflecting on a time when someone’s kindness made me smile or cheered me up”). See Appendix C for the full intervention instructions.

4.2.3 Measures

The primary outcomes assessing social contact and loneliness were measured for 3 days preintervention and for 3 days postintervention, using the same daily diary assessments.

4.2.3.1 Pre- and Post-intervention Diary Assessment

Subjective Perception of Loneliness. The same measures were used as in Study 2 to assess participants’ daily experiences of loneliness.

Objective Social Contact. The same measures were used as in Study 2 to assess number of social interactions and number of interaction partners. To help participants accurately recall their interactions in Study 3, they were asked first to list each interaction they had throughout the day before counting the numbers of social interactions and interaction partners (“To be able to accurately recall, please list each interaction you had in the box below and the initials of people you interacted with.”). Per my preregistration, I winsorized responses more than 3 $SD$ from the mean (e.g., participants reporting 100 or 180 social interactions in one day) by replacing them with the largest value in the dataset for that variable that was within the range of 3 $SD$ from the mean (Whillans et al., 2017).
4.2.3.2 Pre- and Post-intervention Global Assessment

Global measures of loneliness and social contact (i.e., the number of regular contacts) were assessed at three timepoints: at pre-intervention (during the first lab visit), post-intervention (during the second lab visit), and 1 month after completing post-intervention measures.

Retrospective loneliness. Loneliness was assessed with the eight-item revised UCLA Loneliness Scale (e.g., “I lack companionship.”; Russell et al., 1980) that uses a 4-point Likert scale (1 = Never – 4 = Often) for each item. A composite score was calculated by averaging scores on each item (Cronbach’s $\alpha = 0.84$, $M = 2.45$, $SD = 0.63$ at pre-intervention; Cronbach’s $\alpha = 0.84$, $M = 2.32$, $SD = 0.62$ at post-intervention).

Social Network Size. As an objective indicator of social contact, the number of people in each participant’s social network was assessed with the Social Network Index (SNI; Cohen et al., 1997). Social network size was defined as the total number of people participants regularly interact with (at least once every 2 weeks) across 12 different social roles (e.g., family members, relatives, close friends, neighbours; $M = 15.41$, $SD = 10.09$ at pre-intervention; $M = 15.00$, $SD = 8.57$ at post-intervention).

Interpersonal Perception Task. The Interpersonal Perception Task was adapted from Maner et al. (2005) with 8 neutral faces, 1 face for each combination of one race (Asian, Black, Latino, White) × one sex (Male vs. Female), chosen from the Chicago Face Database (Ma et al., 2015). Each of the faces was shown on-screen for one second in a randomized order. Participants were told that the individuals in the photos could be displaying “micro-expressions” and were asked to try to judge their personality using their intuition (“To what extent do you judge the target to be?”; “Using your intuition (gut reaction), try to respond quickly!”; see Appendix C.3. for details). For each of the faces, participants rated their impressions using a 9-point bipolar
response scale for four traits: warmth (1 = hostile, critical” to 9 = “warm, approachable”; \(M = 5.50, SD = 0.95\) at pre-intervention), trustworthiness (1 = “untrustworthy” to 9 = “trustworthy” at pre-intervention; \(M = 5.77, SD = 0.95\)), optimism (1 = “cynical, pessimistic” to 9 = “trusting, optimistic” at pre-intervention; \(M = 5.40, SD = 0.95\)), generosity (1 = “self-centered” to 9 = “generous, altruistic” at pre-intervention; \(M = 5.60, SD = 0.93\)).

4.2.3.3 Daily Records of Intervention Activities

During the 14-day intervention period, each participant was asked to complete a short daily survey on the intervention activities they had performed at the end of each day. Based on their daily reports, participants’ intervention adherence was assessed. On average, participants filled out 12.55 daily reports (\(SD = 1.70,\) range = 6-14) and reported engaging in a total of 10.50 intervention activities (\(SD = 2.50,\) range = 3-14) over the 14-day period.

Participants’ intervention experience was also assessed in the daily surveys. Participants in the Kindness condition were asked to report whether or not they performed their intervention activity that day (e.g., “Did you perform an act of kindness today?”). The total number of days participants performed acts of kindness (out of 14 days) was then calculated. Participants also reported their relationship with their recipients – whether they were strong ties (“someone who you are close to and can confide in”), weak ties (“someone you are not very close to and unlikely to confide in”), or strangers (“someone you have never spoken to before”). The proportion of kindness acts performed toward each relationship type was calculated. Participants in the Control condition were asked to report whether or not they performed their intervention activity alone or with others (“Did your break involve any interaction with others?”). The proportion of breaks involving interactions with others (i.e., social breaks) was calculated.
4.2.4 Analysis Plan

4.2.4.1 Preliminary Analyses

I first tested whether there were condition differences in demographics and baseline primary outcomes using Chi-squared ($\chi^2$) tests for categorical variables and independent samples $t$-tests for continuous variables. In addition, I tested whether there were differences between the two conditions in participants’ intervention compliance (i.e., number of daily reports, number of acts performed), using independent samples $t$-tests.

4.2.4.2 Pre-registered Primary Analyses

As with Study 2, to examine intervention effects on distal outcomes, I tested time (pre- or post-intervention) × condition (Kindness or control) interactions for diary-assessed outcomes (including loneliness and social interactions) using multilevel modeling (lme4 package in R; Bates et al., 2015). As with Study 2 and as preregistered, I controlled for the day of week (with Sunday as a reference group). To unpack any significant time × condition interactions, I additionally calculated simple slopes for participants in the different individual conditions.

4.2.4.3 Exploratory Analysis 1: 1-Month Follow-up outcomes

To explore the trajectory of social outcomes (i.e., global measures of loneliness and social network size) across multiple timepoints (pre-intervention, post-intervention, 1-month follow-up), I used multilevel growth curve modeling to account for repeated measures nested within each participant.
4.2.4.4 Exploratory Analysis 2: Intervention Effects on Interpersonal Perceptions

In addition, I also conducted exploratory analyses testing the intervention’s effects on the changes in interpersonal perceptions, as a potential mechanism of the intervention’s effects on social connection. I tested the time × condition interactions in perceptions of traits in strangers’ neutral faces (bipolar scales; “warm, approachable – hostile, critical”; “trustworthy – untrustworthy”; “trusting, optimistic” – “cynical, pessimistic”; “generous, altruistic” – “self-centered”) across multiple timepoints (pre-intervention, post-intervention, 1-month follow-up), using multilevel growth curve modeling.

4.3 Results
4.3.1 Preliminary Analyses

There were no condition differences on major demographic characteristics, including age, gender, and ethnicity (see Table 4.1 for details). There were no condition differences in diary-assessed and global measures of social outcomes at baseline.

Table 4.2 presents means, standard deviations, and intercorrelations of person-level study variables and control variables. In the current sample, a higher person-average number of daily interactions was correlated with a greater number of unique interaction partners (strong-ties, weak-ties, and strangers), lower levels of diary-assessed and global measures of loneliness, and being older. A higher person-level of diary-assessed loneliness was correlated with a lower number of interactions, fewer strong-tie interaction partners, higher global measures of loneliness, and being a gender other than woman.

I also compared intervention compliance in the Kindness and Control conditions. There was no significant difference in the number of reports participants completed during the intervention
period. However, on average, participants in the Control condition completed intervention activities on more days ($M = 11.00$, $SD = 2.24$) in comparison to participants in the Kindness condition ($M = 10.03$, $SD = 2.69$; mean difference: $0.97$, $p = .005$). Further information is included in Table 4.3 about participants’ intervention activities, including the proportions of participants’ kind acts for strong-ties (47%), weak-ties (29%), and strangers (24%), and the proportion of breaks participants took with others (i.e., social breaks; 34%).
Table 4.1. Demographic characteristics and preintervention differences on key variables

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Full Sample (N = 207)</th>
<th>Kindness (n = 104)</th>
<th>Control (n = 103)</th>
<th>Condition Difference Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>43.47 (12.50)</td>
<td>42.60 (12.64)</td>
<td>44.34 (12.35)</td>
<td>t(203) = -1.00</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td>χ²(3) = 2.87</td>
</tr>
<tr>
<td>Man</td>
<td>54 (26.09%)</td>
<td>23 (22.12%)</td>
<td>31 (30.10%)</td>
<td></td>
</tr>
<tr>
<td>Woman</td>
<td>146 (70.53%)</td>
<td>78 (75.00%)</td>
<td>68 (66.02%)</td>
<td></td>
</tr>
<tr>
<td>Non-binary</td>
<td>7 (3.38%)</td>
<td>3 (2.89%)</td>
<td>4 (3.88%)</td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td>χ² (9) = 0.55</td>
</tr>
<tr>
<td>European</td>
<td>118 (57.00%)</td>
<td>58 (55.29%)</td>
<td>60 (58.25%)</td>
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</tr>
<tr>
<td>East Asian</td>
<td>23 (11.11%)</td>
<td>14 (13.46%)</td>
<td>9 (8.74%)</td>
<td></td>
</tr>
<tr>
<td>Hispanic/Latinx</td>
<td>7 (3.38%)</td>
<td>2 (1.92%)</td>
<td>5 (4.85%)</td>
<td></td>
</tr>
<tr>
<td>South East Asian</td>
<td>6 (2.90%)</td>
<td>3 (2.89%)</td>
<td>3 (2.91%)</td>
<td></td>
</tr>
<tr>
<td>South Asian</td>
<td>4 (1.93%)</td>
<td>1 (0.96%)</td>
<td>3 (2.91%)</td>
<td></td>
</tr>
<tr>
<td>African</td>
<td>3 (1.45%)</td>
<td>1 (0.96%)</td>
<td>2 (1.94%)</td>
<td></td>
</tr>
<tr>
<td>First Nations/Indigenous</td>
<td>3 (1.45%)</td>
<td>2 (1.92%)</td>
<td>1 (0.97%)</td>
<td></td>
</tr>
<tr>
<td>Middle Eastern</td>
<td>1 (0.48%)</td>
<td>0 (0.00%)</td>
<td>1 (0.97%)</td>
<td></td>
</tr>
<tr>
<td>Other/Mixed</td>
<td>42 (20.30%)</td>
<td>23 (22.12%)</td>
<td>19 (18.45%)</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td>χ² (1) = 2.68</td>
</tr>
<tr>
<td>Post-secondary education</td>
<td>197 (95.17%)</td>
<td>102 (98.08%)</td>
<td>95 (92.23%)</td>
<td></td>
</tr>
<tr>
<td>No post-secondary education</td>
<td>10 (4.83%)</td>
<td>2 (1.92%)</td>
<td>8 (7.77%)</td>
<td></td>
</tr>
<tr>
<td>Diary Outcomes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total social interactions</td>
<td>7.93 (7.43)</td>
<td>7.64 (6.29)</td>
<td>8.23 (8.43)</td>
<td>t(206) = -0.57</td>
</tr>
<tr>
<td>Unique strong-tie partners</td>
<td>3.19 (2.51)</td>
<td>3.02 (1.61)</td>
<td>3.34 (3.16)</td>
<td>t(206) = -0.92</td>
</tr>
<tr>
<td>Unique weak-tie partners</td>
<td>2.47 (3.16)</td>
<td>2.36 (2.47)</td>
<td>2.59 (3.73)</td>
<td>t(206) = -0.53</td>
</tr>
<tr>
<td>Unique stranger partners</td>
<td>1.57 (2.79)</td>
<td>1.86 (3.20)</td>
<td>1.27 (2.26)</td>
<td>t(206) = 1.54</td>
</tr>
<tr>
<td>Diary-assessed loneliness</td>
<td>2.78 (1.33)</td>
<td>2.84 (1.29)</td>
<td>2.71 (1.37)</td>
<td>t(206) = 0.68</td>
</tr>
<tr>
<td>Global measures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global measures of loneliness</td>
<td>2.45 (0.63)</td>
<td>2.41 (0.62)</td>
<td>2.50 (0.63)</td>
<td>t(205) = -1.05</td>
</tr>
<tr>
<td>Social network size</td>
<td>15.41 (10.09)</td>
<td>15.56 (11.03)</td>
<td>15.25 (9.09)</td>
<td>t(205) = 0.22</td>
</tr>
</tbody>
</table>

