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Internet-based interventions for loneliness

– Efficacy and latent psychopathological profiles of treatment seekers

Anton Käll

LINKÖPING UNIVERSITY

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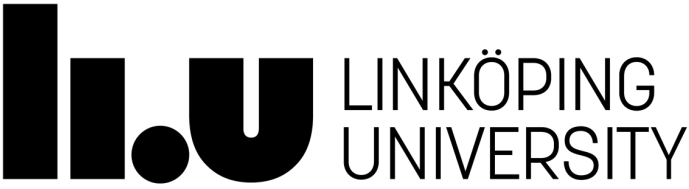

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The Road goes ever on and on,
Down from the door where it began.
Now far ahead the Road has gone,
And I must follow, if I can,
Pursuing it with eager feet,
Until it joins some larger way
Where many paths and errands meet.
And whither then? I cannot say.

J.R.R. Tolkien

Abstract

Loneliness is an adverse emotional reaction thought to stem from an unwanted and impoverished social situation. Though it commonly makes brief appearances across the lifespan for most people, it has received increasing attention as a factor relevant to somatic and psychological well-being when assuming a more chronic form. For this reason, developing ways of alleviating loneliness is an important item on the research agenda tied to this phenomenon. Psychological interventions, and cognitive behavioural therapy (CBT) in particular, have been proposed to have potential for this. This thesis sought to evaluate the effects of two different kinds of internet-based interventions targeting loneliness: one based on CBT, and one based on interpersonal psychotherapy (IPT).

In addition to this general aim, **Study I** also investigated the presence of different subgroups in the sample of people seeking help within the framework of projects. Using the statistical method known as Latent Profile Analysis we discovered five profiles consisting of symptoms of common psychiatric disorders and loneliness. The profiles mainly differed as a function of symptom severity, though one of the larger groups was also characterised primarily by their high ratings of social anxiety. The results suggest that the sample seeking help for their loneliness can exhibit both clinical and non-clinical levels of common mental health problems.

Study II served as the pilot evaluation of an ICBT programme for loneliness. A total of 73 participants were included in a randomised controlled trial where the participants were randomised to either 8 weeks of active treatment or a wait-list control group. The results indicated significantly lower loneliness ratings after the treatment phase for the ICBT condition with a moderate-to-large effect size compared to the control group. Significant differences favouring the ICBT condition were also noted for two of the four secondary measures.

Study III followed up on the participants two years after the conclusion of the initial treatment period. At this point, the control group had also received access to a version of the ICBT programme with therapist support on-demand. The results indicated that the

decrease in loneliness was sustained, along with similarly lasting effects on the secondary outcomes of interest.

Study IV aimed to replicate the findings from the second study with a similar ICBT programme. However, this study also employed an internet-based IPT intervention to allow for conclusions regarding the possibility of reducing loneliness by other means than CBT. A sample of 170 participants were recruited and randomised to one the treatment conditions or to a waitlist control group. The results indicated that the ICBT condition had a significantly steeper reduction in loneliness than both the waitlist and the IPT condition after the conclusion of the treatment. Both active conditions produced a significant increase in quality of life.

In conclusion, internet-based psychological interventions can be efficacious for reducing loneliness, though the efficacy was only found for participants who received access to the ICBT condition in **Study II** and **IV**. The benefits from this treatment programme were sustained up to two years after the conclusion of the intervention. For these reasons, ICBT is proposed to be a good candidate for offering help to people experiencing distressing feelings of loneliness.

Keywords: cognitive behavioural therapy; ICBT; internet interventions; interpersonal psychotherapy; latent profile analysis; loneliness;

Empirical studies

The studies listed below serve as the basis for the thesis. They will be referred to by the roman numeral listed next to them.

I. Käll, A., Shafran, R., & Andersson, G. (2021). Exploring latent profiles of psychopathology in a sample of lonely people seeking treatment. *Journal of Psychopathology and Behavioral Assessment, 43(*3), 686-696.

II. Käll, A., Jägholm, S., Hesser, H., Andersson, F., Mathaldi, A., Norkvist, B. T., Shafran, R., & Andersson, G. (2020). Internet-based cognitive behavior therapy for loneliness: A pilot randomized controlled trial. *Behavior Therapy, 51*(1), 54-68.

III. Käll, A., Backlund, U., Shafran, R., & Andersson, G. (2020). Lonesome no more? A two-year follow-up of internet-administered cognitive behavioral therapy for loneliness. *Internet Interventions, 19*, 100301.

IV. Käll, A., Bäck, M., Welin, C., Åman, H., Bjerkander, R., Wänman, M., Lindegaard, T., Berg, M., Moche, H., Shafran, R., & Andersson, G. (2021). Therapist-guided internet-based treatments for loneliness: A randomized controlled three-arm trial comparing cognitive behavioral therapy and interpersonal psychotherapy. *Psychotherapy and Psychosomatics, 90*(5), 351-358.

Abbreviations

AIC	Akaike Information Criterion
A-BIC	Sample Size Adjusted Bayesian Information Criterion
BIC	Bayesian Information Criterion
BBQ	Brunnsviken Brief Quality of Life Questionnaire
BLRT	Parametric Bootstrapped Likelihood Ratio Test
CBT	Cognitive Behavioural Therapy
CSQ	Client Satisfaction Questionnaire, 8-item Version
DSM-5	Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition
ETL	Evolutionary Theory of Loneliness
FIML	Full Information Maximum Likelihood
GAD-7	Generalized Anxiety Disorder, 7-item Scale
ICBT	Internet-Based Cognitive Behavioural Therapy
IPT	Interpersonal Psychotherapy
LL	Log-Likelihood
LPA	Latent Profile Analysis
LRT	Likelihood Ratio Test
MAR	Missing At Random
MLR	Maximum Likelihood Estimation with Robust Standard Errors
PHQ-9	Patient Health Questionnaire, 9-item Version
REML	Restricted Maximum Likelihood
RMSEA	The Root Mean Square of Approximation
SIAS	Social Interaction Anxiety Scale
SE	Standard Error
SMD	Standardised Mean Difference
ULS-3	University of Los Angeles Loneliness Scale, Version 3
WAI	Working Alliance Inventory, 12-item Short Form

Introduction

Considering social factors in relation to mental health is hardly a new way of thinking. Relationships between people, or a lack thereof, have been considered important in relation to a wide range of constructs found in the context of clinical psychology, from attachment (Hendrick & Hendrick, 1994) to depression (Coyne, 1976). Humans are assumed to have a need to belong, and if that need is not met it might affect several psychological aspects, ranging from cognitive processes to our emotional state (Baumeister & Leary, 1995). Away from a sense of belonging, at the other extreme of the spectrum resides the concept of loneliness. Early accounts in research on the subject notes that it is "widely distributed and severely distressing" (Weiss, 1973, p. 9), a common experience that is not a burden of the unlucky few, but for most people at some time during their lives.

Alberti (2019) describes that the modern definition of loneliness is a rather recent development. Usage of the word as a means of describing the concept of feeling isolated began surfacing in written text around the turn of the 19th century. Back before those days, loneliness simply referred to the objective state of isolation, the lack of contact with other people. It did not carry the burden and emotional qualities now associated with the word, but stated that a person was alone, a matter of fact that did not convey much about the experience itself. Today the situation is different. Via the pen of poets and writers such as Sylvia Plath the concept of loneliness has morphed into something else, pushing its experiential elements to the front. Loneliness is considered painful, and the link between the word and the images and feelings it evokes are seemingly more potent now than in the past.

From this perspective, loneliness is a relatively modern problem, one that has evolved alongside our society and the changes witnessed during the past 200 odd years. More recent developments over the past decade have also served to put a spotlight on loneliness as a health concern. Former U.S. Surgeon General Vivek Murthy drew headlines during his tenure for the Obama administration by proclaiming that we have an ongoing epidemic of loneliness. In the

United Kingdom, the appointment of a loneliness minister has highlighted greater efforts into combating loneliness in the country. At the time of writing, the COVID-19 pandemic is also keeping a tight grip of the possibilities of socialising with others, and the topic of loneliness is seemingly near at hand. Calls for action has been made (e.g., Age U.K., 2017), but not much is known on how to best address the problem of loneliness and its influence on people's mood and health.

The main aim of this thesis has been to explore the idea of offering help for this group by way of internet-based psychological interventions. **Study II** through **IV** details these efforts, while **Study I** provide some insights into the population seeking help for their loneliness. Though the internet and the advent of social media has sometimes been blamed for contributing to loneliness (see Nowland et al., 2018), we also know that the internet can provide an excellent platform for delivering evidence-based psychological treatments for a wide range of conditions and problems (Andersson, 2016).

What is loneliness?

The question *What is loneliness?* can be approached from different angles. Most commonly the question is answered using the definition provided by Peplau and Perlman (1982) in their influential anthology on the topic. This definition relies on three key aspects: First, a perceived deficiency of meaningful interpersonal contact relative to the personal preference for relationships in a given situation. Loneliness is thought to be the result of the discrepancy between these two and may occur in a specific context or be a related to an overall lack of meaningful contact. Secondly, loneliness is a fundamentally subjective experience. Though closely related to similar concepts such as objective social isolation, the subjective experience of feeling isolated and lonely has been shown to be a more effective predictor of distress and negative consequences than an objective lack of human contact (e.g., Coyle & Dugan, 2012; Holwerda et al., 2014). From this follows that one can feel lonely in a crowd or be unbothered by the lack of social contact, if this is within the desired range at the time. The third aspect of loneliness pertains to the affective properties brought on by this discrepancy (Peplau & Perlman, 1982). Though sometimes stressed to be an idiosyncratic reaction (Young, 1982), loneliness is by definition considered to be a distressing experience related to negative affect in general (Newman & Sachs, 2020), and depressed mood and sadness more specifically (Rubenstein & Shaver, 1982). Taken together, these tenets describe some central characteristics of loneliness: its subjective nature and its affective presentation. It also offers an account of how loneliness comes about, in this case via the impoverished quality of social contact in relation to one's standards.

Another way to answer the question also touches on the related topic of why people feel lonely. The social nature of humans and the innate need to belong to a social group serve as a starting point for this line of reasoning (Baumeister & Leary, 1995). Loneliness is in this context assumed to serve as the other end of the extreme, a proof of the fact that this need has been thwarted. Some amount of text has been devoted to address the evolutionary origins and function of loneliness (e.g., Cacioppo et al., 2014). From this perspective, the evolutionary theory of loneliness (ETL) stipulates that loneliness is a signal to an environment or situation where the chances of encountering mutually

beneficial or altruistic interpersonal contact is low, and/or the chances of encountering spiteful or selfish contact is high (Cacioppo & Cacioppo, 2018b). Other tenets of this theory include the initiation of cognitive and bodily changes in preparation for this lack of collaborative contact (e.g., hypervigilance to social threats) and behavioural tendencies serving the purpose of self-preservation. In the short term these changes are proposed to be beneficial for the individual, though long-lasting feelings of loneliness would give rise to the consequences noted in the epidemiological literature, including increased HPA-axis activity (Doane & Adam, 2010) and ultimately an increased risk of all-cause mortality (Holt-Lunstad et al., 2015). Together, these postulates provide an explanation for what loneliness is, why it exists, and how (much like how an overreactive central nervous system provides the conditions for the development of anxiety disorders) the modern world may provide a poor fit for these mechanisms.

It is important to note that the definition provided by Peplau and Perlman (1982) and the theoretical take by Cacioppo and Cacioppo (2018b) do not necessarily contradict one another. The former provides an account of the affective properties of the phenomenon that is commonly found in descriptions of this phenomenon (*I felt lonely, sad, and bored*) and does explain how this feeling comes about (*The current social situation is not in line with my preferences*) that is useful from a clinical standpoint. The latter elaborates on this last line of reasoning by providing an explanation of the evolutionary origins of this state and the cognitive and behavioural correlates noted as frequent companions in populations where loneliness is a concern. For this thesis, both answers to the question *What is loneliness?* will be used, both in the psychoeducation in the interventions but also as a theoretical backdrop.

Finally, both definitions also serve as a demarcation against what loneliness is not. Loneliness is not equal to an objective lack of social contact, also known as social isolation. Feeling lonely is a subjective state that can exist with or without the objective lack of social contact and a social network (Wang et al., 2017). This thesis will concern loneliness rather than other related-though-distinct constructs.

Prevalence and trends over time

The prevalence of loneliness and the supposed increasing incidence over time has gained some attention in recent years. Worrisome headlines frequently pop up in major news outlets, naming loneliness a *plague* (Gil, 2014, July 1) and an *epidemic* (Hafner, 2016, September 6). This has been the case even before the actual COVID-19 pandemic during which loneliness has been named a *"signature concern"* (Killgore et al., 2020). However, before tackling the question of whether a plague or epidemic is actually afoot, it is important to consider what these headlines might be referring to and what the estimates provided in the epidemiological literature actually represent.

When investigating the prevalence of loneliness, one way is to simply ask the respondent some variation of the question "*How often do you feel lonely?"*. Among adults, a study in the U.K. found that around six percent of the population endorsed feeling lonely either often or always, a category referred to as frequently lonely (Victor & Yang, 2012). Dichotomisation into frequently lonely/non-lonely individuals such as this is often found in the literature exploring the connection between loneliness and adverse somatic outcomes (e.g., Holwerda et al., 2014). Using the same procedure, Yang and Victor (2011) also found a wide range of estimates of frequent loneliness in their study of European countries with the prevalence seemingly shifting as a function of nation (with eastern European countries reporting higher estimates then countries in western Europe) and age group (with older adults reporting more frequent experiences of loneliness than younger adults).

While loneliness is sometimes viewed as primarily a problem among the elderly, this has been refuted as a myth (Dykstra, 2009). Today, loneliness is instead suggested to be an issue across the lifespan that may come about as social needs and desires continuously change during life (Qualter et al., 2015). In fact, a recent global survey conducted using a continuous measure found loneliness to be inversely related to age (Barreto et al., 2021), suggesting that the stereotype of the lonely elderly might not be correct. Regardless of the demographic trends, loneliness is a common concern within the healthcare system. Mullen et al. (2019) found that 20 % of patients seeking help at two primary care practices could be classified as

lonely. Similarly, approximately 30 % of a sample from a mental health crisis service had a mean above the threshold of what the authors considered severe loneliness, an average rating of *sometimes* across the items assessing loneliness (Wang et al., 2019).