Note. Data are reported as means (SD) or counts (%). All ps > .05. ¹Demographic survey information was lost for one participant in the Kindness condition (n = 104, N = 207). ²p < .05. ²²p < .01.
Table 4.2. Person-level means, standard deviations, and intercorrelations of pre-intervention central study variables and demographics

<table>
<thead>
<tr>
<th>Variable</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
<th>7.</th>
<th>8.</th>
<th>9.</th>
<th>10.</th>
<th>11.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number of interactions (count)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Strong-tie interaction partners (count)</td>
<td>0.30***</td>
<td>0.28***</td>
<td>-0.37***</td>
<td>-0.25***</td>
<td>0.06</td>
<td>0.20**</td>
<td>0.06</td>
<td>-0.04</td>
<td>0.03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Weak-tie interaction partners (count)</td>
<td>0.21**</td>
<td>-0.12</td>
<td>-0.12</td>
<td>0.06</td>
<td>0.07</td>
<td>0.17*</td>
<td>0.03</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Stranger interaction partners (count)</td>
<td>-0.12</td>
<td>0.01</td>
<td>0.09</td>
<td>0.05</td>
<td>0.01</td>
<td>-0.07</td>
<td>-0.03</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Diary-assessed loneliness (1-7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.73*** -0.08 -0.10 -0.15* 0.01 0.04</td>
</tr>
<tr>
<td>6. Global measures of loneliness (1-4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.16* -0.09 -0.08 0.08 0.01</td>
</tr>
<tr>
<td>7. Social Network Size (count)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-0.10 -0.11 -0.15* 0.07</td>
</tr>
<tr>
<td>8. Age (years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.00 0.18* 0.01</td>
</tr>
<tr>
<td>9. Gender (Woman)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.13 0.15* 0.12</td>
</tr>
<tr>
<td>10. Ethnicity (European)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.12</td>
</tr>
<tr>
<td>11. Education (postsecondary)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)/ %</td>
<td>7.93</td>
<td>3.19</td>
<td>2.47</td>
<td>1.57</td>
<td>2.78</td>
<td>2.45</td>
<td>15.41</td>
<td>43.47</td>
<td>70.53%</td>
<td>57.00%</td>
<td>95.17%</td>
</tr>
<tr>
<td></td>
<td>(7.43)</td>
<td>(2.51)</td>
<td>(3.16)</td>
<td>(2.79)</td>
<td>(1.33)</td>
<td>(0.63)</td>
<td>(10.09)</td>
<td>(12.50)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>207</td>
<td>207</td>
<td>207</td>
<td>207</td>
<td>207</td>
<td>207</td>
<td>205</td>
<td>207</td>
<td>207</td>
<td>207</td>
<td></td>
</tr>
</tbody>
</table>

Note. N =207. Daily measures of social interactions and loneliness were person-averaged (person-level means). Gender was coded 1 = woman, 0 = all other genders; education was coded 1= at least some post-secondary education, 0 = no post-secondary education; ethnicity was coded 1 = European, 0 = all other ethnic groups. *p < .05, **p < .01, ***p < .001.
Table 4.3. Comparison of intervention experiences in the Kindness and Control conditions

<table>
<thead>
<tr>
<th></th>
<th>Kindness (n = 104)$^1$</th>
<th>Control (n = 102)$^1$</th>
<th>Condition Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Reports</td>
<td>12.39 (1.76)</td>
<td>12.76 (1.59)</td>
<td>$t(202.72)=1.58$</td>
</tr>
<tr>
<td>Number of Acts Performed</td>
<td>10.03 (2.69)</td>
<td>11.00 (2.24)</td>
<td>$t(198.96) =2.82^{**}$</td>
</tr>
<tr>
<td>Proportion of Kind Acts for Strong Ties</td>
<td>0.47 (0.23)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion of Kind Acts for Weak Ties</td>
<td>0.29 (0.19)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion of Kind Acts for Strangers</td>
<td>0.24 (0.20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion of Social Breaks</td>
<td></td>
<td>0.34 (0.24)</td>
<td></td>
</tr>
</tbody>
</table>

Note. Data are reported as means (SD). $^1$Intervention diary data were missing for two participants, one in the Kindness condition (n = 104), and the other in the Control condition (n = 102).

$^{**}p < .01.$
4.3.2 Preregistered Analysis Results: Intervention Effects on Daily Loneliness and Social Contact

I predicted that participants in the kindness condition would report decreased daily loneliness and an increased number of social interactions and interaction partners compared to participants in the control condition.

I did not observe a significant time × condition effect on daily level of loneliness (\( b = -0.03, SE = 0.13, t(933.92) = -0.26, p = .80 \); see Table 4.4 for details). Instead, there was a marginally significant effect of time (\( b = -0.15, SE = 0.09, t(930.91) = -1.66, p = .097 \)). When calculating within-condition changes for each condition separately, I found a significant decrease from pre- to post-intervention daily loneliness in the Kindness condition (\( b = -0.19, SE = 0.09, t = -2.03, p = .04 \)) and a marginally significant decrease from pre- to post-intervention daily loneliness in the Control condition (\( b = -0.15, SE = 0.09, t = -1.66, p = .10 \); see Table 4.5 and Figure 4.4).

There was a significant time × condition effect on the total number of daily social interactions (\( b = 2.35, SE = 0.87, t(927.50) = 2.70, p = .007 \); see Table 4.4 for details). When comparing the time × condition interaction model to the model containing only main effects, there was a statistically significant reduction in deviance (chi-square = 7.32, \( df = 1, p = .007 \)), suggesting that the addition of the interaction term significantly improved model fit. When calculating simple slopes, I found a significant decrease from pre- to post-intervention daily social interactions in the Control condition (\( b = -1.57, SE = 0.61, t = -2.55, p = .001 \)) but not in the Kindness condition (\( b = 0.78, SE = 0.61, t = 1.27, p = .20 \); see Table 4.5 and Figure 4.4).

I also analyzed the total number of unique individuals who each participant interacted with daily. There was also a significant time × condition effect on the number of unique strong-tie interaction partners (\( b = 0.89, SE = 0.30, t(929.57) = 2.95, p = .003 \); see Table 4.4 for details).
When comparing the time × condition interaction model to the model containing only main effects, there was a statistically significant reduction in deviance (chi-square = 8.71, df = 1, p = .003), suggesting that the addition of the interaction term significantly improved model fit. When calculating simple slopes, I found a significant decrease in the number of unique strong-tie interaction partners from pre- to post-intervention in the Control condition ($b = -0.72, SE = 0.21, t = -3.37, p < .001$) but not in the Kindness condition ($b = 0.17, SE = 0.21, t = 0.79, p = .43$; see Figure 4.4).

I did not observe a significant time × condition effect on the number of unique weak-tie interaction partners ($b = 0.74, SE = 0.48, t(929.81) = 1.55, p = .12$; see Table 4.4 for details) or stranger interaction partners ($b = 0.42, SE = 0.43, t(925.41) = 0.98, p = .33$).
Table 4.4. Multilevel mixed effects linear model results for daily social contact

<table>
<thead>
<tr>
<th></th>
<th>Diary-assessed Loneliness</th>
<th>Number of Interactions</th>
<th>Strong-tie Interaction Partners</th>
<th>Weak-tie Interaction Partners</th>
<th>Stranger Interaction Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$b$ $(SE)$</td>
<td>$t$</td>
<td>$b$ $(SE)$</td>
<td>$t$</td>
<td>$b$ $(SE)$</td>
</tr>
<tr>
<td>Intercept</td>
<td>2.77(0.17)</td>
<td>16.40***</td>
<td>6.97(0.98)</td>
<td>7.14***</td>
<td>3.42(0.31)</td>
</tr>
<tr>
<td>Time (Pre vs. Post)</td>
<td>-0.15(0.09)</td>
<td>-1.66†</td>
<td>-1.57(0.61)</td>
<td>-2.53*</td>
<td>-0.72(0.21)</td>
</tr>
<tr>
<td>Condition</td>
<td>0.12(0.18)</td>
<td>0.68</td>
<td>-0.65(0.98)</td>
<td>-0.76</td>
<td>-0.36(0.30)</td>
</tr>
<tr>
<td>Condition × Time</td>
<td>-0.03(0.13)</td>
<td>-0.26</td>
<td>2.35(0.87)</td>
<td>2.70**</td>
<td>0.89(0.30)</td>
</tr>
<tr>
<td>Day of week</td>
<td>-0.23(0.17)</td>
<td>-1.32</td>
<td>1.22(1.04)</td>
<td>1.17</td>
<td>-0.01(0.34)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>Estimate</th>
<th>Estimate</th>
<th>Estimate</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within-person variance ($\sigma^2$)</td>
<td>1.19</td>
<td>52.39</td>
<td>6.36</td>
<td>15.78</td>
<td>12.65</td>
</tr>
<tr>
<td>Between-person variance ($\tau_{00}$)</td>
<td>1.19</td>
<td>30.85</td>
<td>2.42</td>
<td>4.43</td>
<td>3.41</td>
</tr>
<tr>
<td>ICC</td>
<td>0.50</td>
<td>0.37</td>
<td>0.28</td>
<td>0.22</td>
<td>0.21</td>
</tr>
</tbody>
</table>

Note. $N = 208, n = 1128-1140$ for daily reports; using all available data and controlling for day of week. Reference group: Time: pre-intervention; Condition: Control; Day of week: Sunday; ICC = Intraclass correlation coefficient. *$p < .05$, **$p < .01$, ***$p < .001$. 
### Table 4.5. Diary assessment of loneliness and social contact by condition and timepoint

<table>
<thead>
<tr>
<th></th>
<th>Kindness (n = 105)</th>
<th>Control (n = 103)</th>
<th>t value</th>
<th>t value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-intervention</td>
<td>Post-intervention</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(n = 298)</td>
<td>(n = 275)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diary-assessed loneliness</td>
<td>2.84 (0.09)</td>
<td>2.64 (0.09)</td>
<td>-2.03*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of total interactions</td>
<td>7.74 (0.44)</td>
<td>8.40 (0.65)</td>
<td>1.27</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of strong-tie interaction partners</td>
<td>3.02 (0.12)</td>
<td>3.18 (0.17)</td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of weak-tie interaction partners</td>
<td>2.41 (0.22)</td>
<td>2.74 (0.31)</td>
<td>0.91</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of stranger interaction partners</td>
<td>1.89 (0.27)</td>
<td>1.81 (0.29)</td>
<td>-0.16</td>
<td></td>
</tr>
</tbody>
</table>

Note. Data are reported as means (SE) adjusted for day of week. †p < .10, *p < .05, **p < .01, ***p < .001.

†p < .1
Figure 4.4. Simple slopes for significant time × condition effects on daily social contact

*Note. Significant decreases are indicated for diary-assessed loneliness in Kindness and Control condition, the total number of interactions in Control condition, and the number of strong-tie interaction partners in Control condition. †p < .10, *p < .05, **p < .01, ***p < .001.
4.3.3 Exploratory Analysis Results: Intervention Effects on Global Measures of Loneliness and Social Contact

I further explored changes in global measures of loneliness and social contact across multiple timepoints, from pre-intervention to the 1-month follow up, using multilevel growth curve modeling.

I did not observe a significant time × condition effect on global measures of loneliness from pre-intervention through the 1-month follow up ($b = 0.002, SE = 0.03, t(406.4) = 0.06, p = .95$; see Table 4.6 and Figure 4.5). Instead, there was a significant effect of time ($b = -0.08, SE = 0.02, t(406.6) = -3.57, p < .001$). When calculating simple slopes, I found a significant decrease in daily loneliness from pre-intervention to 1 month follow-up in both the Kindness condition ($b = -0.08, SE = 0.02, t = -3.53, p < .001$) and the Control condition ($b = -0.08, SE = 0.02, t = -3.57, p < .001$).