All the studies described above assess the frequency by which the respondents experience loneliness. While this way has been helpful in investigating the link with demographic variables and adverse outcomes, it is not the only dimension of loneliness that can be assessed. In addition to the frequency of loneliness, Beutel et al. (2017) found that 3.7 % of their sample from the general population reported being moderately distressed by their loneliness while 1.7 % was severely distressed. This is of interest due to the connection between the experience of distress and the overarching concept of stress (Diemer, 2017), which in turn has been proposed to be one of the principal pathways through which loneliness exerts its influence on other somatic and psychological outcomes (Cacioppo & Cacioppo, 2018b).

None of the studies up to this point deals with the question about whether loneliness is increasing over time. There is some evidence of this. In their analysis of the prevalence of loneliness in China over a 20-year period, Yan et al. (2014) found that the mean ratings of loneliness had increased by roughly on standard deviation over this period. However, cohort studies in Finland (Eloranta et al., 2015) and Sweden (Dahlberg et al., 2018) have found no such increase over time. A third study from the U.S. did not find any evidence for a generational increase in loneliness either, though the authors noted that as the life expectancy increases, the risk factors for loneliness (such as bereavement and physical disabilities) increase with it, thus potentially accentuating the risk of creating circumstances for loneliness over time (Hawkley et al., 2019). All these studies have been conducted with older adults. Among younger adults, studies would seem to indicate an increase in recent years. Hysing et al. (2020) reported an increase among Norwegian college students from 2014 to 2018 of approximately seven percentage points (to a prevalence of 23 %). Classification of loneliness in this study was done by dichotomising those that reported feeling *quite a bit* or *extremely* lonely compared to the other responses. A similar trend has been reported among Danish adolescents on a longer timescale (Madsen et al., 2019);

Using a single item measure the authors found an increase over 23 years of data included in the study, though the estimate in 2014 was substantially lower (7.3 %) than the one found in the Norwegian study. Parsing all these findings into overarching conclusions is difficult, though a seemingly consistent finding is that adolescents and young adults may be experiencing loneliness more frequently now than in the past.

Loneliness as a phenomenon of clinical interest

Neither assessing the frequency or the distress related to loneliness provides insight into whether it is a persistent problem for the respondent. Though it is an inherently aversive phenomenon, it is important to note that brief, transient instances is considered perfectly normal and a basic fact of life (Asher & Paquette, 2003; McWhirter, 1990). The occasional presence of loneliness is thus not necessarily cause for concern. This concern has instead been suggested to be reserved for the long-lasting and frequent versions, where the loneliness assumes a more stable form that is sometimes termed chronic loneliness (Käll et al., 2020; Young, 1982). From a clinical perspective this kind of loneliness is of great interest. For one, the deleterious somatic effects of loneliness is thought to come about as a function of a long-lasting, chronic exposure which over time takes its toll on the body (Cacioppo & Cacioppo, 2018b). Furthermore, chronic loneliness (being classified as lonely at both baseline and follow-up) has been found to predict worse health outcomes compared to transient loneliness (being classified as lonely at one of the time points), although both classifications has been shown to predict worsening trajectories over time (Martín-María et al., 2020; Zhong et al., 2016). Chronicity has also been seen to be a key indicator of negative psychological outcomes (Vanhalst et al., 2018). Understanding how loneliness becomes sustained over time is therefore an important angle to consider.

Loneliness over time and intrapersonal factors

Young (1982) created an initial taxonomy of loneliness chronicity consisting of three categories: transient, situational, and chronic loneliness. The first of these refers to the brief state of emotional distress thought to be a common human experience. The concept of situational loneliness describes a prolonged feeling of disconnection and loneliness thought to originate from a disruption in a person's social network, for example moving to a new city or losing a partner. The timeframe noted by the author for this kind of loneliness is between 6 and 24 months, thought to represent the period of transition needed to re–establish the characteristics of the social network to a satisfactory level. The last category, chronic loneliness, is thought to be experienced by people who have felt lonely for a continuous period of more than two years. While seemingly arbitrary, Young (1982) uses this rule of thumb to aid the clinician in making the

decision of whether to address loneliness as a separate entity within the context of cognitive therapy. A person feeling lonely for years would be assumed to have a stable pattern of unhelpful cognitive and behavioural tendencies that maintain the state and that should be addressed. Chronicity would therefore be understood as the product of intraindividual factors that maintain the state over time. Young (1982) placed a heavy emphasis on the cognitive content and maladaptive assumptions of the chronically lonely in his analysis of this group. According to the author, loneliness can be thought of as consisting of 12 clusters spanning areas such as social isolation (e.g., social anxiety) and problems related to existing relationships (e.g., unrealistic expectations or lack of assertiveness), all of which carry distinct cognitive, behavioural, and emotional manifestations related to the feeling of loneliness. These manifestations and the interplay between them are considered to be the clinically relevant aspects of loneliness as they help maintain the state over time. This served as the first thorough account of the intrapersonal factors that characterise loneliness and that demarcate those who experience it as a transient phenomenon from those with more chronic troubles.

Though Young (1982) mainly based his writing on his clinical experiences, a link between loneliness and psychological factors is frequently found in the literature. For example, loneliness has been linked to the cognitive processes that affect how the social world is perceived (Spithoven et al., 2017). People with higher ratings of loneliness have been noted to have a hypervigilance to social threats (Bangee et al., 2014; Qualter et al., 2013). Loneliness has also been linked to a tendency to expect rejection in social contexts (Watson & Nesdale, 2012; Zimmer-Gembeck et al., 2014) and to exhibit higher levels of negative emotions (e.g., sadness) when faced with scenarios detailing exclusion and lower levels of positive emotions (e.g., happiness) when faced with scenarios describing inclusion and social connection (Vanhalst et al., 2015). Furthermore, loneliness does seem to have certain behavioural correlates that could potentially perpetuate the experience of isolation. This includes a tendency towards withdrawal in social contexts (Watson & Nesdale, 2012) and a higher degree of reliance on avoidance, rather than approach-oriented behaviours (Nurmi et al., 1997). To add to this last finding, loneliness has also been found to have a positive correlation with avoidance motives and a negative correlation with approach motives

in two longitudinal investigations (Gable, 2006). This could suggest that people with high ratings of loneliness may seek to avoid situations with the possibility of social rejection to a larger extent than people with lower ratings. A consistent problem with these studies, however, is the sampling. While this area of research is neither the first nor the last to rely heavily on college students to test hypotheses, there is an additional lack of standardised criteria used to demarcate lonely from non-lonely participants. Furthermore, in studies where the relationship is investigated in a linear, rather than dichotomised, fashion (e.g., via correlations) the loneliness ratings are frequently found around the reported mean for the instruments used, rather than towards the higher end of the range. All in all, the findings do generally point to higher levels of loneliness being related to the maladaptive intrapersonal tendencies, much like Young (1982) speculated. However, the populations used to investigate these connections leave something to be desired.

Loneliness and psychiatric disorders

Loneliness is frequently linked to psychiatric disorders and psychopathological processes. The description of chronic loneliness by Young (1982) details its connection with depressive symptoms and the maladaptive beliefs that serve to perpetuate both loneliness and depression over time. The ties between the two constructs have sometimes seemingly led people to assume that they are one and the same. For example, an item of the Centre for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977) concerns loneliness specifically, suggesting that loneliness should be viewed as a symptom of depression. However, more recent psychometric findings suggest that this idea might not fit with the data. A confirmatory factor analysis conducted on young adults found that symptoms of depression, symptoms of social anxiety, and ratings of loneliness was best represented as three distinct constructs, although the factors were all substantially correlated (Fung et al., 2017). Another confirmatory factor analysis on three samples of adolescents also found three distinct, though interrelated, factors (Danneel, Bijttebier, et al., 2019). Both studies suggest that although loneliness is related to both symptoms of depression and symptoms of social anxiety, it is best represented as a unique construct.

Cross-sectional findings frequently find loneliness to be linked to a wide range of psychopathological symptoms. Beutel et al. (2017) found loneliness to be significantly related to more severe symptoms of major depressive disorder and generalized anxiety disorder in the general population. A later study by the same research group (Klein et al., 2021) reported similar relationships with these diagnoses, but also with stress and suicidality. In another survey of the general population, Stickley and Koyanagi (2016) found that respondents that indicated that they felt lonely sometimes or very much had a substantially raised prevalence of suicidal attempts and suicidal ideation along with an increased risk of suffering from common mental health disorders such as major depressive disorder or phobias. A meta-analytical examination of the literature has also found a moderate correlation between loneliness and psychotic symptoms (Michalska da Rocha et al., 2017). In sum, the relationship between loneliness and psychiatric disorders is seemingly both common and substantial, though the interplay between the different constructs cannot be inferred from these findings.

Perhaps of greater interest in relation to the question of loneliness over time is the longitudinal research that could potentially provide some insight into the "chicken-or-egg" problem for loneliness and the common mental health problems frequently associated with it. With regards to symptoms of depression, cross-lagged model analyses with measurements once every year have found both a reciprocal influence (Cacioppo et al., 2006), but also primarily an impact of loneliness on depressive symptoms (Cacioppo et al., 2010). Using a shorter timeframe of six months, Lim et al. (2016) found that loneliness predicted future ratings of depression and social anxiety, but also that ratings of social anxiety predicted future ratings of loneliness. A reciprocal relationship was also found in a meta-analytical investigation of studies on children and adolescents (Maes, Nelemans, et al., 2019). Lastly, Danneel, Nelemans, et al. (2019) found that social anxiety predicted loneliness, but not depressive symptoms, at later time points and that loneliness in turn predicted later symptoms of depression and social anxiety. As suggested by these studies, loneliness, symptoms of depression and, perhaps most commonly, social anxiety can exert a negative influence on each other, potentially creating a vicious circle. This has led some of the authors (e.g. Danneel, Nelemans, et al., 2019; Lim et al., 2016) to explicitly

recommend addressing symptoms of these disorders to address loneliness and vice versa.

Alleviating loneliness – Prior theories and current directions

With the potential impact of loneliness on the physical and mental health of those afflicted in mind, intervening to help this group has been made a priority in parts of the world, including the U.K. (Age U.K., 2011) and Australia (Australian Coalition to End Loneliness, 2017). How this should be done remains an open question. Masi et al. (2011) conducted an influential meta-analysis detailing interventions aimed at reducing loneliness by different means. Interventions were divided into categories based on the primary mechanism of achieving this reduction: either by providing opportunities for social contact, providing social support directly, improving the participant's social skills, or dealing with maladaptive cognitions about social situation (similar to the ideas outlined by Young, 1982). Though crude, this breakdown helped provide an initial indication of which kind of intervention that might be the primary candidate going forward. Unfortunately, the first three categories showed no or small average improvements compared to the control conditions in randomised controlled trials. Only interventions targeting maladaptive social cognitions showed a consistent effect relative to the control group with a moderate effect size of Cohen's $d = 0.6$, though only four RCTs existed at the time of the analysis. The findings from this study have in part lead to the recommendation of addressing loneliness by means of psychological interventions, and more specifically cognitive behavioural therapy (CBT; Cacioppo, Grippo, et al., 2015). Later efforts of synthesising the quantitative data from interventions targeting loneliness partially support the idea that psychotherapeutic interventions are a candidate for this group; Eccles and Qualter (2020) found a significant effect of this kind of intervention in their meta-analysis of strategies for children and adolescents. Additionally, in a recent meta-analysis of psychological interventions against loneliness we did find a slightly reduced estimate overall ($d = 0.43$), though the effect for CBT interventions was bordering on a moderate effect size (0.49; Hickin et al., 2021). In sum, though the findings by Masi et al. (2011) may have overestimated the average efficacy of psychological treatments targeting loneliness slightly, updated analyses of available studies still point to the potential for this kind of intervention. However, the field is still lacking in terms of both quantity and quality of the clinical trials. On top of this, even though some interventions do

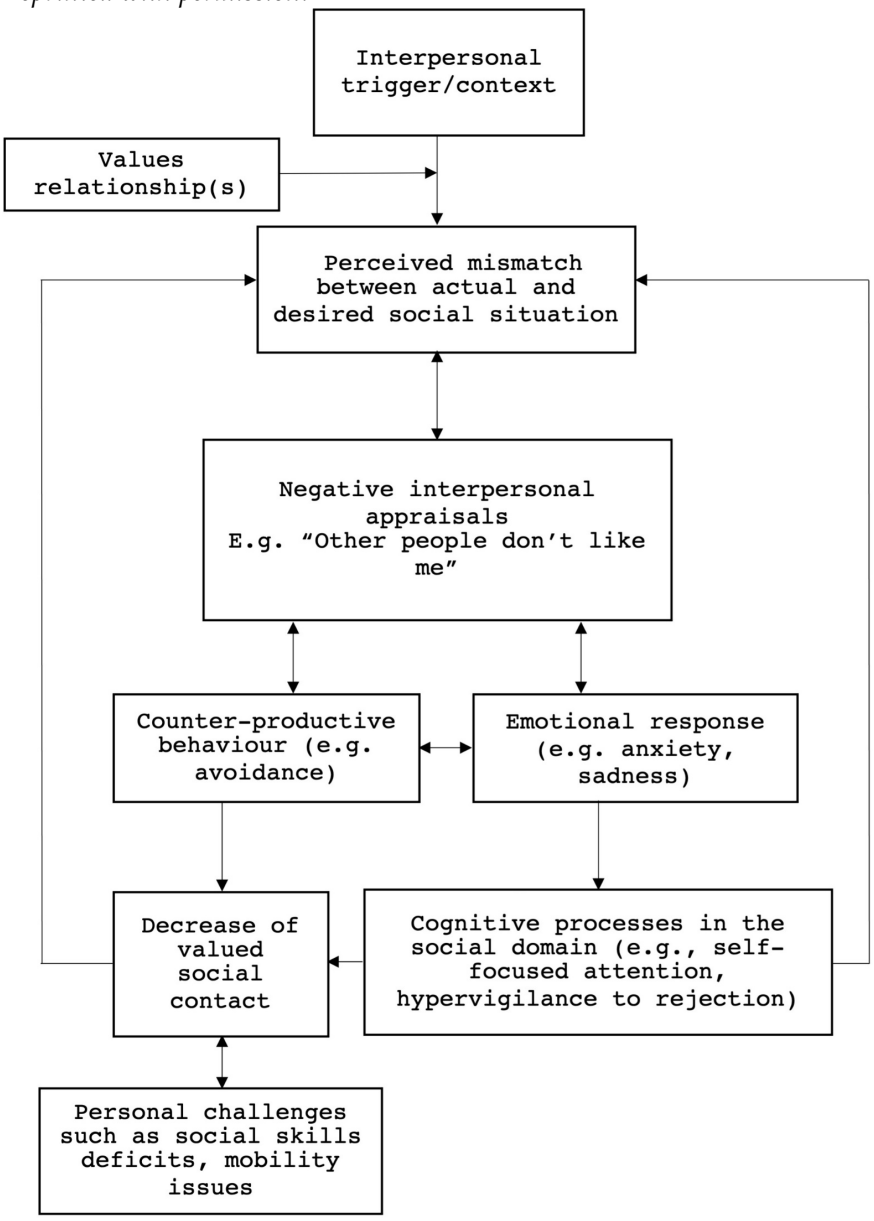
seem like promising candidates, the lack of standardised formats and rationales may hamper efforts to test these interventions more than once and in a rigorous manner.

A cognitive behavioural perspective on chronic loneliness

The processes and maladaptive tendencies described above give some insight into how and why the state of loneliness can become a lasting problem. It also provides some potential targets for clinical intervention, as has been suggested in past descriptions of the maintenance of loneliness over time (Cacioppo & Hawkley, 2009; Cacioppo, Grippo, et al., 2015). However, an obstacle in translating these into clinical practice has been the disconnect between the findings from cognitive neuroscience making up the basis for these models (e.g., Cacioppo, Balogh, et al., 2015) and the clinical methods (e.g., CBT) promoted as a potential antidote for loneliness, not unlike the divide described by McNally (2001) for anxiety disorders. Keeping this in mind, we conducted a synthesis of the literature on the maladaptive cognitive and behavioural tendencies found in this population and what could be gathered from previous successful interventions with the aim of arriving at a clinically useful, testable model of how loneliness is perpetuated over time (Käll et al., 2020). The model can be seen in Figure 1. It details both how the state of loneliness can come about in its transient form, but also how this state may become lasting via some of the maladaptive processes and behavioural tendencies. For example, as mentioned previously individuals who experience loneliness have been suggested to rely more on behavioural strategies that might fail to close the gap between the actual and wanted social situation, such as social withdrawal (Watson & Nesdale, 2012). Another example is the presence of personal challenges such as deficient social skills that may provide worse opportunities to realise the lack of social contact that would help reduce feelings of loneliness. We refer to this as valued social contact, a term used to capture the idea that the personal preferences for this contact can differ between people and over time. From this perspective, the overlap between loneliness and common forms of mental health problems can be understood through shared processes of maintenance, such as the increased vigilance for social threat that can be seen in loneliness (e.g. Cacioppo et al., 2016) and social anxiety disorder (Boll et al., 2016).

Figure 1

A cognitive behavioural model of chronic loneliness. From Käll et al. (2020). Reprinted with permission.



As the name suggests, the cognitive behavioural model (Käll et al., 2020) is proposed to have clinical utility by way of proposing potential targets for intervention, and more specifically by using CBT. CBT has been recommended for the mental health problems that loneliness overlap with in terms of proposed maintaining factors. A meta-analysis investigating the impact of CBT in trials against depressive symptoms found a moderate effect size in the comparison to control groups, Hedges g = 0.71 (Cuijpers, Berking, et al., 2013). Similarly, CBT targeting social anxiety was found to have the greatest effect size (SMD of 1.19 compared to control groups) out of both the pharmacological and psychotherapeutic treatments included in a meta-analysis (Mayo-Wilson et al., 2014). The techniques and strategies for behaviour change disseminated in CBT has also been used successfully in treating a range of transdiagnostic phenomena. This includes perfectionism (Shafran et al., 2017) and procrastination (Rozental et al., 2015), that just like loneliness can be related to psychopathology and psychiatric disorders (Beutel et al., 2016; Egan et al., 2011). Additionally, CBT elements can be found in trials can have successfully reduced loneliness among participants. This includes exposure exercises and social skills training (Hopps et al., 2003), behavioural activation (Choi et al., 2020), and cognitive restructuring (McWhirter & Horan, 1996). All in all, these factors point to the potential utility of CBT for this population, although there is presently a clear lack of standardised formats that have been evaluated in a methodologically sound design.

Other aspects relevant for reducing feelings of loneliness

The cognitive behavioural model (Figure 1) is heavily reliant on intrapersonal factors in the understanding of how loneliness becomes a prolonged phenomenon. It is however important to note that contextual factors and interpersonal factors have also been shown to be closely related to the incidence of loneliness. For example, Lasgaard et al. (2016) identified two clusters of adolescents that had experienced major life events: those who had moved to a new city or whose parents had gone through a divorce and those who had experienced either the loss of a loved one or the incidence of a severe illness. Both clusters had higher levels of loneliness compared to adolescents who had not experienced these events. A cross-sectional study conducted by Bayat et al. (2021) on the same age group also

found events and circumstances such as parents divorcing, bullying, and illness in the family to be related to an increased likelihood of experiencing loneliness. Among adults, a longitudinal examination of the impact of certain life events on subsequent loneliness found a significant increase in loneliness following some, but not all kinds of life events (Buecker et al., 2020). Events such as a divorce, widowhood, and the loss of a job was related to loneliness in both the short- and the long-term, while others such as retirement and cohabitation with a partner did not have a negative impact. Finally, a phenomenological investigation of loneliness among older adults identified losses, whether perceived or actual, of relationships as one of the main reasons for feeling lonely (McInnis & White, 2001). Another theme among the respondents of the study also pointed to difficulties in disclosing their loneliness to others as a barrier to reconnection.

With the link between life events, the interpersonal circumstances, and loneliness in mind, addressing maladaptive intrapersonal tendencies may not be the only way of helping individuals struggling with loneliness. As described in the cognitive behavioural model (Figure 1; Käll et al., 2020), factors related to the incidence of loneliness may also serve as useful targets for intervention. Though some of the events mentioned above (e.g., the loss of a loved one) should probably be considered a fact of life, making this transition easier and reducing the burden may be a way of making the loneliness a situational, rather than a chronic concern.

Providing social support directly has not been seen to be effective in reducing loneliness, as indicated by the non-significant average effect in the meta-analysis by Masi et al. (2011). However, psychological treatments with the intent of helping the individual create a social situation more in line with their needs have shown effects in the case of psychiatric disorders. This is the case for interpersonal psychotherapy (IPT), a form of psychotherapy based in the idea that low mood and common symptoms of psychiatric disorders frequently stem from changes in a person's social network (Weissman et al., 2017). This potentially destructive link between mood (e.g., depressed mood) and event (e.g., a strained marriage) is thought to be bidirectional, such that an event can worsen the mood which in turn increases the chances of more unpleasant interactions with others.

Understanding this link and providing more adaptive ways of reaching the social support currently lacking is thought to be therapeutic elements. IPT frequently focuses on transitions related to life events but has also an explicit focus on chronic difficulties in cases where this is necessary (Weissman et al., 2017). A meta-analysis by Cuijpers et al. (2016) found a moderate average effect compared to control groups in the treatment of major depressive disorder with IPT. Comparisons against pharmacological treatments and other forms of psychotherapy revealed no significant differences, suggesting that IPT has similar effects to, for example, CBT for this patient group. The results of the meta-analysis also found a large effect size in the comparison against passive control groups for treating anxiety disorders, though the effect size for this group of disorders were lower than that found in previous meta-analyses of CBT (Mayo-Wilson et al., 2014). Though IPT has not been tested explicitly for loneliness, it is an intriguing option to consider. The link between loneliness and life/interpersonal events along with the explicit focus on providing better opportunities for reaching the wanted levels of social support are both aspects which suggest a potential for this kind of psychological treatment to be of help. IPT also addresses some of the factors thought to be important in the maintenance of loneliness over time, such as social skills (Weissman et al., 2017). Though not tested or named among the candidates for alleviating loneliness, IPT can make a credible claim as an option to consider. Addressing loneliness by other means than a focus on intrapersonal factors could also provide valuable diversity and allow for inferences regarding the efficacy of different ways of targeting loneliness relative to one another.

Internet-based psychological treatments

While psychological treatments have traditionally been delivered with the therapist and client physically present in the same room, the internet can be used as a way of delivering a treatment remotely. Internet-based psychological treatments, and most commonly internet-based cognitive behavioural therapy (ICBT), has developed into an effective form of psychological treatment to complement other approaches such as individual therapy or group therapy (Andersson, 2018). Advantages of the internet-administration include an increased ability to reach underserved groups and increased flexibility for both the client and the therapist regarding non-content related factors such as time and location. A meta-analysis of trials comparing regular, face-to-face therapies in either a group or individual format to an equivalent ICBT treatment found no significant difference between the two formats (Carlbring et al., 2018), suggesting that that internet-based format is yet another way of producing the proven effects of CBT.

Traditionally, the concept of internet-based psychological treatment is reminiscent of a bibliotherapy where the client is presented with written psychoeducation regarding a mental health problem and how it can be managed via practical assignments and exercises. In the case of ICBT, treatments commonly mimic the session-by-session structure of face-to-face CBT by dividing the treatment into modules which add to or expand on the previous content of the treatment. Additionally, a therapist is often involved, though this is not always the case. A meta-analysis of individual participant data has shown unguided internet-based interventions for depression to reduce depressive symptoms compared to control groups with a small effect size of Hedges $g = 0.27$ (Karyotaki et al., 2017). However, both estimates from other meta-analyses (Andersson et al., 2019) and direct comparisons between guided and unguided interventions suggest that guided treatments produce superior effects compared to unguided counterparts (Baumeister et al., 2014). The latter review also indicated that guided interventions produced higher adherence than treatments with no therapist contact. In terms of cost-effectiveness, guided internet-based treatments have been estimated to reduce the time required per client and week by up to 85 % compared to regular face-to-face therapy (Hedman et al., 2012). A third alternative to the guided/unguided distinction is what has come to be known as on demand-guidance (Rheker et al., 2015) or optional support (Hadjistavropoulos et al., 2017).

With this mode of guidance, participants are invited to request help and feedback when needed. Should the client not request help, no contact is initiated by the therapist. Hadjistavropoulos et al. (2019) found no significant difference in the outcomes when comparing a group receiving regular, weekly therapist contact and a group with on-demand therapist contact in the treatment of anxiety and depression. A later trial by the same research group (Hadjistavropoulos et al., 2019) found similar, non-significant differences between the two modes of therapist guidance when accounting for both symptom reductions and completion rates. However, it should be noted that a trial of ICBT for tinnitus (Rheker et al., 2015) also found no difference between an on-demand guidance and no guidance at all, leaving the findings a bit inconclusive.

The findings and comparisons outlined above mostly concern ICBT, as it is the most tested kind of internet intervention (Andersson, 2018). However, other forms of psychotherapy have also been shown to perform well when administered via the internet. A meta-analysis of available trials of psychodynamic therapy by Lindegaard et al. (2020) found significant reductions of symptoms of anxiety disorders and major depressive disorder. The benefits of the treatments were also visible in the form of an increased quality of life. Of relevance to the potential of using IPT-based interventions for loneliness are the two studies that have also investigated the use of internet-based IPT. Dagöö et al. (2014) compared internet-based IPT to an ICBT treatment for social anxiety disorder. The latter condition led to a greater symptom reduction and to a significantly larger proportion of the participants being classified as responders. Donker et al. (2013), however, found similar benefits from the IPT condition compared to an ICBT equivalent in a non-inferiority trial of internet-based treatments for depressive symptoms. Worth noting is that neither of the IPT conditions in these studies offered the kind of tailored content (i.e., choosing a specific focus to work on) that is thought to be a building block of IPT (Weissman et al., 2017). Given the overall lack of studies and this potential problem of treatment fidelity, further research is needed to conclude whether IPT via the internet is a feasible and efficacious approach.

Aims of the thesis

The overarching aim of the thesis was to investigate the efficacy of internet-based psychological interventions targeting loneliness. Given the non-existent literature of this kind of intervention for the target group, the scope of the studies also encompassed the long-term effects and investigations of the heterogeneity in people applying for participation. The latter is an important step first step in the process of potentially providing tailored treatment options according to a what works for whom-logic.

More specifically, the aims of the project were to:

I. Investigate the existence of subgroups based on symptoms of psychiatric disorders and loneliness in the sample applying for treatment.

II. Investigate the efficacy of an internet-based cognitive behavioural intervention compared to a control group.

III. Investigate the long-term outcomes of the intervention two years after the conclusion of the initial treatment period.

IV. Replicate the results from the first pilot study, as well as test the specificity of the effects by offering a second intervention based on interpersonal psychotherapy, an approach deemed to be a credible and potentially efficacious alternative.

Methods

Instruments

UCLA Loneliness Scale, Version 3 (ULS-3)

The third iteration of the UCLA Loneliness Scale (ULS-3; Russell, 1996) was used as the primary outcome measure in the randomised controlled trials, and as an indicator in **Study I**. The scale consists of 20 items with the aim of providing a uniform estimate of loneliness. Each item consists of a statement to which the respondent is asked to indicate how often they experience a particular experience linked to loneliness on a Likert scale (never/sometimes/often/always). An example item is "How often do you feel close to people?". Scores can range from 20 (minimal loneliness) to 80 (maximum loneliness). The word loneliness is not mentioned in the English version of the questionnaire, though it was used in the Swedish version administered throughout the studies due to the way the concepts alone and lonely use the same word in the Swedish language. The instrument has been noted to have an internal consistency of Cronbach's $\alpha = .92$ and a one-year test-retest coefficient of $r = .73$. No clinical norms or cut-off values exist, though the mean and standard deviation (calculated from the reported standard error) from a recent nationally representative sample in the USA was estimated at 44.03 and 2.76, respectively (Bruce et al., 2019). The internal consistency found in the samples of the studies in this thesis was Cronbach's $\alpha = .85$ (the sample in **Study II**), .87 (the sample in **Study IV**), and .86 for the total sample applying for participation (included in the analyses for **Study I**).