I did not observe a significant time × condition effect on social network size ($b = 0.52, SE = 0.54, t(404.5) = 0.96, p = .34$). Instead, there was a significant effect of time ($b = -0.99, SE = 0.38, t(404.7) = -2.59, p = .01$). When calculating simple slopes, I found a significant decrease in social network size at 1 month follow-up in the Control condition ($t = -2.59, p = .01$), but the change was not significant in the Kindness condition ($t = -0.47, p = .21$).
Table 4.6. Growth modeling for global measures of loneliness and social contact from pre-intervention to follow-up

<table>
<thead>
<tr>
<th></th>
<th>Global measure of loneliness</th>
<th>Social Network Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$b$ (SE)</td>
<td>$t$</td>
</tr>
<tr>
<td>Intercept</td>
<td>2.56 (0.07)</td>
<td>36.24***</td>
</tr>
<tr>
<td>Time (Pre, Post, Follow-up)</td>
<td>-0.08 (0.02)</td>
<td>-3.57***</td>
</tr>
<tr>
<td>Condition (Kindness vs. Control)</td>
<td>-0.09 (0.10)</td>
<td>-0.95</td>
</tr>
<tr>
<td>Condition × Time</td>
<td>0.00 (0.03)</td>
<td>0.06</td>
</tr>
<tr>
<td>Within-person variance ($\sigma^2$)</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>Between-person variance ($\tau_{00}$)</td>
<td>0.29</td>
<td></td>
</tr>
<tr>
<td>ICC</td>
<td>0.75</td>
<td></td>
</tr>
</tbody>
</table>

Note. $N = 208$, $n = 553$. *$p < .05$, **$p < .01$, ***$p < .001$.

Table 4.7. Global measures of loneliness and social contact by condition and timepoint

<table>
<thead>
<tr>
<th></th>
<th>Kindness ($N = 105$)</th>
<th>Time comparison (t test)</th>
<th>Control ($N = 103$)</th>
<th>Time comparison (t test)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-intervention $(n = 104)^1$</td>
<td>Post-intervention $(n = 105)$</td>
<td>Follow-up $(n = 102)$</td>
<td>Pre – Post</td>
</tr>
<tr>
<td>Global measure loneliness</td>
<td>2.41 (0.06)</td>
<td>2.27 (0.06)</td>
<td>2.25 (0.06)</td>
<td>-3.21**</td>
</tr>
<tr>
<td>Social network size</td>
<td>15.56 (1.08)</td>
<td>15.69 (0.97)</td>
<td>14.36 (0.93)</td>
<td>0.22</td>
</tr>
</tbody>
</table>

Note. Data are reported as means (SE). *Pre-intervention survey information was lost for one participant in the Kindness condition ($n = 104, N = 207$). *$p < .05$, **$p < .01$.  

Figure 4.5. Simple slopes for significant time \times condition effects on global measures of loneliness and social contact

Note. Significant decreases in global measures of loneliness were observed in both the Kindness and Control conditions between the pre-intervention and the 1-month follow-up. A significant decrease in social network size was observed in the Control condition between the pre-intervention and the 1-month follow-up.
4.3.4 Exploratory Analysis Results: Effects on Interpersonal Perceptions

In addition, I explored the intervention’s effects on interpersonal perceptions by testing time \( \times \) condition interactions. I did not observe a significant time \( \times \) condition effect on interpersonal perceptions from pre-intervention through the 1-month follow-up.

Instead, I observed significant time \( \times \) condition effects on some of interpersonal perceptions between pre- and post-intervention. Specifically, there were significant time (pre- vs. post-intervention) \( \times \) condition interactions in the perceptions of targets’ warmth (“warm/approachable – hostile/critical”; \( b = 0.37, SE = 0.12, t(203.7) = 3.04, p = .003 \)), trustworthiness (“trustworthy – untrustworthy”; \( b = 0.28, SE = 0.12, t(203.3) = 2.35, p = .02 \)), and generosity (“generous/altruistic – self-centered”; \( b = 0.32, SE = 0.13, t(204.4) = 2.48, p = .01 \); see Table 4.8 and Figure 4.6).

When calculating within-condition changes for each condition separately from pre- to post-intervention, I found a significant increase in the perceptions of targets’ warmth in the Kindness condition (\( b = 0.23, SE = 0.09, t = 2.71, p = .007 \)), whereas there were significant decreases in the perception of targets’ trustworthiness (\( b = -0.23, SE = 0.09, t = -2.68, p = .008 \)) and generosity in the Control condition (\( b = -0.20, SE = 0.09, t = -2.15, p = .03 \)).

I did not observe significant time \( \times \) condition interactions in the perception of targets’ optimism (“trusting/optimistic – cynical/pessimistic”; \( b = 0.20, SE = 0.13, t = 1.61, p = .11 \)).
### Table 4.8. Interpersonal perceptions by condition and timepoint

<table>
<thead>
<tr>
<th></th>
<th>Kindness $(N = 105)$</th>
<th>Time comparison (t-test)</th>
<th>Control $(N = 103)$</th>
<th>Time comparison (t-test)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-intervention $(n = 102)^1$</td>
<td>Post-intervention $(n = 105)$</td>
<td>Follow-up $(n = 102)^1$</td>
<td>Pre – Post</td>
</tr>
<tr>
<td>Warm/approachable – Hostile/critical</td>
<td>5.46 (0.10)</td>
<td>5.68 (0.09)</td>
<td>5.59 (0.10)</td>
<td>2.71**</td>
</tr>
<tr>
<td>Trustworthy – Untrustworthy</td>
<td>5.75 (0.09)</td>
<td>5.80 (0.10)</td>
<td>5.72 (0.10)</td>
<td>0.64</td>
</tr>
<tr>
<td>Generous/altruistic – Self-centered</td>
<td>5.54 (0.10)</td>
<td>5.66 (0.10)</td>
<td>5.54 (0.10)</td>
<td>1.36</td>
</tr>
<tr>
<td>Trusting/optimistic – Cynical/pessimistic</td>
<td>5.38 (0.09)</td>
<td>5.33 (0.08)</td>
<td>5.48 (0.11)</td>
<td>-0.50</td>
</tr>
</tbody>
</table>

*Note. Data are reported as means (SE).\(^1\)Pre-intervention survey information was lost for three participants in the Kindness condition $(n = 102)$ and one participant in the Control condition $(n = 102)$. *$p < .05$, **$p < .01$, ***$p < .001$.\)
Figure 4.6. Simple slopes for significant time $\times$ condition effects on interpersonal perception

*Note.* A significant increase in perceived warmth was observed between the pre- and post-intervention periods in the Kindness condition, but not in the Control condition. Significant decreases in perceived trustworthiness and perceived generosity were observed between the pre- and post-intervention periods in the Control condition, but not in the Kindness condition.

* $p < .05$, ** $p < .01$. 
4.4 Discussion

The current study examined in a community sample whether a 2-week intervention designed to increase a lonely person’s daily prosocial behaviours is effective at mitigating their subjective feelings of loneliness and increasing their social contact. Overall, the results partially support the hypotheses, providing preliminary evidence that will require confirmation in future research. This self-delivered, low-cost intervention holds promise in addressing loneliness and promoting social contact in communities by targeting the desired behavioural change. However, further design modifications to boost its effects on loneliness and social contact following the intervention, along with additional evidence to confirm its effectiveness on the primary outcomes and across time, are advised before this intervention is disseminated for broader use.

4.4.1 Intervention Effects on Loneliness

I assessed the intervention’s effects on loneliness on two timescales: participants’ daily experience of loneliness immediately before and after the intervention, and their global evaluations of loneliness at multiple timepoints—before, immediately after, and 1-month after the intervention. First, regarding the immediate effects on the daily experience of loneliness, lonely community adults reported a reduced level of daily loneliness after the two-week acts of kindness intervention ended, replicating and extending the results of Study 2, which was conducted among university students.

However, the effect was not significantly greater than that of the active control condition. The active control activity, which involved taking an intentional break daily, also marginally reduced daily loneliness, potentially through different mechanisms. Participants in the control condition were encouraged to set aside time to engage in brief activities that could boost their well-being, which may have improved their daily mood in general. Although the majority
(66.5%) of their activities did not involve any interactions with others, having these freely chosen break activities could have transformed their time alone to a more positive solitude experience, which is distinct from feeling lonely while being alone (Lay, Pauly, et al., 2019). In addition, 33.5% of participants’ breaks involved social interactions, suggesting that participants may have used some of their break times to connect with others, such as having coffee or going for a walk with a friend, which might have also helped reduce their loneliness.

Consistent with the findings regarding daily loneliness, I also found significant decreases in the global evaluation of loneliness among participants in both conditions from pre-intervention through the 1-month follow up. The observed longer-term reduction in loneliness after the intervention aligns with the results from Fritz and colleagues (2020), who demonstrated a decline in loneliness two weeks after an acts of kindness intervention. However, since the reduction in loneliness was not more pronounced in the kindness condition compared to the control condition, the observed change in loneliness might also have been influenced by a regression to the mean effect over time among participants who were initially prescreened to report at least some degree of loneliness (Barnett et al., 2005). To rule out this possibility, future research is necessary to investigate whether the intervention’s effect on loneliness surpasses that of other control conditions, including a no-treatment condition in which participants report changes in their overall loneliness evaluations over time.

4.4.2 Intervention Effects on Social Contact

Although I did not observe an increase in social contact in the Kindness condition, the study findings suggest that an intervention increasing prosocial behaviour may help people to sustain their daily social contact, compared to an active control intervention involving taking intentional breaks. Specifically, the number of daily interactions participants had and the number of close
individuals participants interacted with decreased in the active control condition. I noticed a similar pattern of change in the global assessment of social networks, which measures the number of individuals participants were in regular contact with, within the control condition. Specifically, social network size decreased in the control condition over time. However, the pattern of change observed in the kindness intervention condition was not significantly distinct from the control condition, differing from the findings regarding daily social contact.

There are different possible interpretations of these results. One interpretation is that that participants in the Control condition, who were encouraged to take an extra break for themselves, may have spent the majority of their spare time alone and developed a habit of choosing solitude over social interactions during their spare time. Another interpretation is lonely participants in general might have shown a natural decline in social engagement over time, which the acts of kindness intervention might have buffered. Prior studies have shown that loneliness predicts decreased social engagement over time (Böger & Huxhold, 2018; Power et al., 2019). However, these interpretations are speculative, and the current study cannot clarify whether and how the intervention involving intentional break times was causally related to the reduction in social contact observed after the active control intervention. Future research is needed to confirm whether this unanticipated reduction in social contact in the control condition would replicate in another sample.

4.4.3 Intervention Effects on Interpersonal Perceptions

The current study explored the changes in participants’ interpersonal perceptions, as a potential mechanism underlying the intervention’s effects on social connection. Preliminary findings suggest that the Kindness intervention, compared to an active control activity, might help lonely individuals foster or maintain positive trait impressions of others post-intervention, in
terms of targets’ warmth, trustworthiness, and generosity, which reflect fundamental dimensions of trait impressions (e.g., trustworthiness; Andrew H. Chwe & Freeman, 2023). Lonely individuals often exhibit hypersensitivity to negative social cues and potential dangers, such as rejection and exclusion, leading to behaviour such as withdrawal or aggression (Bangee et al., 2014; Qualter et al., 2013). The intervention’s positive effects on trait impressions could potentially mitigate their social vigilance and encourage increased engagement with others. However, this intervention’s effects on interpersonal perception, observed right after the intervention ends, did not appear to be sustained during the 1-month follow-up. The two-week intervention might not be potent enough to create lasting changes in individuals’ interpersonal perceptions, which might require more continued changes in their social behaviours and environment. Future studies could also explore the effects of increasing prosocial behaviour on different aspects of social cognition, such as negative attentional or interpretation biases commonly observed in chronically lonely individuals (S. Cacioppo et al., 2015; Qualter et al., 2013, 2015). These changes in social cognition could lead to more positive long-term effects on their social relationships (Hickin et al., 2021; Masi et al., 2011).

4.4.4 Limitations and Future Directions

In this study, I recruited adults based on their self-reported loneliness levels, instead of targeting certain social groups who are assumed to be at a greater risk of loneliness (Hickin et al., 2021). However, I acknowledge that there are groups of community residents who are overrepresented in the current study sample, such as residents with post-secondary education, residents who identified as women, and people of European origin. Also, although this online-based research could lower the geographical barriers for people from remote areas to participate in the study, the recruitment was limited to residents who had access to electronic devices such
as smartphones or desktop computers, which were necessary for participating in the online lab sessions and completing online surveys. Similarly, only English-speaking people were eligible for this study. I acknowledge that these eligibility criteria may have created barriers for individuals who lack access to electronic devices or have different first languages. Future research should incorporate different strategies to make the intervention more accessible to participants with different needs, such as considering alternative formats for delivering the intervention and accommodating different languages to ensure inclusivity and greater generalizability of findings.