Brunnsviken Brief Quality of Life Questionnaire (BBQ)

The Brunnsviken Brief Quality of Life Questionnaire (BBQ) is a 12-item instrument measuring subjective quality of life (Lindner et al., 2016). The instrument was used as a secondary outcome measure in **Study II**, **III**, and **IV** and an auxiliary variable in **Study I**. It is divided into six item pairs, each measuring the respondent's quality of life within a given domain. The domains are Leisure time, Learning, Creativity, Friends and Friendships, and View of self. The item pairs ask the participant to indicate how pleased they are with a domain, as well as how important they consider the domain to be for their quality of life.

Ratings are made on a scale between 0 (I do not agree at all) and 4 (I agree completely). The total sum consists of the product of each item pair, with a possible range between 0 and 96. Psychometric properties during the validation phase has been reported as an intraclass correlation between measurement occasions of .82, and an internal consistency of Cronbach's α = .76 (Lindner et al., 2016). During this process, the authors also found a convergent validity with the Quality of Life Inventory (QoLI) of r = .65. For the studies described in this thesis, the internal consistency was found to be α = .82 (**Study II**), .87 (**Study IV**), and .71 (**Study I**).

Social Interaction Anxiety Scale (SIAS)

The Social Interaction Anxiety Scale (SIAS) consists of 20 items that aim to measure the social interaction anxiety that is part of the clinical presentation of social anxiety disorder (Mattick & Clarke, 1998). It was used as a secondary outcome measure in **Studies II** through **IV** and as an indicator in **Study I**. The respondent is asked to indicate how characteristic the statement that makes up the item is for them, with ratings ranging from 0 (Not at all) to 4 (Extremely). Total sum scores can range between 0 (no social interaction anxiety) and 80 (maximum social interaction anxiety). The psychometric properties found during the validation of the instrument include an internal consistency of α = .94 and a 12-week test-retest reliability of r = .92 (Mattick & Clarke, 1998). SIAS scores have been seen to correlate substantially (r of .73) with the Liebowitz Social Anxiety Scale (LSAS) and have demonstrated very similar within-group effect sizes when used in the same assessment battery after treatment of social anxiety disorder (an effect size of 1.34 for LSAS and an effect size of 1.35 for SIAS; Heimberg et al., 1999). A score above one standard deviation from the community sample mean (> 34) was found to correctly classify 86 % of participants with a diagnosis of social phobia (Brown et al., 1997). On a related note, the mean in a sample of respondents with social anxiety disorder was found to be 44.5 with a standard deviation of 9.6 (Mörtberg et al., 2017). In **Study I** we use this mean as a guideline for the distinction between clinical and sub-clinical levels of symptoms of social anxiety disorder. The internal consistency in the current studies were α = .92 (**Study II**), .93 (**Study IV**), and .94 (**Study I**).

Patient Health Questionnaire, 9-item Scale (PHQ-9)

The Patient Health Questionnaire, 9-item Scale (PHQ-9) is a depression inventory assessing the presence and severity of Major Depressive Disorder according to the DSM-IV criteria (Kroenke et al., 2001). PHQ-9 was used as a secondary outcome measure in **Studies II** through **IV** and as an indicator in **Study I**. Each of its nine items assesses a specific symptom of the disorder and how often it has been present during the past two weeks. Ratings are made on a scale from 0 (Not at all) to 3 (Nearly every day). Sum scores can range from 0 to 27. Severity ranges has been defined as minimal (a sum of 1-4 points), mild (5-9), moderate (10-14), moderately severe (15-19), and severe (20-27). Psychometric properties include an internal consistency of $\alpha = .89$ and a two-day test-retest coefficient of 0.84 (Kroenke et al., 2001). In the present studies, the internal consistency was noted at Cronbach's $\alpha = .78$ (**Study II**), .86 (**Study IV**), and .86 (**Study I**), respectively.

Generalized Anxiety Disorder, 7-item Scale (GAD-7)

Symptoms of generalized anxiety disorder (GAD) was measured using the Generalized Anxiety Disorder 7-item scale (GAD-7; Spitzer et al., 2006). GAD-7 was used as a secondary outcome measure in **Studies II** through **IV** and as an indicator in **Study I**. The seven items measure the frequency of GAD symptoms during the past two weeks. As with the PHQ-9, ratings are made on a scale from 0 (Not at all) to 3 (Nearly every day), with a possible sum score range between 0 and 21 points. Severity can be interpreted according to the following ranges: minimal (a sum of 0-4 points), mild (5-9), moderate (10-14), and severe (15-21). The psychometric properties of the instrument include an internal consistency of Cronbach's $\alpha = .92$ and a test-retest ICC of .83. In the studies reported in this thesis, the internal consistency was reported as Cronbach's $\alpha = .82$ (**Study II**), .89 (**Study IV**), and .90 (**Study I**).

Other measures

Client Satisfaction Questionnaire, 8-item version (CSQ)

The eight item-version of the Client Satisfaction Questionnaire measures a respondent's satisfaction with a psychotherapeutic treatment (Attkisson & Zwick, 1982). Each of the eight items measures a different facet of the treatment, such as the contact with a therapist.

Items are scored individually between 1 (the lowest degree of satisfaction) and 4 (the highest degree of satisfaction) before being summed up with a possible sum score ranging from 8 to 32. The internal validity has been reported to be excellent, Cronbach's $\alpha = .93$ (Attkisson & Zwick, 1982). In the studies reported as part of this thesis, the internal consistency was Cronbach's $\alpha = .93$ (**Study II**) and .91 (**Study IV**). For **Study II**, we also looked at the individual percentages of some items to get a detailed insight into how participants rated different aspects of the treatment and the study in general.

Working Alliance Inventory, 12-item short form (WAI)

The short-form version of the Working Alliance Inventory measures a respondent's experience of the alignment between the therapist and the respondent in terms of goals and the means of getting there, as well as the personal bond between the two parties (Tracey & Kokotovic, 1989). Each of the items are rated on a seven-point scale between one and seven, with the total sum ranging between 12 and 84. Higher scores indicate a greater working alliance. The internal consistency during the validation of the instrument has been described as Cronbach's $\alpha = .93$. The instrument was administered during the third week of treatment in **Study IV**. The instrument's internal consistency was measured at Cronbach's $\alpha = .95$ in our sample.

Credibility and Expectancy Questionnaire (CEQ)

The Credibility and Expectancy Questionnaire (Devilly & Borkovec, 2000) is an instrument consisting of six items measuring how credible a treatment rationale is and to what degree the respondent expects a treatment to be helpful for them. Each item is scored between 1 and 10 with the latter indicating greater credibility or expected improvement attributed to the treatment. The sum score of the six items can range between 6 and 60. Reported psychometric properties during the validation of the instrument include an internal consistency between a Cronbach's α of .84 and .85 and a one-week test-retest coefficient of .82 for the expectancy items and .75 for the credibility items. In the study utilising this questionnaire (**Study IV**), the internal consistency was found to be Cronbach's $\alpha = .92$. The measurement took place during the third week of treatment.

Interventions

The SOLUS programme (CBT)

The intervention for which we evaluated the effects relative to a waitlist control group in **Study II** and **IV** is referred to as the SOLUS programme. The programme consisted of eight (in **Study II**) or nine (in **Study IV**) parts, also called modules. During the active treatment phase, each participant assigned to the ICBT condition would receive access to one new module containing psychoeducation and practical homework assignments to be conducted during the week. The platform on which the intervention was hosted, *iterapi*, has been used for many similar studies (Vlaescu et al., 2016). Contact with the participants was handled using the internal messaging system. Therapists would unlock one module per week, regardless of whether the participant had completed the prior module or not.

The content of the modules can be seen in Table 1. The content was based in a cognitive behavioural framework emphasising the role of intrapersonal psychological factors in the maintenance of loneliness over time. Providing tools for minimising the impact of these factors, as well as the impact of symptoms of common psychiatric disorders, was thought to provide better opportunities for the kind of social contact lacking at present. This lack of contact was in turn hypothesised to give rise to feelings of loneliness. Taking the subjective aspect of loneliness into account, the psychoeducation emphasised the need to identify what is missing for the specific participant in their specific situation. The term valued social contact was used to refer to the kind of social contact deemed by the participant to counteract feelings of loneliness and provide a sense of belonging. In some cases, behaviours aimed at increasing valued social contact would need to address the quantity of social contacts (e.g., in the case of a small or non-existent social network). In other cases, efforts were instead focused on the quality of existing relationships (e.g., a relationship in which one's partner does not provide emotional support). The psychoeducation and the examples given within it provided scenarios related to both quantitative and qualitative aspects. Other techniques and strategies introduced in the modules were provided as a means of helping realise this valued

social contact by reducing the impact of obstacles such as social anxiety, lacking social skills, or maladaptive beliefs.

Table 1

CBT Modules

Module 1 – What is loneliness? Information about loneliness and its relation to thoughts and behaviours. Introducing a functional behavioural model (*The vicious circle of loneliness*).
Module 2 – Your goals and values Assignments regarding goal setting and identifying values. Additionally, a behavioural task for putting the psychoeducation into practical use.
Module 3 – Behaviours and loneliness Introduction to valued social contact and a modified version of behavioural activation as tool for this. Assignments for creating valued social contact.
Module 4 –Challenging behavioural and emotional obstacles Continued work in accordance with module 3 with a rationale for exposure if social anxiety plays a role for the loneliness.
Module 5 – Thinking and loneliness Psychoeducation about thoughts and dysfunctional thinking patterns. Assignments for challenging dysfunctional cognitive content and beliefs that are related to loneliness.
Module 6 – Behavioural experiments Introduction to behavioural experiments and two assignments making use of this technique.
Module 7 – Social skills and communication* Psychoeducation about social skills and how to communicate effectively. Describes a range of subjects such as active listening, making small talk, and body language. Assignments for integrating these into other efforts of creating valued social contact.
Module 8 – Evaluation A structured evaluation of the previous modules and planning for which techniques to continue using.
Module 9 – Relapse prevention Planning for the continued work and what to do in case feelings of loneliness becomes a problem once again.

Note. * Added for Study IV, not part of modules in Study II

The SOLUS IPT Programme (IPT)

This programme made use of the principles of interpersonal psychotherapy (IPT). It was created specifically for **Study IV** with the help of an experienced IPT-therapist (with D-level credentials equivalent to competence in advanced casework and independent supervision of other practitioners). While the CBT programme put an emphasis on the intrapersonal factors, such as maladaptive cognitions and counter-productive behavioural patterns, the IPT programme instead focuses on interpersonal factors. IPT hypothesises that psychopathology emerges as a response to interpersonal events, and that the bidirectional relationship between the two serves to perpetuate the emotional responses over time (Lipsitz & Markowitz, 2013). Establishing an understanding of the link between changes in mood (in this case the onset of loneliness) and event (e.g., a break-up) is a central tenet. IPT also inquiries into the social needs of the client as unmet needs are proposed to be of importance in understanding the incidence of mood disorders and adverse mood states. IPT is traditionally divided into phases, with the first phase assessing the current situation, the second phase working on a focus area of choice (an ongoing conflict, bereavement and complicated grief, a role transition, or an overarching pattern of interpersonal deficits), and a third phase of preparing for maintaining gains.

While loneliness has been investigated as a secondary outcome in a pair of outcome studies (Duberstein et al., 2018; Johnson et al., 2019), the SOLUS project marks the first time targeting loneliness with the method in a systematic, manualised fashion (to our knowledge). Its hypothesised efficacy was based in the fact that loneliness can arise in relation to interpersonal events (e.g. Fried et al., 2015; Lasgaard et al., 2016) and is closely linked to the concept of social support (Chen et al., 2014; Smith et al., 2021). The ability of IPT to increase social support has been proposed to be one of the mechanisms responsible for its efficacy in treating major depressive disorder and other forms of psychopathology (Lipsitz & Markowitz, 2013). Furthermore, in cases where loneliness can be viewed as a consequence of interpersonal events, the IPT programme was thought to provide the tools needed to and reduce the potential negative impact (e.g., through the use of communication analysis or identifying alternative sources of the needed social support).

The IPT programme was built using the aforementioned structure in mind. Modules 1 through 3 served as an assessment including the creation of a timeline and an interpersonal inventory. Participants would then choose a focus based on perceived fit to their situation and work on that focus in modules 4 through 8. The last module would then serve as the end phase, emphasising the need for maintaining gains and providing exercises and strategies to help with this. The focus areas to choose from can be seen in Table 2.

Table 2

The IPT Focus Areas

Focus – Grief Participants who had experienced the loss of a loved one could choose this focus. The focus had two main themes, processing the grief surrounding the loss, and creating new ways of making up for the lost social support.
Focus – Role transition Role transition refers to the abrupt change in one's social role(s) that could be related to a multitude of events, for example moving to a new city or losing a job. The work in this focus is centred around understanding how the social needs and wants have changed during the transition and where one could find new sources of the social support that is lacking at present.
Focus – Interpersonal deficits Interpersonal deficits are a more chronic pattern of difficulties in the interpersonal realm that makes it hard to create and maintain satisfying relationships. Participants working with this focus would identify strengths and deficits and work on creating social support with these in mind.
Focus – Conflict If part of a conflict with at least one other person, the conflict focus may have been relevant. In these modules, the participant would work on identifying the different perspectives of the conflict, how the conflict interferes with social needs, and how to communicate effectively.