When testing the effects of the intervention, I compared the kindness intervention to an active control program to mitigate the influence of confounding variables, including the placebo effect. The active control program involved equivalent intervention tasks (i.e., taking an extra break), and had identical intervention components and structures, including implementation intentions and just-in-time intervention support. However, it is important to note that there may have been unexpected effects associated with the active control activity of taking an extra break. I observed significant time × condition interactions comparing intervention effects to the active control activity for daily social contact and interpersonal perceptions. However, I did not find significant changes within the kindness condition for some of these outcomes (i.e., daily social contact and the perception of targets’ trustworthiness and generosity). In these cases, the intervention effects could have been at least partially driven by the changes observed in participants in the active control condition, such as decreased social contact and more negative interpersonal perceptions. Therefore, future studies should compare the kindness intervention to different types of active control interventions and activities to ensure the replication of
intervention effects across various control conditions. This approach will be essential to help establish the robustness of the intervention effects.

Given the importance of assessing longer-term effects of interventions (Hickin et al., 2021), this study aimed to test whether the intervention effects on changes in social contact and loneliness are maintained even 1 month after the intervention. The current findings showed a sustained decrease in global assessments of loneliness, even one month after the intervention ended. However, the findings do not confirm that the intervention’s effect was stronger than that of the active control condition. In addition, the current findings do not provide evidence for the intervention’s effect on participants’ social network size. Future studies are needed to address potential confounding factors, including regression to the mean and placebo effects.

The current intervention used a just-in-time intervention approach, which delivers support in the evening when participants report elevated loneliness. This approach was based on the findings of Study 1, which suggested a link between elevated loneliness and reduced prosocial engagement among individuals with chronic loneliness. However, the current study design does not allow for isolating the specific effects of just-in-time intervention components on the proximal outcome, which is participants’ prosocial engagement. A micro-randomized trial (MRT) design has emerged as a method that enables researchers to examine the causal effects of intervention options on proximal outcomes. This design involves a sequential factorial design that randomly assigns intervention options at multiple decision points (Qian et al., 2022). Future studies that incorporate such a study design can provide valuable insights into the effective just-in-time intervention. These studies can explore the impact of different intervention options (e.g., implementation intentions) and timing (e.g., evening when participants report experiencing loneliness “more than usual”) on the intended proximal outcomes (i.e., daily prosocial behavior).
4.4.5 Conclusion

This study examined the effectiveness of an intervention designed to increase daily prosocial behaviour on reducing loneliness and increasing social contact among lonely individuals. Building on the findings of Study 2, which showed positive intervention effects on daily social connection in university students, this study extended the kindness intervention to the general population beyond a university setting. This study provides preliminary evidence for intervention effects on reducing loneliness and, possibly, maintaining social contact. By targeting behavioural change, specifically by encouraging daily prosocial behaviour, this intervention shows promise as a self-delivered and cost-effective approach to mitigating loneliness and promoting social contact in lonely adults within the community. However, given that the preregistered hypotheses were only partially supported, further study is needed before disseminating or scaling up this intervention in the wider community.
Chapter 5: Overall Conclusions

5.1 Synthesis

Despite the growing recognition of social connection as a public health priority, there remains a significant gap in evidence-based interventions for addressing both loneliness (perceived isolation) and a lack of social contact, which in severe cases can lead to social isolation. Past research has explored the causes of loneliness and social isolation, as well as their impact on health. This dissertation extends the existing literature by examining the dynamic relationship between loneliness and prosocial behaviour. I aimed to leverage this relationship to address the pressing problem of social disconnection.

The three studies conducted in this dissertation sought to answer questions about the relationships between loneliness, social contact, and prosocial behaviour: (1) How are different time scales of loneliness (chronic and transient) associated with engagement in prosocial behaviour in daily life? (2) Does an intervention promoting daily prosocial behaviour effectively reduce university students’ loneliness and increase social contact in daily life? (3) Can an intervention promoting daily prosocial behaviour, with just-in-time (JIT) intervention support during moments of elevated loneliness, reduce loneliness and increase social contact among lonely adults in the community? A summary of the research questions and key findings of each of the three studies can be found in Table 5.1.
### Table 5.1. Summary of key findings

<table>
<thead>
<tr>
<th></th>
<th>Study 1</th>
<th>Study 2</th>
<th>Study 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sample</strong></td>
<td>100 adults aged 50+ in Metro Vancouver</td>
<td>407 university students</td>
<td>208 adults in British Columbia who self-reported experiencing loneliness</td>
</tr>
<tr>
<td><strong>Research design</strong></td>
<td>Daily life assessment</td>
<td>Randomized controlled trial</td>
<td>Randomized controlled trial</td>
</tr>
<tr>
<td><strong>Primary outcomes</strong></td>
<td>Daily prosocial behaviours</td>
<td>Daily loneliness; daily social contact</td>
<td>Daily loneliness; daily social contact; global measures of loneliness and social contact at a 1-month follow-up</td>
</tr>
<tr>
<td><strong>Primary predictors</strong></td>
<td>Transient and chronic loneliness</td>
<td>Three experimental conditions; 2-week intervention increasing daily prosocial behaviour</td>
<td>Two experimental conditions; 2-week intervention increasing daily prosocial behaviour</td>
</tr>
<tr>
<td><strong>Potential mechanism examined</strong></td>
<td>Social vigilance (assessed using fear of negative evaluation)</td>
<td>Direct contact with the recipient(s)</td>
<td>Social vigilance (assessed using snap judgements of strangers’ traits)</td>
</tr>
<tr>
<td><strong>Key findings</strong></td>
<td>Chronic loneliness moderates the associations between transient loneliness and prosocial behaviour. Participants with high chronic loneliness showed reduced engagement in prosocial behaviours on days they experienced elevated transient loneliness.</td>
<td>An acts of kindness intervention increased students’ daily social contact, and also reduced daily loneliness in lonely students. Anonymous acts of kindness did not yield the same effects.</td>
<td>Participants who received the acts of kindness intervention reported decreased daily loneliness and global loneliness at both post-intervention and a 1-month follow-up (though the decreases were not significantly different from the decreases observed in the active control condition). Participants in the kindness condition maintained levels of daily social contact after the intervention, whereas participants in the active control condition showed a decrease in levels of daily social contact.</td>
</tr>
</tbody>
</table>
5.1.1 Theoretical Framework for Interventions

Study 1 aimed to establish a theoretical framework for intervention by observing the daily psychological processes involved in individuals’ experiences of loneliness and social withdrawal. Using repeated daily life assessments, the study found that individuals who experience chronic loneliness tend to withdraw from opportunities to engage in prosocial behaviour on days when they feel lonelier. The findings from Study 1 revealed the mechanism of social withdrawal that may perpetuate loneliness and isolation, and provide insights into potential targets for interventions to alleviate loneliness.

5.1.2 Intervention Aimed at Promoting Prosocial Behaviour

Review papers focusing on loneliness have emphasized the importance of interventions that prioritize targeting loneliness as a primary goal, rather than treating it as a secondary outcome of other conditions such as mental health problems or psychological well-being (Eccles & Qualter, 2021; Heinrich & Gullone, 2006). In Study 2 and 3, the acts of kindness intervention was specifically designed to mitigate participants’ loneliness and promote social contact. The intervention framework was developed based on relevant theories and evidence regarding the key mechanisms involved in the development and maintenance of loneliness, including the insights gained from Study 1. Specifically, this intervention aims to disrupt the vicious cycle of loneliness, social vigilance, and social withdrawal.

To date, interventions for loneliness have primarily focused on increasing opportunities for socialization or social support (e.g., befriending programs), providing social skills training, or addressing cognitive processes (e.g., thought patterns, mindfulness skills; Hickin et al., 2021; Mann et al., 2017; Masi et al., 2011). Extending this literature, I took a different approach by
targeting changes in participants’ behaviours within their daily social environment. Specifically, the intervention aims to promote participants’ daily prosocial behaviour, which is an innate human behaviour that connects people with each other. My expectation was that encouraging lonely individuals to engage in prosocial behaviour would reorient their focus from their own loneliness and social preservation motives to a more proactive role in initiating positive social interactions with others, without attempting to directly change in their beliefs about others or cognitive processes. The findings of Studies 2 and 3 support the idea that engaging in acts of kindness may help to mitigating the subjective experience of loneliness and promote or maintain social contact among university students as well as high-lonely adults in the wider community.

By combining two methodologies (daily life assessments and randomized controlled trials), this dissertation provides converging evidence regarding the relationship between daily loneliness, social contact, and prosocial behaviour. Using daily life assessments allowed me to observe naturally-occurring daily psychosocial processes associated with chronic loneliness, providing insights into why some people experience prolonged periods of loneliness. These observational findings provided the theoretical basis for developing the intervention content in Studies 2 and 3. In Studies 2 and 3, the use of a randomized controlled trial design enabled me to examine the causal effects of increasing daily prosocial behaviour on participants’ loneliness and social contact following intervention. Importantly, all three studies involved observation or intervention on participants’ social behaviours within their natural daily routines and environments, rather than in controlled laboratory settings. This approach maximized the ecological validity of the study findings.
5.1.3 Theoretical Contributions

This dissertation sheds light on some potential mechanisms that may underlie the relationship between loneliness and prosocial behaviour. Firstly, I assessed the role of social vigilance in the relationship between loneliness and prosocial behaviour using two different measures: self-reported fear of evaluation (i.e., vigilance to negative social evaluation; Study 1) and snap judgments of strangers’ traits (i.e., vigilance to negative facial cues; Study 3). These two measures may tap into different aspects of individuals’ vigilance to negative social outcomes. Self-reported fear of evaluation may indicate more explicit sensitivity to negative social evaluation, which is more closely related to social anxiety and fear of rejection (Heimberg et al., 2010). In contrast, snap trait impressions of strangers may be more related to general interpersonal perceptions of others (Andrew H. Chwe & Freeman, B, 2023). However, both measures share real-world implications for individuals’ decisions of whether to approach or avoid social opportunities. In Study 1, I examined participants’ self-reported vigilance to the possibility of being negatively evaluated by others, which can lead to social withdrawal and avoidance in lonely individuals (Lucas et al., 2010). The findings from Study 1 suggest that fear of evaluation may be associated with the reduced engagement in prosocial behaviour on lonelier days among chronically lonely adults. These individuals may become more sensitive to negative social outcomes and perceive opportunities for prosocial behaviour as potential sources of further social pain, rather than potential avenues for reconnecting with others when their loneliness is elevated. These findings align with theories of loneliness that emphasize hypervigilance to social threats as a key factor in the cycle between loneliness and social withdrawal (J. T. Cacioppo et al., 2014; J. T. Cacioppo & Hawkley, 2009).
In Study 3, I assessed participants’ snap judgements of strangers’ traits as a measure of their social vigilance. A tendency to judge strangers to be untrustworthy or hostile can indicate vigilance to negative social cues and can in turn influence decisions to either engage or withdraw from social opportunities (Qualter et al., 2015). One possible interpretation of the findings is that the acts of kindness intervention may have helped individuals maintain positive perceptions of others, particularly with respect to targets’ warmth, generosity, and trustworthiness. This interpersonal perception might have played a role in maintaining social engagement with others. Future studies are needed to replicate the intervention’s effect on participants’ interpersonal perceptions, and further examine whether improving lonely individuals’ interpersonal perception leads to the changes in their social behaviours and loneliness.

Furthermore, in Study 2, I explored the role of direct contact with recipients during prosocial activities by comparing the effects of regular acts of kindness with anonymous acts of kindness that involved no contact with the recipients. The results suggest that direct contact with recipients may be a crucial ingredient for improving people’s daily social connection. I speculate that positive experiences of social contact, directly perceiving the positive impacts of one’s actions, and feeling a sense of connection with recipients, may counter negative social expectations and reinforce engagement with others even after the intervention ends.