Some of the content in the modules were unique, while other parts could be found in two or more of the focus areas. An example of this

was the use of the method communication analysis which helps systematically break down the communication with others to help gain perspective on what transpired and how to communicate more effectively in the future. Participants who could not work with their primary choice of focus could choose another one (e.g., if the other party of a conflict did not wish to work on solving a conflict). One module was unlocked each week during the assessment phase but unlocking of modules in the focus phase was contingent on the participant choosing a focus (which would then unlock one module per week that had passed since the treatment entered the focus phase during week four). The therapists in this condition were asked to bring focus to the relationship between mood and events throughout the treatment, in addition to more generic tasks such as providing reminders and clarifying information about the modules.

Inclusion and exclusion criteria for the randomised controlled trials (studies II and IV)

The inclusion and exclusion criteria for the two randomised controlled trial were consistent on all but one criterion. This discrepancy was the use of a formal cut-off score for the primary outcome measure (ULS-3) for **Study II**, but not for **Study IV**. The reasoning behind the decision to not use a formal loneliness criterion in **Study IV** was the lack of available validated clinical cut-offs. A mean close to that of the groups described by Russell (1996) during validation of the instrument (a sum score of 40) was used in **Study II** to provide some formal guidance. However, when planning for the new RCT, this criterion was not thought to provide better insight into who was and who was not lonely enough to participate in our trials. We instead relied on the participants' own experience, a clear specification regarding the focus on loneliness in the recruitment materials, and the need for loneliness to be the primary concern of the prospective participant. While other psychiatric diagnoses (except for those named as exclusion criteria) was allowed, loneliness had to be considered the primary problem at the moment. The inclusion and exclusion criteria can be seen in Table 3.

Table 3

Inclusion and Exclusion Criteria Used in the Randomised Controlled Trials

Inclusion criteria	
Study II	**Study IV**
18 years old or older	18 years old or older
Loneliness causing distress	Loneliness causing distress
Speak/write/comprehend Swedish	Speak/write/comprehend Swedish
Access to computer/smartphone and an internet connection	Access to computer/smartphone and an internet connection
ULS-3 score of ≥ 40	

Table 3
(continued)

Exclusion criteria	
Study II	**Study IV**
Diagnosed personality syndrome	Diagnosed personality syndrome
Ongoing substance abuse	Ongoing substance abuse
Acute need for treatment of other psychiatric disorders	Acute need for treatment of other psychiatric disorders
Other ongoing psychotherapeutic treatment	Other ongoing psychotherapeutic treatment
Recent changes in psychotropic medications	Recent changes in psychotropic medications

Demographic characteristics

Beyond the minimum age of 18, the demographic characteristics of the participants in the studies did not serve as reasons for inclusion or exclusion. The aim was to recruit and offer treatment to a wide range of people with the commonality being their experience of loneliness. Demographic characteristics of the people completing the screening (and who were included in **Study I**) can be seen in Table 1 of the first paper.

The demographic characteristics of the participants in the randomised controlled trials (**Study II** and **IV**) can be seen in Table 4.

Table 4

Demographic Characteristics of the Samples from the Randomised Controlled Trials

	Study II (*n* = 73)	**Study IV (*n* = 170)**
	Mean (SD)	Mean (SD)
Age	47.20 (17.63)	47.52 (16.40)
	n (%)	*n (%)*
Sex (number and % women)	52 (71.2)	129 (75.8)
Marital Status		
Single	34 (46.6)	89 (52.3)
In a relationship/Married	23 (31.5)	41 (24.1)
Divorced/Widow/Widower	15 (20.5)	40 (23.6)
Highest Completed Educational Degree		
No completed degree	0 (0)	1 (0.6)
Primary school	2 (2.7)	1 (0.6)
Secondary school	23 (35.4)	33 (19.4)
College/University	42 (64.6)	109 (64.1)
Other vocational education	5 (6.9)	17 (10.0)
Postgraduate	1 (1.4)	9 (5.3)
Previous treatment for mental illness: Yes	34 (46.6)	96 (56.5)
Ongoing use of psychopharmaceutic medication	19 (26.1)	39 (22.9)

While a psychiatric diagnosis (except for those named above as part of the exclusion criteria) did not serve as a reason for being excluded from the studies, the presence of them was expected given the connection between loneliness and mental health problems. Table 5 details the prevalence of DSM-5 diagnoses as indicated by the MINI interview that served as part of the intake procedures.

Table 5
Counts and Frequencies of Psychiatric Diagnoses

	Study II (*n* = 73)		**Study IV (*n* = 170)**	
	n	%	*n*	%
Major Depressive Disorder	13	17.8	49	28.8
Panic Disorder	1	1.4	15	8.8
Agoraphobia	1	1.4	10	5.8
Social Anxiety Disorder	5	6.8	32	18.8
Obsessive Compulsive Disorder	1	1.4	6	3.5
Post-Traumatic Stress Disorder	3	4.1	9	5.3
Alcohol Use Disorder	4	5.5	12	7.1
Bulimia Nervosa	3	4.1	1	1.1
Binge Eating Disorder	2	2.7	1	2.9
Generalized Anxiety Disorder	11	16.2	9	14.1

Study summaries

Study I

Aims, design, and methods

Study I sought to examine the sample applying for participation in our studies to identify potential subgroups with regards to symptoms of psychiatric disorders and loneliness. Given the lack of studies of populations seeking help specifically for their loneliness and the construct's relationship with psychopathology, this was thought to provide valuable information when conceptualising loneliness from a clinical perspective. To do this, we used the cross-sectional intake data from the recruitments of what later became **Studies II** and **IV**. In total, data from 332 participants were included of which 326 provided complete data for all the outcome measures of interest. Participants from the intakes were recruited with very similar intake requirements (and identical criteria visible for the participants when applying for participation via the web platform). Information regarding the studies were also sent out with very similar means in both studies, e.g., social media posts, paid advertisements in national newspapers, and physical posters detailing information about the studies. The information specified that the studies were aimed at people experiencing distressing feelings of loneliness.

The effort to identify subgroups in this sample was made using the method latent profile analysis (LPA). LPA, and its close relative latent class analysis (LCA), is a statistical, data-driven procedure for identification of subgroups within a population (Wang & Wang, 2012). Compared to methods such as cluster analysis, LPA and LCA adds the possibility for formal significance testing by using, for example, a likelihood ratio test. Additionally, the method offers several indices to be used as guidelines in selection on the number of classes/profiles. ULS-3, SIAS, GAD-7, and PHQ-9 was used as indicators for the analysis. In the current study the fit between the model and the data was evaluated using a range of tests and indices. First of all, we made use of the log-likelihood statistic, the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), and the sample-size adjusted Bayesian Information Criterion (A-BIC). For these a lower

number indicates a better fit. Formal significance testing of the number of profiles that best suit the data was conducted using the likelihood ratio test (LRT) as well as the parametric bootstrapped likelihood ratio test (BLRT). Both of these tests the hypothesis that *n* profiles fit the data better than *n* + 1 profile(s) with a *p*-value lower than the alpha level of .05 suggesting that original hypothesis should be rejected in favour of the alternative with additional classes/profiles. Third, the entropy value was given consideration. Entropy specifies the classification certainty and can vary between 0 and 1, with a value closer to 1 indicating greater certainty and thus being preferable. Per the recommendations described by Tein et al. (2013) and Nylund et al. (2007) in their simulation studies, the BIC parameter and the BLRT were considered especially important.

While the indices and the significance testing are of great importance for the interpretation of the results, it is also essential that the final model is interpretable in relation to existing theory (Wang & Wang, 2012). The procedure of interpreting the results and arriving at meaningful conclusions thus involves both the statistical information and a qualitative comparison to the theoretical backdrop.

Other than arriving at the number of subgroups, we also investigated whether these subgroups differed with regards to connections to auxiliary variables. The included auxiliary variables were age, whether the participant lived alone or not, sex (0 = female, 1 = male), and quality of life (BBQ ratings). We also included a variable on whether participants attributed their feeling of loneliness to a specific event or not (coded as 0 = no, 1 = yes). These data were not available from the first intake (for **Study II**), meaning that 70 % (*n* = 231) of the respondents had data available for the analysis. Including auxiliary variables in the analyses can be done in a number of ways. They can be specified as part of the model, though this runs the risk of altering the extraction process and producing results that are hard to reproduce in other samples (Wang & Wang, 2012). Another method, and the solution chosen for the current study, is to use the Bolck-Croon-Hagenaars method (Bolck et al., 2004). It is conducted as a secondary step after finalisation of the latent profile extraction. A simulation study has shown this stepwise method to produce unbiased estimates of the effect of class/profile membership on covariates even under the presence of data conditions such as non-normality (Bakk & Vermunt, 2016). The

analyses were conducted using Mplus, version 8.4 (Muthén & Muthén, 1998-2019) with an alpha level of .05.

Results

Descriptive statistics for the indicators can be seen in Table 6.

Table 6

Descriptive Statistics for the Indicators of the LPA Analysis.

	n	Range	Mean	SD
UCLA Loneliness Scale, version 3	332	32-75	58.80	7.28
Social Interaction Anxiety Scale	328	0-74	35.87	17.21
Patient Health Questionnaire-9	328	0-27	11.48	6.39
Generalized Anxiety Scale-7	326	0-21	7.78	5.46

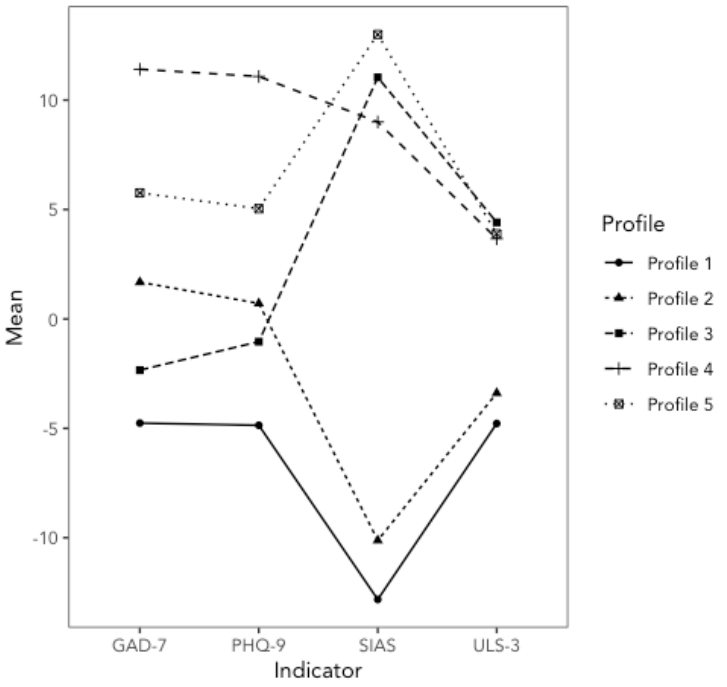
Results from the LPA models along with fit indices and test statistics can be viewed in Table 3 of the first paper. Estimated descriptive statistics and percentages for each profile is available in Table 4 of the same paper.

Number of latent profiles and their characteristics

The model chosen as the best fit to the data was the one with 5 profiles and equal error variances for all profiles. This choice was based on the fact that this model had the lowest BIC value and a better fit than the model with four profiles as suggested by the BLRT. Allowing error variances to differ between the profiles did not result in a better model, as suggested by the higher BIC value. An illustration of the five profiles with their means on the indicators relative to one another can be seen in Figure 2.

Figure 2

Estimated Profile Means for Each Indicator (Grand-Mean Centred). From Käll, Shafran et al. (2021). Reprinted with permission.



The loneliness ratings of the five profiles had a bimodal distribution, though the ratings were consistently higher than the estimates available from the validation of the instrument, as well as the one

found in a more recent sample (Bruce et al., 2019). As seen in Table 4 of the first paper, the first profile was also the largest one (n = 109), consisting of approximately one third of the total sample. This profile did not exhibit above-average means on any of the indicators. Relative to the instruments' norms, the depressive symptoms were mild, and the symptoms of generalized anxiety were classified as minimal. This, along with social anxiety ratings below clinical levels, lead us to name the profile in question *Mild psychopathology.* The second profile derived from the sample accounted for 14.8 % of the respondents (n = 49). In line with the first profile, this one had lower ratings of loneliness and symptoms of social anxiety, though it differed in the severity of the other two indicators relative to the first profile. The second profile exhibited a moderate severity for symptoms of depression and mild, bordering on moderate, symptoms of generalized anxiety. Due to this, we choose the name *Moderate depression and worry*. The third profile is referred to as *Primarily social anxious* and was the second largest profile overall with 27.1 % (n = 90) of the sample in it. As the name suggests, this profile was primarily characterised by the ratings of social anxiety which was above the threshold of what was considered a clinical level. The symptom ratings for the indicator of generalized anxiety were mild on average, though the ratings of depressive symptoms were of a moderate severity. Similar to the last two profiles, the ratings of loneliness in this profile were substantially higher than that of profile 1 and 2. The fourth profile, dubbed *Severe psychopathology*, was the smallest one with just 6.6 % (n = 22) of respondents in it. This group exhibited severe ratings and clinical symptom levels across all indicators. Lastly, the fifth profile, *moderate psychopathology*, contained 18.7 % (n = 62) of the participants in the sample. This sample had clinical symptom levels on the social anxiety measure, moderately severe ratings of depressive symptoms, and a moderate severity for the symptoms of generalized anxiety.

Demographic characteristics of the latent profiles

Of the five variables that were included in the analysis with the BCH method, two had a significant value for the overall test: mean BBQ ratings (p < .001) and the mean age of the participants (p < .001). The other three (differences between profiles in the proportions of the sexes, whether they lived alone, and whether they attributed their loneliness to a specific event or not) did not have a significant test statistic for the

overall test (*p*-values of .932, .671, and .084, respectively). For age, the pairwise comparisons between the estimated profiles revealed significant differences between the first profile, *mild psychopathology*, and profiles three through five which all exhibited a higher severity for the indicators of psychiatric symptoms. The test also revealed a significant difference between the second profile, *moderate depression and worry*, and profiles three, *primarily socially anxious*, and four, *severe psychopathology*, for this variable. The comparisons suggest that the profiles three through five had a significantly younger mean age than the first two profiles. The results from the comparisons on quality of life had a similar trend; profile one differed significantly from profiles three, four, and five. Profile two differed significantly from profile three, but not from profile four and five.

Discussion

The study provides an initial investigation of the heterogeneity in psychiatric symptoms and loneliness among participants that sought help within the trials detailed in this thesis. Using a latent profile analysis, we identified five subgroups. As expected, the loneliness ratings were high throughout the profiles. The trend was towards the profiles with higher ratings of social anxiety to also have higher ratings of loneliness.

In relation to the indicators measuring symptoms of psychiatric disorders, the profiles mainly differed in the severity of these symptoms. The profile containing the most participants exhibited mild and minimal symptoms of major depressive disorder and generalized anxiety, respectively. This profile also had an average rating well below the clinical cut-off for the indicator of social anxiety. Profile two had slightly higher, though still comparatively mild symptoms for these three indicators. This can be contrasted to the three other profiles which were all characterised by high levels of symptoms of social anxiety as well as more severe means for the other indicators (save for profile three, for which the ratings of worry were of a mild severity). All in all, about two-thirds of the sample belonged to a latent profile with two or more average symptom ratings within the clinical range. This was somewhat expected given previous findings (e.g., Klein et al., 2021) connecting loneliness with common psychiatric disorders. Since we actively aimed to recruitment participants with high levels of loneliness for the randomised controlled trials, a high level of psychiatric symptoms was expected to follow. However, this was not the case for the entire sample. The largest profile was characterised by mild or minimal symptom levels, which shows that common mental health problems is not a necessary feature of this population. With that being said, the results do suggest that it is common enough that inquiries into the presence of psychiatric disorders should be made when encountering patients with loneliness as a concern.

Though the severity of the psychiatric symptoms were seemingly the most distinct difference between the profiles, the results also suggest that symptoms of social anxiety could be a unique feature of some people in this population. The most prominent feature of the third profile, which was the second largest of the five, was that its members primarily differed in what kind of symptom ratings that characterised

the group, rather than the severity level. Additionally, profile three through five all had mean ratings above the clinical cut-off used for interpretation of the scores. Much like the finding about the commonality of psychiatric symptoms in this sample, the large proportion of participants with high levels of social anxiety is expected. Theoretical models of loneliness (Cacioppo & Hawkley, 2009; Käll et al., 2020) tend to emphasise maladaptive processes related to social cognition that have also been theorised to play a role in the maintenance of social anxiety (Buckner et al., 2010). Similarly, social anxiety and loneliness have been noted to have a reciprocal relationship (Lim et al., 2016; Maes, Nelemans, et al., 2019). The findings from the current study suggest that high levels of social anxiety are a common feature among participants who are distressed enough by their loneliness to seek help specifically for this problem. Of note is that this was not the case for the entire sample, which once again suggests that clinical symptoms levels are not a prerequisite for seeking help. The take-away is that assessment of social anxiety and related psychopathological processes should be conducted when encountering loneliness in a clinical setting.

Related to differences between the profiles in both severity and kind of psychiatric symptoms was the additional analysis of auxiliary variables. Only two of the variables had significant value for the overall test: age and quality of life. The overall trend was that symptom levels for the indicators were inversely related to the mean age of the profile (i.e., older participants had, on average, lower ratings of psychiatric symptoms and loneliness than younger participants). This was particularly the case for the ratings of social anxiety. The same relationship was noted between quality of life and the means on the indicators (i.e., lower quality of life, higher symptom ratings). The relationship between profile membership and age is interesting as it may suggest that loneliness has a weaker relationship with psychiatric symptoms among older adults. Though this is an intriguing finding, it is worth noting that the standard errors suggest a rather large spread within the profiles as well which may reduce the effectiveness of age as a predictor for symptom burden in general and problems related to social anxiety more specifically.

The study provides a unique look into a group of people seeking help for their distressing loneliness, but some limitations are worth

mentioning. For one, the sample size is not ideal for this kind of data-driven approach to exploring heterogeneity. A larger sample would also allow for validation of the model by splitting the sample in two. Secondly, the exclusion criteria named on the website via which the participants completed the screening may have created a more homogenous sample than intended, which is important to consider when interpreting the results.

To sum up, **Study 1** provides an initial exploration of the population seeking help for their distressing feelings of loneliness with regards to symptoms of common mental health problems. The primary factor of differentiation was the symptom severity, though higher levels of social anxiety was the primary identifying characteristic of the second largest group in the sample. The overall take-away is that loneliness and clinical symptom levels of common psychiatric disorders is often present together, though it is not always the case. As such, addressing loneliness may need to attend to other problems as well, though options for treatment should be able to stand on their own.

Study II

Aims, design, and methods

Study II was a randomised, controlled trial investigating the efficacy of an internet-based psychological treatment based on the principles of CBT. Participants were randomly allocated to receive immediate access to the ICBT programme or to remain on a waitlist for the during of the initial treatment period which lasted eight weeks. Randomisation was conducted by an independent party not involved in other aspects of the study with a 1:1 ratio.

In total, 73 participants were recruited during a two-week period in January 2016. Recruitment made use of social media posts, posters, and a paid advert in a national Swedish newspaper. Prospective participants were directed to the study website where they could take part of additional information about the study, including criteria for inclusion/exclusion. Participants completed a screening procedure via the iterapi platform (described in Vlaescu et al., 2016). They were then called for a structured interview consisting of the MINI 6.0 Neuropsychiatric Interview (Lecrubier et al., 1997) and some additional questions concerning their ability to participate in the study. All data collected from the screening and the interview was considered for the decision on inclusion/exclusion in the randomisation procedure. The principal investigator had the final authority regarding this, though the discussion leading up to the decision involved all interviewers.

Five final-year students of the clinical psychologist programme at Linköping University served as assessors, therapists, and creators of the treatment content during the trial. All had undergone training in using the MINI interview. Additionally, all had at least three semesters worth of clinical experience in conducting CBT. The creation of the SOLUS programme was overseen by two supervisors, both of which were licensed clinical psychologists. Clinical supervision was provided by the same supervisors and conducted every other week. In between sessions case consultation was possible on an on-demand basis.

The therapists provided feedback on completed assignments in each module and reminders if work was not progressing at the intended pace (one module per week). Contact was handled via a messaging function on the encrypted platform and was asynchronous. Therapists were to provide feedback within 24 hours on weekdays. Other questions or concerns from the participants received a response within the same timeframe.

The statistical analyses were conducted using SPSS version 24 and Mplus version 7.3. Between-group comparisons for completers/non-completers of the post-treatment assessment was made using independent *t*-tests and χ^2-tests. The main outcomes were evaluated using robust regression models estimated via full information maximum likelihood, allowing for retention of all available data in the analysis. Maximum likelihood estimation provides bias-free estimates under the assumption that data is missing at random (MAR), meaning that data can be missing as a function of the values of other variables but not the would-be value of the variable of interest (Enders, 2010). The MLR estimator provided robust standard errors. Between-group differences were tested using the coding scheme of treatment = 0.5, control = -0.5 whilst controlling for pre-treatment scores (in essence an ANCOVA model with the added benefit of missing data management using maximum likelihood estimation). Effect sizes were calculated using a formula similar to Cohen's *d* (Cohen, 1988) in which the between-group difference was divided by the pooled standard deviation from the pre-treatment assessment. The ratings of module completion were based on a judgement by the therapist in question who based their decision on whether they considered the participant to have shown an understanding of the rationale behind the module in their work with that week's assignments.

Results

All in all, seven participants (10 %) declined further participation during the treatment phase. Of these, four belonged to the treatment group and three to the control group. Out of the 73 participants randomised as part of the study, 61 provided data at post-treatment (84 %). Participants who completed the post-treatment assessment did not differ significantly from those who did not on any demographic variable or outcome measure (all *p*s > .22).

On average, participants in the treatment condition completed 4.89 out of the 8 modules (*SD* = 3.03). A total of 12 participants (33 %) completed all 8 modules and 18 participants completed 5 or more. The completion rate of modules was not significantly related to the post-treatment ratings of loneliness (r = .11, p = .61) while controlling for pre-treatment ratings.

The observed means from both groups can be seen in Table 7. The regression models revealed a significant difference at post-treatment for the primary outcome measure favouring the treatment group, b = -4.65, SE = 1.57, p = .003, d = 0.77 [95 % CI 0.22, 1.33]. The treatment group also rated their quality of life significantly higher than the control group at post-treatment, b = 13.95, SE = 3.48, p < .001, d = 0.81 [95 % CI 0.40, 1.22]. For the other secondary outcome measure, we did not find a significant difference between the groups for neither GAD-7, b = -1.72, SE = 0.98, p = .077, d = 0.39, 95% CI [0.04, 0.81], nor PHQ-9, b = -2.03, SE = 1.09, p = .061, d = 0.41, 95% CI [0.02, 0.84]. However, the ratings of social anxiety as measured with SIAS revealed a significant difference favouring the treatment group at the post-treatment time point, b = -5.37, SE = 2.38, p = .024, d = 0.35, 95% CI [0.04, 0.66].

Table 7
Observed Means at Pre- and Post-Treatment in Study II

	Pre-treatment		Post-treatment	
Outcome measure	*M* (SD)	*n*	*M* (SD)	*n*
ULS-3				
CBT	58.61 (4.15)	36	50.52 (6.95)	27
Wait-list	59.62 (7.47)	37	56.24 (9.41)	34
BBQ				
CBT	32.61 (17.21)	36	45.48 (16.95)	27
Wait-list	32.14 (17.86)	37	32.06 (18.67)	34
SIAS				
CBT	31.81 (14.12)	36	25.41 (12.20)	27
Wait-list	34.39 (16.90)	37	31.76 (16.40)	34
PHQ-9				
CBT	10.14 (5.68)	36	6.26 (4.10)	27
Wait-list	9.46 (4.30)	37	8.09 (4.83)	34
GAD-7				
CBT	7.03 (4.60)	36	4.89 (3.64)	27
Wait-list	6.76 (4.40)	37	6.35 (4.47)	34

The mean sum for the CSQ-8 was 23.96 (SD = 4.67). Breaking down the percentages for the questions deemed to be of primary interest, 63% (*n* = 17) of the participants considered the quality of the treatment to be good, and 11% (*n* = 3) rated it as excellent. Of the remaining participants, 22% (*n* = 6) considered the quality to be moderate while 4% (*n* = 1) thought it was poor. For perceived relevance, 15 of the 27 participants (55%) rated the modules as mostly relevant for their problems (*n* = 15), 11% considered them very relevant (*n* = 3) and 30% (*n* = 8) rated the content as somewhat relevant. Four percent (*n* = 1) rated the modules as not at all relevant, 52% (*n* = 14) answered that the treatment had been somewhat useful in helping them deal with their problems, 26% (*n* = 7) rated the treatment had been very useful, and the remaining 22% (*n* = 6) rated the usefulness as not at all useful. In regard to overall satisfaction, 55% (*n* = 15) said that they were mostly satisfied,

22% (n = 6) chose very satisfied, 19% (n = 5) considered themselves indifferent, and 4% (n = 1) rated themselves as unsatisfied.

Discussion

The results from the first pilot study indicated that a group receiving access to an ICBT intervention targeting loneliness rated their loneliness significantly lower than a control group on a waitlist after the intervention phase. The between-group difference at the post-treatment time point was of a moderate, bordering on large, magnitude. While the lack of clinical norms makes it difficult to contextualise this main finding, the effect size is comparable to that found for ICBT treatments for anxiety disorders (Pauley et al., 2021) and slightly higher than two of the three outcomes reported for transdiagnostic psychological treatments targeting depression and anxiety disorders (Newby et al., 2015). The post-treatment ratings were still higher than the estimate found in a nationally representative study of U.S. adults (Bruce et al., 2019), which may suggest that the average frequency of loneliness was still elevated compared to that of the general population.

The results indicated additional benefits of the intervention beyond a reduction in loneliness, namely an increase in quality of life (with a large effect size) and a decrease in symptoms of social anxiety (with a small effect size). Compared to the control group there were no significant difference for the measures of symptoms of depression and generalized anxiety, though the effect sizes were both slightly larger than that of the comparison for social anxiety ratings.

In terms of acceptability, most of the participants in the treatment group completing the post-treatment assessment considered the quality to be good or better. Two-thirds of this group also considered the intervention to be either mostly or very relevant for their problems. Given the novelty of the intervention and the focus on loneliness, these numbers are encouraging though there is certainly room for improvement. For example, one-fifth of the responding participants in the treatment group reported that the intervention had not helped them deal with their problems.

Limitations include the fact that most of the participants had a university degree, which suggests that the sample may not be representative relative the general population. Additionally, the results do not allow us to disentangle the effect of the actual treatment modules from other non-specific factors such as the therapeutic alliance.

In relation to the aim of the study, the results show that the treatment condition was efficacious in reducing loneliness relative to a wait-list control group. The benefits were also visible in two of four secondary outcomes, quality of life and symptoms of social anxiety. The treatment was considered acceptable and relevant by most participants.

Study III

Aims, design, and methods

Study III followed up on the participants from **Study II** two years after the conclusion of the initial treatment period. At this time, the control group had received access to the same intervention as the treatment group, though their therapist contact was conducted in an on-demand fashion. The study investigated the change between the post-treatment and follow-up time point, possible differences in the follow-up trajectory between the two different versions of guidance, and the relationship between the use of treatment techniques and reliable change on the loneliness measure. Additionally, questions regarding the incidence of events and circumstances plausibly related to the participants health and well-being was asked to help investigate the impact of external factors during the follow-up period.

All participants that had not formally discontinued treatment during the intervention were contacted via email. Participant who did not complete the questionnaires on the initial prompt were called and sent additional email reminders.

Participants belonging to the control group in **Study II** were offered access to the same CBT-based programme as the treatment group from the study, though the groups differed in regard to how their therapist contact was structured. The original treatment group from **Study II** received feedback within 24 hours on weekdays (or a message on Mondays if they had not progressed during the week), while the control group (referred to as the guidance-on-demand group in the context of **Study III**) had the option to contact a therapist if they felt the need to. One of the therapists from the initial treatment period provided support for the participants in this condition. Participants in the guidance-on-demand group had no restrictions on the availability of therapist contact and could contact the therapist as often as required.