Taken together, this dissertation contributes to the existing body of literature that highlights the significant role of countering hypervigilance to negative social outcomes in effectively promoting social engagement among lonely individuals (J. T. Cacioppo & Hawkley, 2009; van Roekel et al., 2018). This dissertation suggests that providing repeated opportunities for individuals to have positive social experiences, such as through engagement in prosocial behaviours, may help to counteract lonely individuals’ negative social expectations (Trew &
Alden, 2015). Further research is necessary to explore the key mechanisms involved in interventions targeting loneliness. This includes evaluating changes in cognitive, emotional, and behavioural factors that are related to individuals’ social connections. Such knowledge will contribute to the development of effective interventions that address various aspects of loneliness experiences.

5.1.4 Practical Implications for Future Interventions

This dissertation has practical implications for the development and implementation of interventions to combat loneliness and promote social contact. First, this work provides preliminary evidence regarding the potential for a brief prosociality-focused intervention to address loneliness and promote social contact across different age groups. Given the lack of effective interventions to combat loneliness and social isolation, this prosociality-based approach warrants further study.

I acknowledge that the size of the intervention’s effects on the primary outcomes were small in magnitude, such as for the changes in daily loneliness observed in Study 3 (Cohen’s $d = 0.13$). However, it is worth highlighting that the magnitude of changes appeared to be larger for participants with a higher level of baseline loneliness (i.e., 1 $SD$ or more above the mean), in both university students (large effect size for participants with a baseline loneliness score of 2.7 or above; Cohen’s $d = 0.83$) and lonely adults in community (small to medium effect size for participants with a baseline loneliness score of 3.1 or above; Cohen’s $d = 0.35$). In particular, the results of Study 2 (in which the decrease in loneliness only occurred for high-lonely participants in the regular acts of kindness condition, but not in the other two comparison conditions) suggest that the intervention may hold particular promise for participants experiencing high levels of
loneliness. The low-cost, the self-administered nature, and the potential reach of this intervention are also unique strengths which should be taken into consideration when assessing its anticipated effect size on users. Given the systemic barriers (such as costs and geographical distance to mental health services) and internal barriers (including stigma around loneliness or asking for professional help) that often impede people from accessing more time- or resource-intensive forms of mental health care and sources of support, this intervention provides a relatively accessible and approachable option. I hope these findings inspire further research on the broad benefits of prosocial engagement for the actor, and that this intervention—with further refinement and testing—will eventually become the basis of an easily accessible and scalable way to effectively address loneliness and encourage social contact in communities. This intervention could also complement other loneliness interventions and be implemented in parallel with other macro-level efforts to promote social connection in communities, with potentially additive effects.

More broadly, this research highlights the potential of targeting changes in social behaviours to mitigate loneliness, rather than solely focusing on changes in cognitive processes. Previous work on psychological interventions for loneliness has predominantly emphasized cognitive approaches, such as attempting to directly change maladaptive social cognitions, with the assumption that these cognitive changes will lead to improved social behaviours and reduced loneliness (Käll et al., 2020; Mann et al., 2017). Similar to another study that demonstrated the effects of behavioural activation (BA) aimed at increasing rewarding social activities in mitigating loneliness among homebound older adults (Choi et al., 2020), this dissertation supports the idea that interventions aimed at behavioural change can lead to improvements in
daily social engagement and reductions in loneliness following the intervention—without a
direct or heavy-handed attempt to directly change people’s social cognitions.

In this dissertation, I added novel intervention design elements to tailor the acts of kindness
intervention specifically for lonely individuals in Study 3. The acts of kindness intervention is
currently primarily known as a positive psychological intervention aimed at increasing individual
happiness (Curry et al., 2018). In adapting it as an intervention to combat loneliness and to
increase social contact, I used different strategies to lower the barriers that lonely individuals
may face when engaging in prosocial behaviours. For instance, I implemented a “saying-is-
believing” exercise that helps participants to overcome their negative expectations regarding how
others would respond to their prosocial actions.

To my knowledge, this study is the first to incorporate the just-in-time intervention
framework, which has so far primarily been used in health behavioural interventions, into a
loneliness intervention. Drawing upon the findings from Study 1, I anticipated that lonely
participants would be more likely to experience psychological barriers (such as social vigilance)
to engaging in prosocial behaviours during moments of elevated loneliness. To support their
prosocial engagement during these vulnerable moments, additional intervention exercises were
delivered in the evenings when they reported heightened levels of loneliness.

These intervention components may have effectively engaged participants who reported
feeling lonely at baseline. In Study 3, the intervention overall appeared to promote acts of
kindness among participants, with an average engagement rate of 71.4% during the intervention
period (performed 10 out of the 14 days). However, I cannot isolate the effects of specific
intervention components on participant engagement using the existing data, so this remains a
question for future research. Nonetheless, I hope this research will inspire future interventions to
consider potential barriers to intervention engagement for lonely individuals and incorporate intervention design elements that address their specific needs.

Finally, this work highlights the potential of an approach that empowers individuals with chronic loneliness to become givers and contributors to their communities. Individuals experiencing loneliness and isolation are often seen as being on the receiving end of others’ support. One common approach to address loneliness is to provide social support from professionals, volunteers, or peer support workers, through programs like intentional friendship programs (e.g., Mccorkle et al., 2009; Simpson et al., 2014). These social support programs are important, especially for individuals who experience numerous barriers to developing and maintaining new relationships, including people with serious mental illness. However, solely being the recipient of others’ generosity may sometimes backfire, making one’s status salient and causing people to feel pitied or embarrassed (Sandstrom et al., 2019). This dissertation highlights that possibility that empowering lonely people to be givers, rather than solely recipients, may be an effective approach to restoring their social connections while also addressing the stigma surrounding loneliness (Mann et al., 2017).

5.2 Future Directions

5.2.1 Exploring Pathways: Prosocial Engagement, Loneliness, and Health

This dissertation suggests that prosocial engagement is a behaviour that can promote social contact and help alleviate loneliness. The findings of Study 3 also indicated a potential longer-term effect, showing a sustained decrease in loneliness even one month after the intervention ended. However, since the current findings did not confirm that the intervention’s effect was stronger than that of the active control condition, future research is necessary to re-
evaluate the intervention’s lasting impacts on participants’ social connections, while controlling for confounding factors, such as placebo or regression to the mean effects.

Furthermore, future studies are needed to understand how and under which conditions a prosociality-based intervention leads to lasting effects. There are several potential mechanisms that warrant exploration. Prosocial engagement and its positive social experiences may initiate a positive feedback loop of positive social cognitions (positive interpersonal perceptions and expectations) and increased social engagement, which, in turn, could contribute to lasting changes in participants’ social connection over time. Prosocial engagement might exhibit enduring effects when it contributes to building and strengthening people’s long-term relationships with their recipients. Moreover, the intervention could help people to cultivate a lasting habit of recognizing and engaging in opportunities for prosocial engagement within their social environments. For instance, in a previous study, participants engaged in a week-long repeated conversations with strangers noticed increased opportunities to initiate conversations with strangers even after the intervention concluded (Sandstrom et al., 2022). In addition, future studies could aim to identify key moderators that may determine the longer-term effects of prosociality interventions, such as motivations of actions (e.g., other-directed motivation; autonomous motivation; Lok & Dunn, 2020; Weinstein & Ryan, 2010), optimal frequency or dosage (e.g., Lyubomirsky & Porta, 2010), and types of prosocial engagement (e.g., variety; Kurtz & Lyubomirsky, 2008).

Longitudinal studies have shown a link between more frequent and regular engagement in prosocial activities, such as volunteering and informal helping, and reduced risks of mortality and health issues (Hui et al., 2020; Kim et al., 2020; Poulin, 2014). However, the specific pathway underlying this relationship is still not well understood. Future research could examine
whether improved social relationships are one of the mechanisms through which regular prosocial engagement improves individuals’ health.

5.2.2 Addressing Heterogeneity of Intervention Effects

In the field of intervention science, there is growing recognition of the importance of considering the heterogeneity of intervention effects (Bryan et al., 2022). Individuals experiencing loneliness comprise a diverse group, influenced by various factors that impact their social connectedness. Therefore, different components of interventions, including the kindness intervention, may have varying effects on different individuals. This dissertation reported the average intervention effects across individuals. However, to move towards a more tailored approach, rather than a ‘one-size-fits-all’ approach (Hickin et al., 2021), future research should examine moderators of the intervention effects on different subgroups of lonely individuals. For instance, future research could explore moderators such as age groups (e.g., younger versus older adults; Chi et al., 2021; Manoli et al., 2022; Wrzus et al., 2013) and personality factors (e.g., cynicism; Poulin, 2014), which may help explain the various influences of prosocial engagement on loneliness and social engagement. This examination would help determine who benefits most from this specific intervention, and who does not.

5.2.3 Promoting Inclusivity in Loneliness Research and Interventions

Relatedly, there is a pressing need to promote inclusivity and accessibility in both research and the design and reach of intervention programs, especially for groups who are often marginalized in the loneliness literature (Mann et al., 2017). Despite efforts to recruit community-dwelling adults from diverse backgrounds in Studies 1 and 3, certain groups remain underrepresented in these samples. These include individuals who are not familiar with using electronic devices for online surveys and intervention programs, people with physical disabilities
who may encounter additional barriers in participating in lab sessions, and individuals who are not comfortable using English. Loneliness experiences vary among individuals (Hickin et al., 2021; Mann et al., 2017). It is crucial for researchers to make efforts to engage with diverse groups of lonely individuals, particularly those who have been marginalized in the past literature. By prioritizing diversity and inclusiveness in research, future research can create interventions that better serve and address the unique challenges faced by individuals experiencing loneliness.

5.2.4 Promoting Macro-Level Research and Interventions

This dissertation primarily focuses on the psychological mechanisms that impact individuals’ social connections, such as social behaviour, emotion, and cognition, and the individual-level intervention that I have developed and described in this dissertation targets behavioural changes within individuals. This approach has strengths in uncovering the complex mechanisms that explain individual experiences of loneliness and developing interventions that individuals can undertake on their own initiative. However, it is important to acknowledge that individuals’ social behaviour and loneliness experience are also influenced by multi-level socio-cultural contexts that extend beyond the scope of an individual, including demographic changes, shifts in norms and values, economic and political changes, and geographical variations in how individuals live, work, and interact in their homes, neighborhoods, and public spaces (Luhmann et al., 2022). Importantly, solely focusing on individual-level interventions runs the risk of treating a societal problem that affects a wide population as an issue of individual responsibility. Future studies that adopt an interdisciplinary lens will be necessary to gain a comprehensive understanding of the macro-level factors that influence individuals’ social connectedness. This understanding is crucial to develop evidence-based interventions and policies to address
loneliness without placing the sole burden of responsibility on individuals. Future research should also explore community-level or regional-level interventions that target macro-level factors to effectively promote social connections. Ultimately, given that numerous factors contribute to loneliness and social isolation, no single intervention is likely to provide a complete solution for everyone. Instead, researchers and stakeholders should work together to develop, test, and promote complementary individual-level and macro-level strategies that may have additive effects on these pressing public health issues.