The outcome measures for **Study III** were identical to those in **Study II** (and subsequently in **Study IV**). On top of the primary and secondary outcome measures, participants received additional

questions regarding factors of potential relevance to their loneliness and mood following the two-year period between the post- and follow-up assessment. These asked about whether there had been any additional psychological treatment, any new or changed doses of psychotropic medications, any life events that had impacted their life in a negative way, and whether they had been diagnosed with a physical disability or somatic illness. The questions were phrased as to ask the participant whether they had experienced any of these events since the conclusion of the treatment (either 2 years afterwards for the original treatment group, or approximately 22 months for the guidance-on-demand group). Each question was answered with either yes (coded as 1) or no (coded as 0).

In addition to the outcome measures and the questions regarding external factors, some additional questions were asked regarding the use of the techniques introduced throughout the treatment programme. These questions were only asked at the follow-up time point. The questions asked about the use of the following techniques: exposure with reductions of safety behaviours, behavioural experiments, behavioural activation, cognitive restructuring techniques, strategies for stopping habits of rumination, setting goals using a structured approach and clarifying personal values, and lastly using functional analysis to understand situations. Participants gave a response for the frequency of use during the follow-up period with the alternatives being not at all (coded as 0), on a few occasions (1), sometimes (2), and regularly (3). Two types of scoring were used, one adding the score for each item to a total sum (a number between 0 and 28) and one where we dichotomised the variable as either no or infrequent use (if the participant indicated that they had not used the technique at all or only on a few occasions; a score of 0 or 1) or regular use (if the participant indicated that they sometimes or regularly used the technique; a score of 2 or 3). The latter score (referred to as active use) was coded as either 0 (no or infrequent use) or 1 (active use).

Reliable change from pre-treatment to the follow-up assessment was investigated using the formula provided by Jacobson and Truax (1991). According to this, reliable change is calculated by subtracting the pooled mean of the follow-up measurement from the pooled mean at intake and dividing by the standard error of the difference between the two scores. The reliability coefficient used in the calculation of

standard error of difference was the one-year test-retest coefficient provided in the validation study of the primary outcome measure, r = .73 (Russell, 1996). The cut-off was calculated as ± 8.71, where a score higher than that value represented reliable change and a score below the negative threshold indicated reliable deterioration.

Changes on the outcome measures between post-treatment to follow-up was evaluated using a piecewise mixed effects model. A piecewise model allows for estimation of change during distinct phases of a longitudinal study (Raudenbush & Bryk, 2002), such as for example a treatment phase and a follow-up phase which are assumed to have different trajectories (e.g., a steeper slope during the active treatment followed by less change during the follow-up period). In relation to the aim of the study we were interested in the results from the fixed effects of time during the follow-up phase (i.e., the overall change for the entire sample from post-treatment to follow-up) and the interaction between condition (coded as guidance-on-demand = -0.5 and the original treatment group = 0.5) and time, giving an indication of whether the two conditions differed in their change up to the follow-up assessment. The intention-to-treat principle was applied to the data and parameter estimation made use of restricted maximum likelihood (REML) via the *nlme* package (Pinheiro et al., 2018) in the software R. Maximum likelihood estimation is one of two recommended approaches for missing data management according to Enders (2010) and is viable under the MAR assumption. Significance testing of the fixed effects from the model was made using a Wald-test (dividing the estimate by the standard error and comparing the quotient to a z-distribution with a critical value of 1.96).

Investigations of whether the external factors were related to the odds of achieving reliable change from intake to the follow-up assessment was conducted using a multiple binary logistic regression analysis (with the variables coded as reliable change no/yes and each external factor no/yes). Results are reported as odds ratios.

The relationship between use of the techniques introduced during the treatment programme and reliable change from the pre-treatment to follow-up time point was modelled with the help of a multiple linear regression analysis with all techniques entered into the model simultaneously using forced entry.

Results

Rates of completion and descriptive statistics of the outcomes

In total, 59 % of the 73 participants (n = 43) randomised at the start of **Study II** provided data for the primary outcome measure at the follow-up assessment. For the secondary outcome measures, response rates were either 56 % (n = 41) for BBQ, PHQ-9, and GAD-7, or 58 % (n = 42) for SIAS. The two groups did not differ significantly in their response rates, $\chi^2(1) = 0.66$, $p = .417$. Those who completed the follow-up assessment did not differ from those who did not differ significantly with regards to ratings at pre- or post-treatment (all p-values > .10). Descriptive statistics for rates of module access and completion can be seen in Table 8 along with between group comparisons. The groups did not differ significantly in how many modules they accessed (p = .058), but they did differ in the number of completed modules (p = .043) with the original treatment group completing more modules than the guidance-on-demand group.

Table 8

Average Rates of Module Access and Completion.

	OTG	GD	
	M (SD)	*M* (SD)	*t*-value
Accessing*	5.88 (3.03)	4.47 (3.22)	-1.93 p = .058
Completing†	4.89 (3.03)	3.41 (3.11)	-2.06, p = .043

Note. OTG = Original treatment group, GD = Guidance-on-demand group.

* Operationalised as opening the module, as logged by the web platform.

† Operationalised as number of modules with assignments completed to a satisfactory degree as judged by their therapist.

The observed means and standard deviations from the follow-up assessment are visible in Table 9.

Table 9

Observed Means and Standard Deviations for the Outcome Measures at the Two-Year Follow-Up Assessment

Measure	*M* (SD)
ULS-3	
OTG	47.57 (8.48)
GD	48.23 (12.99)
BBQ	
OTG	47.26 (20.05)
GD	52.45 (23.78)
SIAS	
OTG	23.60 (11.05)
GD	25.77 (17.09)
PHQ-9	
OTG	6.05 (5.17)
GD	6.32 (6.11)
GAD-7	
OTG	4.21 (4.21)
GD	3.68 (3.00)

Note. OTG = Original treatment group, GD = Guidance-on-demand group.

Change on the outcome measures from post-treatment to follow-up

The results from the follow-up phase of the piecewise mixed effects models can be seen in Table 10.

Table 10

Estimates from the Models Evaluating the Primary and Secondary Models at Post-treatment

Measure	*b*	SE	95 % CI	*p*-value
ULS-3				
Time (Follow-Up Phase)	-5.09	1.13	-7.34, -2.84	> .0001
Time * Condition	5.44	2.27	0.94, 9.93	.0182
BBQ				
Time (Follow-Up Phase)	9.55	2.46	4.66, 14.43	.0002
Time * Condition	-17.47	4.92	-27.24, -7.70	.0006
GAD-7				
Time (Follow-Up Phase)	-1.37	0.69	-2.72, -0.01	.0489
Time * Condition	1.97	1.37	-0.75, 4.69	.1536
PHQ-9				
Time (Follow-Up Phase)	-0.96	0.83	-2.62, 0.69	.2502
Time * Condition	1.63	1.67	-1.67, 4.94	.3295
SIAS				
Time (Follow-Up Phase)	-3.37	1.59	-6.52, -0.23	.0359
Time * Condition	4.65	3.17	-1.64, 10.93	.1460

Effect sizes for the comparison within (from pre-treatment to follow-up) and between the two groups (at the follow-up assessment) can be viewed in Table 3 of the third paper.

In total, 26 out of the 43 participants that provided data at the two-year follow-up (60 %) had achieved reliable change during the period. One participant (2 %) had seen an increase in loneliness ratings qualifying as reliable deterioration.

Events and external factors during the follow-up period

A total of 19 of the 46 participants (41 %) who answered the questions regarding external factors indicated that they had experienced an adverse life event since the conclusion of their treatment phase. Adverse life events were not significantly related to reliable change at the follow-up assessment, OR = 0.55 (95 % CI 0.12, 2.36), p = .416. With regards to additional psychological treatment, 14 out of the 46 (30 %) said that they had undergone additional treatment since the having access to the SOLUS programme. This factor was not significantly related to the odds of achieving clinical change either, OR = 4.08 (95 % CI 0.89, 18.72), p = .071. Additionally, 13 participants (28 %) indicated that they had been diagnosed with a physical disability or somatic illness during this period. The incidence of a diagnosis of this kind was not significantly related to the likelihood of achieving reliable change, OR = 1.24 (95 % CI 0.25, 6.10), p = .790. For the last factor, changes in psychotropic medication, 14 participants (30 %) said that they had either changed their dosage or started using a psychotropic medication. Like the rest of the factors, this was not significantly related to the likelihood of having undergone reliable change since the start of the study, OR = 0.86 (95 % CI 0.15, 4.95), p = .873.

The relationship between reliable change and use of treatment techniques

The average total sum for the use of treatment techniques during the follow-up phase was 8.75 (SD = 5.70) out of a maximum of 21. On average, participants reported active use of 2.84 of the 7 techniques (SD = 2.46) during this period. Individual averages for the techniques along with beta-coefficients for the multiple regression analysis can be seen in Table 4 of the third paper.

Discussion

The main aim of **Study III** was to follow up on how participants rated their loneliness and symptoms of common mental health problems two years after the initial treatment phase concluded. Included in this analysis was also the control group from **Study II** who had now received access to the SOLUS programme as well, though with a different mode of therapist support. Both the observed ratings and the statistical analysis indicate a decline in loneliness ratings during the two years since the first treatment period. The significant interaction between time and condition suggest that this was driven by the change in the group that received access to the treatment with guidance-on-demand. This is hardly surprising as the follow-up time point effectively serves as the post-treatment time point for this group as well, meaning that the reduction since the posttreatment assessment reflects both the change during their treatment phase and the follow-up phase. For the whole sample, 60 % of the respondents had a score indicating reliable change as compared to before the study began. All in all, the findings suggest that the reduction of loneliness in **Study II** was enduring. However, the lack of an untreated control group means that we cannot rule out other causes such as regression to the mean in explaining the further reductions since the posttreatment assessment. Furthermore, the results for the within-group comparisons of the pre-treatment to follow-up assessments suggest that the effect sizes are somewhat smaller than what has been found in other investigations regarding the long-term efficacy of ICBT (Andersson et al., 2018).

Though not of primary interest in relation to the aims of the study, the benefits of the treatment extended beyond the noted reductions in loneliness. We did see significant reductions for some, but not all, of the secondary outcome measures at the follow-up assessment. The observed ratings and the effect size all suggest either moderate or large decreases in symptoms of mood and anxiety disorders as well as an increase in quality of life compared to before the study.

The likelihood of having undergone reliable change during the study was not significantly related to any of the four external factors assessed as part of the follow-up assessment. There was a trend towards an increased likelihood of reliable change in the group with additional psychotherapy, which is a troublesome in relation to the internal validity of the conclusions above. However, it is worth noting that we

have no additional information about what kind of therapy this concerned, for how long this happened, and whether the therapeutic contact also had loneliness as its focus, making it hard to draw conclusions about this marginally significant relationship.

We did not find a significant relationship between the use of any of the CBT techniques included in the programme and the likelihood of having achieved reliable change during the study. The investigation was exploratory and also sought to understand the frequency by which participants made use of the techniques after the active treatment phase ended. All in all, the overall frequency of use was rather low, and the non-significant results stand in contrast to the findings presented by Harvey et al. (2002) that found the use of techniques to have a significant relationship with the long-term outcome of CBT. Future investigations would benefit from a larger sample size, as well as specific examinations into how and why the techniques were used.

A limitation to consider is also the rather low response rate. Though the 60 % of participants who provided data for the primary outcome measure did not differ from those who did not on any of the previous time points, the low proportion of participants that filled in the follow-up assessment is important to keep in mind as it reduces the statistical power.

In conclusion, the results from **Study III** do suggest that ICBT for loneliness can have lasting positive effects in terms of reductions in loneliness, but also for other related constructs. Whether participants had undergone reliable change during the study or not was not significantly related to neither the incidence of health-related events and factors, nor to the reported use of CBT techniques introduced throughout the programme.

Study IV

Aims, design, and methods

Study IV attempted to replicate the findings from **Study II** with the use of an internet-based CBT programme. Additionally, the efficacy of a second active psychological intervention based on interpersonal psychotherapy was investigated. The study itself was a three-arm randomised controlled trial with a 2:2:1 randomisation ratio (treatment:treatment:control). The study lasted for 10 months, with participants being assessed at pre-treatment, every other week during the treatment period, at post-treatment, and additionally four months after the post-treatment assessment. The trial was registered at Clinicaltrials.gov (identifier: NCT03807154).

A total of 170 participants were included during two intakes. The first took place in January 2019 (n = 116) and the other in January 2020 (n = 54). The original plan was to conduct a two-centre study in the U.K. and in Sweden with parallel recruitment and treatment, but this was changed due to delays of the ethics application and a lack of staff for the U.K. part of the trial. The two recruitments in Sweden were a way to approximate the number of participants that would have been involved in the two-centre trial. Randomisation was conducted by two parties not involved in other aspects of the study and made use of the participants pseudonymised study code.

Participants were recruited via several pathways including social media posts, three paid newspaper advertisement, physical posters, and two articles in local newspapers. All information specified that the study concerned help for those experiencing distressing loneliness. Informed consent was provided digitally via the same platform on which the programme was hosted. As in **Study II**, participants first completed a series of screening questionnaires and were then, should no obvious exclusion criteria be named among the responses, called for a structured interview. The M.I.N.I. Neuropsychiatric interview (Sheehan et al., 1998) was used to screen for psychiatric disorders. The presence of most psychiatric disorders did not serve as a criterion for exclusion, though the severity (such as severe bulimia nervosa) and primacy (such as the loneliness not being the product of isolation due

to severe OCD) were considered important factors. Psychiatric diagnoses that required specialised care (e.g., anorexia nervosa), or more immediate attention (e.g., suicidal plans) were considered reason for exclusion, though all the collected information up to this point was considered. The decision on whether to include a participant or not was made at meetings staffed by two licensed clinical psychologists (one of which was the P.I.) and all the interviewers.

Regarding staff, a total of eight students at the clinical psychology programme at Linköping University and one licensed clinical psychologist interviewed the participants after the screening. Training in using the structured interview was provided by a licensed clinical psychologist. Additionally, eight therapists were involved in the treatment of the participants. Four of these were master's students with at least three semesters clinical experience of conducting cognitive behavioural therapy. The other four was licensed clinical psychologists, one of which had primarily received training in CBT. The other three had a background in psychodynamic psychotherapy. Every therapist treated participants in both arms and received additional A-level training in IPT (equivalent to a basic understanding of IPT and readiness to use it in clinical practice under supervision).