5.3 Final Remarks

Prosocial behaviour, intended to benefit others, is an essential ingredient for a cooperative and harmonious society (Hui et al., 2020). This research program provides preliminary evidence that interventions that encourage prosocial behaviour may help to address social disconnection in communities. Given the urgency and public health implications of addressing loneliness and social isolation, prosociality-based interventions merit further development and testing. Individuals experiencing chronic loneliness or isolation are often perceived as recipients of others’ support. However, empowering them to be the givers, rather than solely recipients, may be a promising approach to restoring their social connections.
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Appendices

Appendix A  Supplemental Information for Chapter 2

A.1  Table A.1. Day-level and person-average loneliness as predictors of number of prosocial actions, controlling for daily prosocial opportunities

<table>
<thead>
<tr>
<th></th>
<th>$b$</th>
<th>$SE$</th>
<th>$z$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed effects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.14</td>
<td>0.09</td>
<td>-1.47</td>
<td>.14</td>
</tr>
<tr>
<td>Day-level loneliness</td>
<td>0.02</td>
<td>0.04</td>
<td>0.57</td>
<td>.57</td>
</tr>
<tr>
<td>Person-average loneliness</td>
<td>-0.03</td>
<td>0.02</td>
<td>-1.39</td>
<td>.17</td>
</tr>
<tr>
<td>Day-level prosocial opportunities</td>
<td>0.41</td>
<td>0.02</td>
<td>20.91</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Person-average prosocial opportunities</td>
<td>0.46</td>
<td>0.04</td>
<td>11.02</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Age</td>
<td>0.006</td>
<td>0.004</td>
<td>1.35</td>
<td>.18</td>
</tr>
<tr>
<td>Sex</td>
<td>0.07</td>
<td>0.08</td>
<td>0.92</td>
<td>.36</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>0.04</td>
<td>0.07</td>
<td>0.60</td>
<td>.55</td>
</tr>
<tr>
<td>Education</td>
<td>0.02</td>
<td>0.09</td>
<td>0.20</td>
<td>.84</td>
</tr>
<tr>
<td>Day-level loneliness × person-average loneliness</td>
<td>-0.04</td>
<td>0.02</td>
<td>-2.37</td>
<td>.02</td>
</tr>
<tr>
<td><strong>Random effects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept variance</td>
<td>0.03</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loneliness slope variance</td>
<td>0.001</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. $N = 95$, $n = 1046$ daily reports. Loneliness was originally scored from 0 to 100 and rescaled to produce a score from 0 to 10. Sex coded 1 = female, 0 = male; education coded 1 = at least some post-secondary education, 0 = no post-secondary education; ethnicity coded 1 = European, 0 = all other ethnic groups. There was missing data for age ($n = 5$), resulting in a final $N = 95$ for this model.
### A.2 Table A.2. Day-level and person-average loneliness as predictors of number of prosocial actions controlling for relationship status

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>SE</th>
<th>z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed effects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.49</td>
<td>0.17</td>
<td>-2.93</td>
<td>.003</td>
</tr>
<tr>
<td>Day-level loneliness</td>
<td>0.008</td>
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<td>0.20</td>
<td>.84</td>
</tr>
<tr>
<td>Person-average loneliness</td>
<td>-0.009</td>
<td>0.03</td>
<td>-0.30</td>
<td>.77</td>
</tr>
<tr>
<td>Sex</td>
<td>-0.0008</td>
<td>0.007</td>
<td>-0.12</td>
<td>.90</td>
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<tr>
<td>Gender</td>
<td>0.34</td>
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<td>.005</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>0.15</td>
<td>0.12</td>
<td>1.21</td>
<td>.23</td>
</tr>
<tr>
<td>Education</td>
<td>0.38</td>
<td>0.13</td>
<td>2.91</td>
<td>.004</td>
</tr>
<tr>
<td>Relationship status</td>
<td>0.009</td>
<td>0.12</td>
<td>0.07</td>
<td>.94</td>
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<tr>
<td><strong>Cross-level interaction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day-level loneliness × person-average loneliness</td>
<td>-0.04</td>
<td>0.02</td>
<td>-2.70</td>
<td>.007</td>
</tr>
<tr>
<td><strong>Random effects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept variance</td>
<td>0.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loneliness slope variance</td>
<td>0.001</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. N = 94, n = 1037 daily reports. Loneliness was originally scored from 0 to 100 and rescaled to produce a score from 0 to 10. Sex coded 1 = female, 0 = male; education coded 1 = at least some post-secondary education, 0 = no post-secondary education; ethnicity coded 1 = European, 0 = all other ethnic groups. Relationship status coded 1 = in a relationship, 0 = not. There was missing data for age (n = 5) and relationship status (n = 1), resulting in a final N = 94 for this model.*
Appendix B  Supplemental Information for Chapter 3

B.1  Intervention Instructions

<table>
<thead>
<tr>
<th>Acts of Kindness</th>
<th>Anonymous Acts of Kindness</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General instruction</strong></td>
<td>In our daily lives, we all perform acts of kindness, generosity, and thoughtfulness—both large and small. All acts of kindness aim to benefit the people around us — they can be your friends or family, acquaintances who you do not often interact with, or strangers who you are meeting for the first time. <strong>Acts of kindness</strong> take countless forms. Have you ever put a smile on someone’s face with your kind words or gestures? Have you shown your support and care to another person regardless of their age, gender, or background? Have you considered that your small kind acts could change someone’s day or even, sometimes, someone’s life? This is the charm of selfless giving - it has infinite possibilities. The next 2 weeks will be your “Kindness Weeks”! During these 2 weeks, you will perform ONE <strong>act of kindness each day</strong>. These acts can be done for your friends, your family members, acquaintances, or even strangers whom you have never met!</td>
<td>In our daily lives, we all perform acts of kindness, generosity, and thoughtfulness—both large and small, known by others or done anonymously. Despite how they are performed, all acts of kindness aim to benefit the people around us and even those beyond our tight-knit communities. While we most often share our kindness openly and directly, <strong>Anonymous Acts of Kindness</strong> are rarer, but may take countless forms. Have you ever put a smile on someone’s face without letting that person know it was you? Have you shown your support and care to another person whose age, gender, and even name was unknown to you? Have you considered that your small kind acts could change someone’s day or even, sometimes, someone’s life without ever meeting that person? This is the charm of anonymous giving - it has infinite possibilities. The next 2 weeks will be your “Kindness Weeks”! During these 2 weeks, you will perform ONE <strong>anonymous act of kindness each day</strong>. These acts can be done for your friends, your family members, acquaintances, or even strangers whom you have never met!</td>
</tr>
<tr>
<td>Two categories</td>
<td>There are two ways in which you can be kind to others: you can either make others happier and put a big smile on their face, or you can act compassionately, and reach out and provide support to a person who is struggling in order to reduce their difficulties. To diversify your kindness weeks, we encourage you to focus on one of these two types of kind acts each week during the following 2 weeks. Please see below for examples of the two types of acts of kindness. You are welcome to add your own ideas! [List of examples]</td>
<td></td>
</tr>
<tr>
<td>Planning phase</td>
<td>We would now like you to plan your acts of kindness that you would like to perform in the next two weeks. Take a moment to picture your Kindness Weeks; where will you be; what will you do; who will you encounter? Try to think of kind acts that you can easily incorporate into your daily routine. For the first week, please plan kind acts that make someone smile (please see the left column for examples). For the second week, try to act more compassionately to the people around you who are struggling with difficulties by giving them support. We would now like you to plan your acts of kindness that you would like to perform in the next two weeks. Take a moment to picture your Kindness Weeks; where will you be; what will you do; who will you encounter? Try to think of kind acts that you can easily incorporate into your daily routine. For the first week, please plan kind acts that make someone smile (please see the left column for examples). For the second week, try to act more compassionately to the people around you who are struggling with difficulties by giving them support. We would now like you to plan the breaks that you would like to take on your own in the next two weeks. Take a moment to picture your Break Weeks; where will you be; what will you do; who will you encounter? Try to think of breaks that you can easily incorporate into your daily routine. For the first week, please plan breaks in which you have fun (please see the left column for examples). For the second week, try to take breaks that help you to rest and relax.</td>
<td></td>
</tr>
</tbody>
</table>

Even strangers whom you have never met!
Let’s spread some kindness over the next two weeks! See your Kindness Weeks as an **opportunity to go beyond your usual kind acts**. Try to think of things that you wouldn’t have done if it weren’t your Kindness Weeks, but still **something you can truly perform**. Please do not plan any acts that may place yourself or others in danger.

<table>
<thead>
<tr>
<th>(please see the right column for examples).</th>
<th>(please see the right column for examples).</th>
<th>(please see the right column for examples).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Let’s spread some kindness over the next two weeks! See your Kindness Weeks as an <strong>opportunity to go beyond your usual kind acts</strong>. Try to think of things that you wouldn’t have done if it weren’t your Kindness Weeks, but still <strong>something you can truly perform</strong>. Please do not plan any acts that may place yourself or others in danger.</td>
<td>Let’s spread some kindness over the next two weeks! See your Kindness Weeks as an <strong>opportunity to go beyond your usual kind acts</strong>. Try to think of things that you wouldn’t have done if it weren’t your Kindness Weeks, but still <strong>something you can truly perform</strong>. Please do not plan any acts that may place yourself or others in danger.</td>
<td>Let’s enjoy some “break time” over the next two weeks! Try to think of <strong>things that you can truly perform</strong>! Please do not plan any breaks that may place yourself or others in danger.</td>
</tr>
<tr>
<td><strong>“Making someone smile”</strong></td>
<td><strong>“Acting compassionately”</strong></td>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------------------------</td>
<td></td>
</tr>
<tr>
<td>Giving a genuine compliment or saying something kind to someone.</td>
<td>Reaching out to someone who may need emotional support and asking them how they're doing.</td>
<td></td>
</tr>
<tr>
<td>Surprising someone with a small gift.</td>
<td>Offering money or food to a homeless person.</td>
<td></td>
</tr>
<tr>
<td>Sharing a meal or snacks with another person.</td>
<td>Treating someone who is having a bad day to tea or coffee.</td>
<td></td>
</tr>
<tr>
<td>Greeting a stranger and asking about their day.</td>
<td>Conversing with someone who looks isolated (e.g., someone sitting alone in the classroom).</td>
<td></td>
</tr>
<tr>
<td>Cooking or baking for someone as a surprise.</td>
<td>Lending a helping hand to someone in a challenging situation (e.g., offering to help someone carry something heavy, etc.).</td>
<td></td>
</tr>
<tr>
<td>Expressing gratitude to someone you appreciate (e.g., writing a short thank-you note).</td>
<td>Donating to charity to help those in need.</td>
<td></td>
</tr>
<tr>
<td>Making someone genuinely laugh (e.g., telling a joke or sharing a funny meme).</td>
<td>Sharing a photo of your day with someone to cheer them up.</td>
<td></td>
</tr>
<tr>
<td>Surprising your roommate or family member by helping with household chores.</td>
<td>Helping with your roommate or family member’s house chores when they are distressed.</td>
<td></td>
</tr>
<tr>
<td>Inviting someone to take a short walk to refresh them.</td>
<td>Taking someone who is stressed for a walk.</td>
<td></td>
</tr>
<tr>
<td>Engaging in physical contact with someone as a gesture of affection (e.g., giving them a big hug).</td>
<td>Engaging in physical contact with someone who is in a time of need (e.g., giving them a big hug).</td>
<td></td>
</tr>
<tr>
<td>Your own ideas!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table B.1.2. List of Examples for Anonymous Acts of Kindness Condition

<table>
<thead>
<tr>
<th>“Making someone smile”</th>
<th>“Acting compassionately”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaving an anonymous message for someone you are grateful for (e.g., instructor/co-worker or friends, thanking them and telling them why you’re grateful).</td>
<td>Handwriting an anonymous letter to a friend who you know needs emotional support.</td>
</tr>
<tr>
<td>Leaving an anonymous card with a nice comment (e.g., a general compliment for someone: “you are an amazing person, the world is much better with you in it!”) in a random mailbox, on someone’s desk, or on a door.</td>
<td>Leaving sticky notes with encouraging messages (e.g., “Don’t let yesterday take up too much of today”) in a public space (e.g., a classroom).</td>
</tr>
<tr>
<td>Writing your favourite quote on a sticky note and leaving it for someone who would appreciate it on a washroom door, a mirror, a fridge, or on a table.</td>
<td>Leaving an anonymous funny note or cartoon in a public place (e.g., a library desk) to cheer up someone who is having a blue day (e.g., “Hey you who is having a blue day, open this card!”).</td>
</tr>
<tr>
<td>Writing a thank-you note to someone you usually do not pay attention to (e.g., leaving a sticky note on your mailbox for a mail person or on a washroom mirror for a janitor).</td>
<td>Doing a small chore for someone who is having a busy or stressful day without letting them know (e.g., empty the trash cans in the unit).</td>
</tr>
<tr>
<td>Leaving a nice or funny note inside a book you borrowed from the library or in a book that you’re selling or donating (e.g., a textbook).</td>
<td>Writing letters to someone in need of emotional support. By using online services to reach out to those in need, you can find people who would benefit from letters of encouragement. Some of these websites include: <a href="http://www.morerloveletters.com/">http://www.morerloveletters.com/</a> <a href="http://www.cardsforhospitalizedkids.com/">http://www.cardsforhospitalizedkids.com/</a></td>
</tr>
<tr>
<td>Cleaning a public space for people who share the space (e.g., it could be as small as throwing away trash that was lying around).</td>
<td>Anonymously donating money online (it does not necessarily have to be a large amount; even donating one dollar can help someone in need). You can find people who would benefit from the financial support you provided: e.g., <a href="https://chuffed.org">https://chuffed.org</a> <a href="https://www.gofundme.com/">https://www.gofundme.com/</a></td>
</tr>
<tr>
<td>Leaving a note on someone’s car telling them how well they parked.</td>
<td>Leaving an anonymous note or food for a homeless person that you often see on the street.</td>
</tr>
<tr>
<td>Leaving a few quarters at the vending machine for someone to get a free drink or snack.</td>
<td>Donating clothes or blankets to one of the clothing donation bins on campus. These are available in most residences and can also be found using online services (e.g., Big Brothers Big Sisters).</td>
</tr>
<tr>
<td>Leaving a cookie or snack for someone with an inviting note (e.g., leaving a bag of pretzels on someone’s desk or in their room).</td>
<td>Donating unused food to a nearby food bank (e.g. the AMS food bank at the Life Building).</td>
</tr>
<tr>
<td>Taping coins (e.g., 5, 10 or 25 cents) around a playground for kids to find.</td>
<td>Place a positive body image note in pockets (e.g., jeans, hoodies, sweatpants’ pockets) at a department store.</td>
</tr>
</tbody>
</table>

Your own ideas!
Table B.1.3. List of Examples for Control Condition

<table>
<thead>
<tr>
<th>“Having fun”</th>
<th>“Relaxing and resting”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Listening to a song that you enjoy.</td>
<td>Taking a short nap to re-energize yourself.</td>
</tr>
<tr>
<td>Doing a quick creative hobby that you enjoy (e.g. sketching, painting, baking).</td>
<td>Going on a short walk for a scenic view.</td>
</tr>
<tr>
<td>Reading a few pages of your favourite book.</td>
<td>Taking technology-free time to let your eyes relax.</td>
</tr>
<tr>
<td>Watching a short video on your favourite YouTube channel.</td>
<td>Decluttering or reorganizing your workspace (e.g., desk) to make yourself more comfortable in the space.</td>
</tr>
<tr>
<td>Doing a mentally challenging game (e.g., sudoku or a mobile game).</td>
<td>Taking a brief meditation or engaging in deep breathing exercises to relax.</td>
</tr>
<tr>
<td></td>
<td>You can find brief meditation or mindfulness breathing instructions in the link below:</td>
</tr>
<tr>
<td></td>
<td><a href="https://www.youtube.com/watch?v=iebciuBXCh4">https://www.youtube.com/watch?v=iebciuBXCh4</a></td>
</tr>
<tr>
<td></td>
<td><a href="https://www.youtube.com/watch?v=nmFUDkj1Aq0">https://www.youtube.com/watch?v=nmFUDkj1Aq0</a></td>
</tr>
<tr>
<td>Watching a funny video or meme.</td>
<td>Sitting down to enjoy a cup of tea or coffee.</td>
</tr>
<tr>
<td>Treating yourself to your favourite snack.</td>
<td>Letting your mind wander freely.</td>
</tr>
<tr>
<td>Your own ideas!</td>
<td></td>
</tr>
</tbody>
</table>
Appendix C  Supplemental Information for Chapter 4

C.1 Intervention Instructions

<table>
<thead>
<tr>
<th>Intervention - Kindness Condition</th>
<th>Control - Break Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intro</strong></td>
<td></td>
</tr>
<tr>
<td>In our daily lives, we all perform <strong>acts of kindness</strong>, generosity, and thoughtfulness—both large and small.</td>
<td>In our daily lives, we are often caught up in our daily routines and forget to set aside some <strong>time to have a break</strong>—even just a short one!</td>
</tr>
<tr>
<td>All acts of kindness aim to <strong>benefit the people around us</strong>—they can be your friends, family, acquaintances, or even strangers who you are meeting for the first time. <strong>Acts of kindness</strong> take countless forms.</td>
<td>Having some time to rest can be beneficial for your mind and body. <strong>Breaks</strong> can be taken in a variety of different ways.</td>
</tr>
<tr>
<td>Have you ever put a <strong>smile</strong> on someone’s face with your <strong>kind words or gestures</strong>? Have you shown your <strong>support and care</strong> to another person?</td>
<td>Are you taking enough breaks for yourself, even when you are <strong>having a busy day</strong>? When you do take a short break, do you pause your ongoing activities and try to do <strong>something relaxing</strong> or <strong>something fun and exciting</strong>?</td>
</tr>
<tr>
<td>Have you considered that your <strong>small kind acts</strong> could change someone’s day or even, sometimes, someone’s life? <strong>This is the charm of selfless giving</strong>.</td>
<td>Have you considered that taking a break can help you recharge your energy, regain focus, and improve performance on your upcoming tasks? <strong>This is the charm of taking a break</strong>.</td>
</tr>
<tr>
<td>The next <strong>2 weeks</strong> will be your “<strong>Kindness Weeks</strong>”! During these 2 weeks, we encourage you to perform at least <strong>one more act of kindness</strong> than you usually would do <strong>each day</strong>.</td>
<td>The next <strong>2 weeks</strong> will be your “<strong>Break Weeks</strong>”! During these 2 weeks, we encourage you to take at least <strong>one more short break</strong> than you usually would take <strong>each day</strong>.</td>
</tr>
<tr>
<td>You might be already performing acts of kindness in your daily life. We’d still like to challenge you to add an <strong>extra one</strong> to your day!</td>
<td>You might be already taking some breaks scheduled throughout your daily life. We’d still like to challenge you to add an <strong>extra one</strong> to your day!</td>
</tr>
<tr>
<td>During these <strong>two special weeks</strong>, we would like you to try to <strong>pay extra attention</strong> to opportunities where you can <strong>share your kindness with others</strong>.</td>
<td>During these <strong>two special weeks</strong>, we would like you to try to <strong>pay extra attention</strong> to opportunities where you can <strong>take some time off for yourself</strong>.</td>
</tr>
</tbody>
</table>
Before you begin to think about your next 2 weeks, here are some stories that might inspire you!

The following short passages are three people’s experiences about receiving acts of kindness and how those acts impacted their days.

[Reading Materials]

"A few weeks ago I was having a rough day because my family had just received some hard news from the doctor regarding my mom's health. I had been keeping mostly to myself and didn't have much energy to really talk a lot to my friends. One day when I was home, I heard a knock on the door. My friend stopped by to drop off a little bag filled with some of my favourite snacks. They said the gift was nothing big but, having them stop by and show that they were thinking of me meant a lot to me on that day. On tough days, knowing that I am cared about by the people around me really makes a difference."
• Rebecca

"I ended up falling off my bike on the side of the road. A man came up and actually called me a cab. What really stood out to me about this interaction was that he actually waited with me until the cab arrived without even saying much. It meant a lot to me that he stood by my side to really make sure I was okay."
• Anderson

"We bought two little rings for my daughter from a stall at the fair. My youngest child’s ring was a little big and we went into a shop where she dropped it. After getting her out of her wheelchair to check her clothes and the floors, we decided it had disappeared. A customer helped us look for the ring and asked how expensive it was, and I explained that we only just got it from a stall outside the store. We continued looking when the lady reappeared with

Before you begin to think about the next 2 weeks, here are some stories that might inspire you!

The following short passages are three people’s experiences about taking some time out of the day for themselves and how those acts benefited them.

[Reading Materials]

"I’ve received many benefits from taking a regular break, not the least of which is getting a chance to catch my breath when I’m super busy. I find that when I work myself to the bone, it really decreases my productivity, as the less energy I have, the less I can do. By taking a break, I can hit the reset button to refocus and re-energize myself."
• Rebecca

“Breaks have assisted me in developing better habits. Taking a lunch break has allowed me to incorporate healthy habits into my regular day, whether it’s finding time to stroll outside or prepare and eat a better meal. I sometimes even try to fit in a 10-minute nap, which energises me! I think that I’ve also been feeling a lot more refreshed since I started taking more time out of the day for myself.”
• Anderson

“Taking regular breaks is important for me. In the middle of the day, I try taking a 5 minute break to reset my frame of mind. I sometimes do some light exercises like jumping jacks or dynamic stretching, to get a small boost of endorphins. When I’m on break, I do some fun activities that I know can boost my mood, like watching a funny youtube clip or eating snacks before going back to work. It brings fun to my day.”
• Claire
Claire

[Writing exercise]
As you just read in the stories, people remember and appreciate others' kindness - even strangers'.

However, recent research studies have shown that people tend to underestimate how much their small gestures of kindness would mean to the person who receives it.

People often feel uncertain about how their kind act might be received by others and think their kind act was of less value than the recipients actually experience it to be.

Due to this common misunderstanding, people often don't end up initiating acts of kindness.

However, in reality, the research is clear: people usually appreciate good intentions and the warmth conveyed in a kind act, regardless of what the action actually was.

Now, we would love to hear your thoughts!
**Why do you think that acts of kindness could be more meaningful and impactful to receivers than what people often assume?**

Please share a **personal experience** as an example where someone’s act of kindness brought a positive impact to your day!

**How did it make you feel? Why did you appreciate their kindness? Do you have any advice to someone who may be hesitant to reach out and perform an act of kindness for someone?**

[Writing exercise]
As you just read in the stories, taking a small break is great for your body and your mind.

However, recent research studies have shown that people tend to underestimate the effect a small break could have on their well-being as well as productivity.

People often think that it is counterproductive to take a break and that it takes up time that might be better spent catching up on work.

Due to this common misunderstanding, people often don't end up taking regular breaks.

However, in reality, the research is clear: taking a short break usually improves our performance and boosts our moods, regardless of what you actually do during the break.

Now, we would love to hear your thoughts!
**Why do you think that taking a short break could bring more benefits than what people often assume?**

Please share a **personal experience** as an example where taking a small break benefited your body and mind!

**How did it make you feel? Why do you think the break was beneficial to you? Do you have any advice you would give to someone who may be hesitant about taking short breaks in their day?**
### Implementation Intentions I: Making Concrete Plans

We now encourage you to plan some of your acts of kindness that you would like to perform over the next two weeks.

First, please take a moment to picture your next two weeks. *Where will you be; what will you be doing?*; *who are you likely to encounter and spend time with?*

Now, please take a moment to make a plan for the kind acts that you could incorporate into your days!

Before you start planning, please read through the tips and once you read each tip, check the box to go to the next page!

**A few tips here:**

- See your Kindness Weeks as an **opportunity to go beyond your usual kind acts**. Try to think of things that you wouldn't have done if it weren't your Kindness Weeks, but still something you can realistically perform.

- Acts of kindness can take many forms! You could **make others happier and put a big smile on their face**, or act compassionately and reach out and provide support to a person who is struggling.

---

We now encourage you to plan some of the breaks that you would like to take for yourself over the next two weeks. First, please take a moment to picture your next two weeks. *Where will you be; what will you be doing?*

Now, please take a moment to make a plan for the breaks that you could incorporate into your days!

Before you start planning, please read through the tips and once you read each tip, check the box to go to the next page!

**A few tips here:**

- See your Break Weeks as an **opportunity to go beyond your usual breaks**. Try to think of things that you wouldn't have done if it weren't your Break Weeks, but still something you can realistically perform.

- Breaks can be taken in many ways! You could **take a break that puts a big smile on your face**, or you can do something that allows you to destress, rest and relax.

- Think about **break times that relate to your values, skills, and interests**. For example, if baking desserts is
- Think about **acts of kindness that relate to your values, skills, and interests**. For example, if sharing delicious food with others is important to you, you could consider inviting your friend or neighbour to your table or bake cookies for them! If you have organisational skills, you could apply those skills by cleaning out shared spaces with your neighbours!

There are always **opportunities**!

- On the days you are in your workplace or neighbourhood, you could bring someone a beverage or snack. You could also make a special attempt to recognize someone who often gets overlooked, by complimenting or thanking them, or spending time learning about their day.
- On days you spend more time at home, you could direct your kind acts towards someone you live with or someone close by like your neighbour. You could also reach out to someone by calling them or sending them a text message to show your care!
- On days you do not get much free time, you can do a small act of kindness that does not require much time or effort, like spending a few minutes to send someone a kind message to cheer them up or thank them, or asking someone how their day is! You can also give your seat to someone who looks very tired on the bus or let someone go in front of you!

To get more ideas, see the list of example acts that might inspire you down below!

[example table]

- Please take a moment to familiarize yourself with the variety of acts and **try to diversify your plan**!

- On the days you are in your workplace or neighbourhood, you could do something there to give yourself a break: for example, taking a short walk during your lunch break or grabbing your favourite drink.
- On days you spend more time at home, you could take your break at home: for example, watching your favourite youtube video or working on your garden.
- On days you do not get much free time, you can take a small break that does not require much time or effort, like spending a few minutes to stretch and clear your mind, or a short meditation exercise to re-energize yourself! You can also simply open your window to get a breath of fresh air, or just sit and let your mind relax!

To get more ideas, see a list of example breaks that might inspire you down below!

[example table]

- Please take a moment to familiarize yourself with the variety of breaks and **try to diversify your plan**!
• But please don’t hesitate to come up with your own acts of kindness or modify the ones given in the list. We would love to see your own unique ideas!
• Please do not plan any acts that may place yourself or others in danger.

Great! Now, please write down kind acts you could perform during the coming weeks below. Please specify (1) when, (2) where, (3) to whom, and (4) what acts of kindness you would like to perform!

• **When:** think of a particular moment of the day, such as *after getting out of bed, on the way to work, on the way back to home, before having breakfast, during lunch break, when you get home from work.*

• **Where:** think about the place where you will perform the activity, such as *in the park, in the neighbourhood, in your working environment, on the way to work, or at a sports field.*

• **To whom:** think about the people who will be around you or who you can reach out to.

• **What** acts of kindness: you can get more ideas from the list of example acts below. We hope that some might inspire you, but feel free to come up with your own!

**Examples:**
"When I get home (where) after work on Wednesday (when), I will make my neighbour (to whom) a margarita to have as they rest after their long day (what)."

Now, please plan and write down at least 5 acts below. As you go about your 2 weeks, please try to diversify your plan and try new things from each category!

• But, please don’t hesitate to come up with your own breaks or modify the ones given in the list. We would love to see your own unique ideas!
• Please don’t plan any breaks that may place yourself or others in danger.

Great! Now, please write down breaks you could perform during the coming weeks below. Please specify (1) when, (2) where, and (3) what breaks you would like to take!

• **When:** think of a particular moment of the day, such as *after getting out of bed, on the way to work, on the way back to home, before having breakfast, during lunch break, when you get home from work.*

• **Where:** think about the place where you will take the break, such as *in the park, at home, in your working environment, the surroundings of work, on the way to work, or at a sports field.*

• **What** types of breaks: you can get more ideas from the list of example breaks below. We hope that some might inspire you, but feel free to come up with your own!

**Examples:**
"When I get home (where) after work on Wednesday (when), I will make myself a margarita and drink it while looking at the sunset (what)."

Now, please plan and write down at least 5 acts below. As you go about your 2 weeks, please try to diversify your plan and try new things from each category!
We understand that there will be days that will be busier than usual. In this case, feel free to check out the kindness examples in the table with an asterisk * for some inspiration.

If you already do kind acts toward the people around you every day, we’d like to challenge you to **add at least one more** per day.

We did not ask you to plan every act of kindness for the next two weeks, but just 5 acts of kindness. As your week goes, please respond to the opportunities where you may be able to use these acts!

If you already take breaks every day, we’d like to challenge you to **add at least one more** per day.

We did not ask you to plan every break activity for the next two weeks, but just 5 activities. As your week goes, please respond to the opportunities where you may be able to use these acts!

---

### Implementation Intention II: Overcoming Obstacles

Great – we have a plan now!

However, you may encounter **obstacles** to your acts of kindness during the next two weeks.

Let’s make a plan to overcome them using “If/Then” sentences: 

*If* … happens, *then* I will do…*

You’ll have a chance to practice on the next page.

You can see one of the **common barriers** people said they had experienced below and some **possible action plans** they made.

**If** I don’t feel like interacting with anyone, *then* I will

- Take a moment to myself and reflect on a time when someone’s kindness made me smile or cheered me up.
- Find something I can do remotely, such as calling a friend to check in with them or writing a message to someone who needs support.
- Find something I can do for a neighbour living close by such as dropping off a small note or gift in their mailbox.

**If** I feel tired/unwell, *then* I will

- Pick a break from the “resting and relaxing” column of examples in my booklet.
- Take a break that boosts my energy level, such as listening to music, jumping jacks or a quick nap.

---
Your turn!
Come up with an idea for an action you can take when you encounter the situation! What do you think are some ways to get around this barrier?

If I don’t feel like interacting with anyone, then I will

Feel free to get ideas from the action plans above.

[text box entry]

Let’s practice one more!

If I feel too busy to do my act of kindness, then I will

• Find and do a small, quick act of kindness during my next break opportunity
• Tell myself, some kind acts take less than 5 minutes!
• Remind me that even a small kind act can mean something to others

Your turn!
Come up with an idea for an action you can take when you encounter the situation! What do you think are some ways to get around this barrier?

If I feel tired/unwell, then I will

Feel free to get ideas from the action plans above.

[text box entry]

Let’s practice one more!

If I feel too busy to take my break, then I will

• Find and take a simple, quick break during my next break opportunity
• Tell myself, some breaks take less than 5 minutes!
• Remind me that even a short break is helpful!

Your turn!
Come up with an idea for an action you can take when you encounter the situation! What do you think are some ways to get around this barrier?

If I feel too busy to do my act of kindness, then I will

[text box entry]

Now try to make plans for the barriers you may encounter!

Below is a list of common barriers people have said about performing daily acts of kindness.

Please choose two barriers that you think might apply to you.
Let's pick the first barrier:
[drop down selections]
- If I feel too busy, then
- If I don't feel like interacting with anyone, then
- If I am worried that I might forget, then
- If I am feeling too tired, then
- If I don't have a chance to meet anyone in person, then
- If I feel nervous about seeing other people, then
- If I feel grumpy or moody, then
- Other: Please write your own_________

Below, write down the barrier you selected/came up with using the “If/Then” format and what you will do when this situation arises to ensure you still perform an act of kindness that day.

If you are finding this task difficult, you can click on this link to find helpful information.

If you would like additional help, feel free to ask the session RA for help by going back into the main Zoom room or sending them a direct message in the chat.

Let's pick the second barrier:
[drop down selections]
- If I feel too busy, then
- If I don't feel like interacting with anyone, then
- If I am worried that I might forget, then
- If I have a full schedule already, then
- If I don't feel like interrupting my work, then
- Other: Please write your own_________

If you would like additional help, feel free to ask the session RA for help by going back into the main Zoom room or sending them a direct message in the chat.

Let's pick the second barrier:
[drop down selections]
- If I feel tired/unwell, then
- If I feel too busy, then
- If I am worried that I might forget, then
- If I have a full schedule already, then
- If I don't feel like interrupting my work, then
- Other: Please write your own_________

Below, write down the barrier you selected/came up with using the “If/Then” format and what you will do when this situation arises to ensure you still take your break that day.

If you are finding this task difficult, you can click on this link to find helpful information.

If you would like additional help, feel free to ask the session RA for help by going back into the main Zoom room or sending them a direct message in the chat.
Below, write down the barrier you selected/came up with using the “If/Then” format and what you will do when this situation arises to ensure you still perform an act of kindness that day.

Please copy your statements into the booklet we sent to you!

Here are some possible action plans you could have made:

**If** I am worried that I might forget to do my act of kindness, **then** I will
- set a reminder on my phone the night before to remind me to do my act of kindness that day
- change my phone screen or stick a post-it note on my mirror to remind myself
- do some quick that boost my energy level, such as jumping jacks, a quick nap or stretching, before I find something to do today
- find an act from the brief act of kindness example list

**If** I feel too tired to do my act of kindness, **then** I will…
- do some quick that boost my energy level, such as jumping jacks, a quick nap or stretching, before I find something to do today
- find an act from the brief act of kindness example list

**If** I have a full schedule during the day, **then** I will
- take my break during my commute to work
- take a quick break before I go out for my plans
- take a quick break between schedules

**If** I don’t feel like interrupting my work, **then** I will
- Make a reminder to take my break right after completing the task at hand
- Take my break before starting my work

**If** I am worried that I might forget to take my break, **then** I will
- set a reminder on my phone the night before to remind me to take my break that day
- change my phone screen or stick a post-it note on my mirror to remind myself

If you are finding this task difficult, you can click on this link to find helpful information

If you would like additional help, feel free to ask the session RA for help by going back into the main Zoom room or sending them a direct message in the chat.
<table>
<thead>
<tr>
<th>Ending remark</th>
<th>Before we end, please read through the checklist below.</th>
<th>Before we end, please read through the checklist below.</th>
</tr>
</thead>
<tbody>
<tr>
<td>This is what will happen during the next two weeks:</td>
<td>You will receive a text message reminding you of the ongoing Kindness Weeks on the first day of each week.</td>
<td>You will receive a text message reminding you of the ongoing Break Weeks on the first day of each week.</td>
</tr>
</tbody>
</table>

- tell myself that my kind act can energise me and the person I will reach out to.

*If I* don’t have a chance to meet anyone in person, *then* *I* will
- Find something I can do remotely, such as calling a friend to check in with them or sending an encouraging message to someone
- Find something I can do for a neighbour living close by such as dropping off a small note or gift in their mailbox

*"If I* feel nervous about interacting with someone, *then I* will
- take a moment to myself and reflect on a time where someone’s kindness made me happy or smile; tell myself that I can do the same
- ignore my anxiety and go on with my intention help their day better
- reach out to someone remotely first (send a text message, send a funny picture, etc.)

*If I* feel grumpy or moody, *then I* will
- listen to my favourite happy song and share the song with someone who might need some cheering up
- take a deep breath and ask myself what kindness means to me
  take a moment to myself and attend to my needs before I think of someone who might also need some cheering up
| • You will receive a text message that includes a short survey link asking about your daily experience. | • You will receive a text message that includes a short survey link asking about your daily experience. |
| • On some random evenings, you may get a short, booster exercise to help you with your Kindness Weeks. | • On some random evenings, you may get a short, booster exercise to help you with your Break Weeks. |
| The first few days might feel awkward or strange, but trust us! It will feel more comfortable with time! | The first few days might feel awkward or strange, but trust us! It will feel more comfortable with time! |
C.2 Figure C.1. CONSORT flowchart

Enrollment → Assessed for eligibility ($n = 773$) → Excluded ($n = 551$)
- Not meeting inclusion criteria ($n = 196$)
- Declined to participate, unable to reach out, or fill out survey after finishing recruitment ($n = 328$)
- Not completing pre-intervention diary assessment ($n = 27$)

Randomized ($n = 222$)

Kindness condition ($n = 110$)
- Pre-intervention global assessment and intervention ($n = 105$)
- Discontinued study participation ($n = 5$)

Allocation → Kindness condition ($n = 110$)

Control condition ($n = 112$)
- Pre-intervention global assessment and intervention ($n = 103$)
- Discontinued study participation ($n = 9$)

Post-intervention assessment ($n = 105$)
- Diary assessment
- Global assessment

Follow-Up I → Post-intervention assessment ($n = 105$)

Follow-Up II → 1-month follow-up survey ($n = 100$)

Post-intervention assessment ($n = 103$)
- Diary assessment
- Global assessment

1-month follow-up survey ($n = 97$)

Note. There are missing data points due to the data loss (pre-intervention global assessment, $n = 1$, intervention diary, $n = 2$).
C.3 Interpersonal Perception Task

The following pictures show faces of men and women.

They were all asked to put on a neutral facial expression so that their emotions and personality would NOT be readily visible in the pictures.

However, research has shown that people can still detect other people’s emotions and assess their personality because people can subconsciously notice subtle microexpressions on others’ faces. Microexpressions are brief involuntary facial movements that reflect individuals’ true emotions.

People are especially accurate when they make their judgments based on their immediate gut reactions, so you should try to go with your gut reactions when rating the people in the photos.

Next, you will see pictures of 8 different men and women.

Each face will be presented for ONLY 1 second. You will then be asked to judge their personality.

Do NOT dwell on each question. Using your intuition (gut reaction), try to respond quickly!

Example picture (Asian, Woman):

To what extent do you judge the target to be:

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<th>-2</th>
<th>-1</th>
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<th>+2</th>
<th>+3</th>
<th>+4</th>
</tr>
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</table>

<table>
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<th>Warm, approachable</th>
<th>Trustworthy</th>
<th>Trusting, Optimistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-centered</td>
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