Clinical supervision was provided in two separate meetings, one for the participants receiving IPT and one for those receiving CBT. The supervisor for the IPT group was a D-level IPT therapist. CBT supervision was provided by a licensed psychologist who created the modules in the pilot study. The meetings took place every other week with the potential for on-demand consultation in between sessions if needed.

Participants randomised to either of the treatment condition received access to the modules of the intervention for nine weeks with one module being unlocked every Monday. For the CBT condition access to the later modules was provided regardless of progress with the earlier modules. For the IPT condition, the first three modules were provided in a similar fashion, though access to later modules were contingent on the participant choosing a focus in the third module. When this choice was made, a module was unlocked every week regardless of progress within the focus area.

The statistical analyses conducted for the study made use of the of Mplus, version 8.4 (Muthén & Muthén, 1998-2019) and SPSS, version 25. For all two-way comparisons (e.g., for the between-group comparison of therapeutic alliance for the active treatment groups) we employed an alpha level of .05, though this was corrected to 0.166 for the three-way comparisons (e.g., the primary and secondary outcomes). All reported *p*-values were interpreted relative to one of these two alpha levels depending on whether the analysis was a two- or three-way comparison. The intention-to-treat principle was applied to the data. Missing data for the primary and secondary outcomes were handled with the use of full information maximum likelihood estimation. These analyses thus made use of all available data under the assumption that data was missing at random (MAR). For the other analyses, missing data was handled using listwise deletion. For the between-group comparisons of the primary model, the effect size was calculated by subtracting the estimated mean change from one group from the estimated mean change of the other and dividing by the pooled standard deviation at pre-treatment (equivalent to Cohen's *d*). For the models concerning the secondary outcomes, the effect size was calculated in a similar way, but made use of the end point difference in ratings.

For the loneliness measure which was measured every other week during the treatment phase we used a latent growth curve model. To compare the change in loneliness for the control group to those of the active treatments, a model with two dummy-coded variables (0 = Waitlist control group, 1 = CBT/IPT) was specified. A second model was then specified to compare the two active treatments (-0.5 = IPT, 0 = Control group, 0.5 = CBT) to one another. The MLR option was used for robust standard errors. Significance of the parameters was evaluated using Wald-tests. The model was built iteratively with the indices of model fit as a guideline, which is this case was the Tucker-Lewis index (TLI), the comparative fit index (CFI), and the Root Mean Square Error of Approximation (RMSEA). The final model had a linear slope, no covariance between slope and intercept, and fixed residual variances. The fit indices indicated a good fit for TLI and CFI (0.964 and 0.967, respectively) and an acceptable fit for the RMSEA (0.074) according to the cut-offs provided by Hu and Bentler (1999).

The secondary outcome models were built in the same fashion as in **Study I**. This meant that we specified a regression model with the pre-treatment scores as a covariate and dummy-coded variables for between-group comparisons. The models for the secondary outcome measures also made use of MLR estimation.

For the research question regarding change during the follow-up phase we added an additional timepiece to the primary outcome model outlined above. For this analysis, only data from participants in the treatment groups was included due to the fact that no post-treatment data was collected for the control group. Only fixed parameters were evaluated in this model (by fixing the variance in slope at 0). Instead of a dummy variable, the grouping option was used to get separate slopes for the two active treatment group during this phase.

Results

During the treatment phase 8 % (n = 14) of the included participants dropped out of the study. There was no significant difference in the likelihood of dropout between the three arms, $\chi^2(2) = 4.20$, $p = .122$. Seventy-six percent (n = 130) of the sample completed the post-treatment assessment. The proportions of completers to non-completers did not differ significantly between the groups, $\chi^2(2) = 5.15$, $p = .076$. For the primary outcome measure where data was collected every other week during the treatment phase, participants completed 81 % of the measurements. The follow-up four months after the completion of the treatment phase had a response rate of 60 % with 82 out of the 136 participants in the treatment groups providing data for all outcome measures.

In the IPT condition, the participants who choose a focus area most commonly selected interpersonal deficits (57 %). This was followed by the 27 % that choose role transition, the 17 % that focused on interpersonal conflict, and lastly the 5 % that choose grief as their focus area. Overall, participants in the IPT condition completed on average 6.01 (SD = 3.31) of the nine modules, while participants in the CBT condition completed an average of 5.46 modules (SD = 3.33). For access of the modules, participants in the IPT condition accessed on average 6.93 modules (SD = 2.93), compared to an average of 6.85 (SD = 2.99) in the CBT condition. Neither of these means differed significantly

between the groups (p = .328 and .885, respectively). From a therapist perspective, the IPT condition required significantly more time allocated in total minutes per participant (M = 136.68, SD = 75.92) than the CBT condition (M = 103.94, SD = 51.24), t = -2.95, p = .004. Ratings of working alliance and treatment credibility (at week 3), as well as ratings of satisfaction with the treatment can be seen in Table 11. The two active treatment groups did not differ significantly for any of these factors.

Table 11

Ratings of Working Alliance, Treatment Credibility, and Satisfaction with the Treatment Along with a Between-Group Comparison

	IPT	CBT	
	Mean (SD)	Mean (SD)	*t*-value
WAI-12	56.28 (15.43)	56.20 (16.02)	0.27, p = .979
CEQ	31.23 (10.12)	32.04 (11.64)	-0.381, p = .704
CSQ	22.25 (5.02)	23.89 (5.51)	-1.53, p = .129

Observed means for all three conditions at pre- and post-treatment, as well as at the four-month follow-up are available in Table 5 of the appendix of the fourth paper. The results from the models estimating between-group differences on the primary and secondary outcome measures can be seen in Table 12. Using the calculation for reliable clinical change, the results indicated that 37 % of respondents (17 out of 46 participants) in the CBT group met the criterion for reliable clinical change. In the IPT condition, this number was 14 % (8 out of 57 participants). For the waitlist, 11 % (3 out of 27 participants) had a change score indicating reliable clinical change. None of the participants in the CBT or waitlist conditions were classified as reliably deteriorated. In the IPT condition, one participant (2 %) had a change score qualifying as reliably deteriorated.

Table 12

Estimates from the Models Evaluating the Primary and Secondary Models at Post-Treatment

Measure	*b*	SE	99 % CI	*p*-value	Effect size
ULS-3					
WL vs IPT	-1.36	1.44	-4.19, 1.48	.348	0.18
WL vs CBT	-5.22	1.70	-9.61, -0.83	.002*	0.71
IPT vs CBT	-3.87	1.33	-7.28, -0.45	.004*	0.53
BBQ					
WL vs IPT	10.70	3.15	2.59, 18.80	.001*	0.65
WL vs CBT	16.40	4.07	5.93, 26.88	< .001**	0.99
IPT vs CBT	5.71	3.68	-3.76, 15.17	.120	0.35
GAD-7					
WL vs IPT	-1.47	0.94	-7.28, -0.45	.116	0.29
WL vs CBT	-2.62	0.96	-5.08, -0.15	.006*	0.51
IPT vs CBT	-1.14	0.78	-3.15, 0.86	.143	0.22
PHQ-9					
WL vs IPT	-1.61	1.08	-3.73, 1.16	.140	0.26
WL vs CBT	-2.93	1.19	-6.00, 0.13	.014*	0.48
IPT vs CBT	-1.32	0.94	-3.74, 1.10	.160	0.22
SIAS					
WL vs IPT	-4.55	2.21	-10.26, 1.15	.040	0.27
WL vs CBT	-5.95	2.59	-12.61, 0.72	.022	0.36
IPT vs CBT	-1.39	2.18	-5.66, 2.87	.522	0.08

* Significant at $\alpha < .0166$ ** Significant at < .001

For the follow-up period, the model indicated a non-significant increase in rating of loneliness for the CBT group, *b* = 1.66 [95 % CI -0.57, 3.88], SE = 1.14, *p* = .144. The ratings from the IPT group indicated a non-significant decrease during this period, *b* = -1.25 [95 % CI -2.97, 0.47], SE = 0.88, *p* = .155.

The comparison between the active treatment at the four-month follow-up time point indicated no significant difference between CBT and IPT in ratings of quality of life, *b* = 2.63 [95 % CI -4.15, 9.42], SE = 3.46, *p* = .447, *d* = 0.16. This was also the case for social anxiety, *b* = -1.29 [95 % CI -5.66, 3.07], SE = 2.27, *p* = .561, *d* = 0.08, symptoms of depression, *b* =

0.46 [95 % CI -1.61, 2.53], SE = 1.06, p = .661, d = -0.08, and generalized anxiety, b = -0.53 [95% CI -2.33, 1.28], SE = 0.92, p = .572, d = 0.10.

Due to the Covid-19 pandemic towards the end of the treatment phase of the second intake, a sensitivity analysis was conducted to see whether the two intakes differed in slope. This was evaluated in a separate model using a dummy-coded time-invariant predictor (intake in 2019 = 0, intake in 2020 = 1). The results from this model did not suggest a difference between the years in neither initial loneliness ratings, b = -0.64 [95 % CI -2.88, 1.61], SE = 1.14, p = 0.578, nor change in loneliness during the treatment phase, b = 0.85 [95 % CI -1.80, 3.50], SE = 1.34, p = 0.522.

A second sensitivity analysis was conducted to test whether participants who provided data at the post-treatment assessment differed from those who did not in terms of their trajectories of change in loneliness. In this we dummy-coded participants as either having complete data at post-treatment (0) or missing data (1). The results of this analysis did not indicate a significant difference in change during treatment between the two groups for the sample as a whole, b = 2.53 [95 % CI -1.77, 6.85], SE = 2.20, p = .249, nor when only analysing members in the treatment groups, b = 0.85 [95 % CI -2.98, 4.67], SE = 1.95, p = .665. The results were also non-significant found when analysing participants with complete or missing data at follow-up, b = 0.07 [95 % CI -2.73, 2.86], SE = 1.424, p = .913.

Lastly, a third sensitivity analysis was conducted to compare the trajectories of loneliness during the treatment phase for those who met the criteria for a psychiatric diagnosis during the intake procedure (operationalised as meeting the criteria of a diagnosis according to the MINI Interview). Meeting the criteria for one or more diagnoses did predict a higher initial loneliness level, b = 3.06 [95 % CI 0.75, 5.37], SE = 1.18, p = .009, and a lower decrease in loneliness during the treatment, b = 3.83 [95 % CI 1.37, 6.29], SE = 1.26, p = .002.

Discussion

The results from **Study IV** turned out to be both expected and somewhat surprising. One of the main messages were that the CBT condition, much like in **Study II**, outperformed the waitlist condition with a moderate effect size. However, contrary to our hypothesis, participants in the IPT condition did not experience a significantly larger reduction in loneliness than the control group. The CBT condition also outperformed the IPT condition in terms of reduced loneliness, a surprising finding given the belief that the two active treatments would perform similarly well. The differential impact of the two approaches is interesting for a number of reasons. For one, the two programmes are built on approaches with different assumptions when it comes to what factors are of principal importance to the maintenance of loneliness over time. These factors in turn have implications for we seek to end these feelings of isolation. In the case of CBT, this is hypothesised to be by way of promoting the use of a more functional approach to tackling maladaptive thought patterns and behaviours. Models of loneliness based in this school of thought tends to emphasis intrapersonal factors such as these when considering how loneliness is perpetuated over time (e.g., Käll et al., 2020). Though we did not investigate changes in the proposed mechanisms (e.g., reduced avoidance of/in social situations), the fact that loneliness was reduced in a group receiving an intervention with this focus could be interpreted as a sign for the efficacy of this approach. In a similar vein, the non-significant comparison between the group receiving IPT and the waitlist could point to a lack of effect for interventions focusing more on interpersonal factors. Because of this, the results of the study may be taken as an initial investigation of the relative efficacy of interventions focusing on intrapersonal factors rather than interpersonal factors. However, it is important to note that this line of reasoning is strictly theoretical at this point and that empirical investigations of this hypothesis remains to be conducted. Furthermore, this conceptualisation of loneliness through the lens of IPT-based theory has not been tested in a systematic format, and there may be other, more fruitful ways of thinking about loneliness from an IPT perspective. Thirdly, IPT as an internet-based treatment has only been tested on a few occasions (Dagöö et al., 2014; Donker et al., 2013) and questions about the ability to translate the traditional face-to-face approach to an internet format remain to some extent.

As in the pilot, the benefits from the CBT condition were not solely a reduction in loneliness, but also a large increase in ratings of quality of life. This finding was not restricted to the CBT condition, participants in the IPT condition also rated their quality of life significantly higher than participants on the waitlist though the effect size for this comparison was moderate rather than large. Other than that, the CBT condition also had significantly lower ratings of depressive symptoms and generalized anxiety than the waitlist, but not symptoms of social anxiety. This is the opposite pattern compared to the findings in **Study 2**, though it should be noted that the effect sizes for these comparisons are all similar to the ones from the pilot. Participants in the IPT condition did not see any significant benefits relative to the waitlist for any outcome measures looking at psychiatric symptoms.

Though no significant improvements were noted, the results at the four-month follow-up indicated that the reductions in loneliness during the treatment phase was sustained after the conclusion of the active treatment. This is in line with the findings from **Study III** which also found that the reduction in loneliness was maintained two years after the conclusion of the treatment. However, it is worth noting that any inferences about the causal role of the treatment in reducing loneliness beyond the active treatment phase are hampered by the fact that we do not have an untreated control group to compare against.

Related to the results from the follow-up time point, the comparisons between the active conditions did not show any significant differences between the groups for the secondary outcome measures. We did not directly compare the two active groups on the primary outcome measure at the follow-up time point as we thought that the change in loneliness for each group was of greater interest. However, the observed means and the estimated effect sizes point to fairly similar reductions in loneliness at this time, which was not the case at post-treatment. This is interesting as IPT has been seen to have effects that may come about after the conclusion of the active treatment phase (Fairburn et al., 2015), which are often relatively brief. Completely dismissing the efficacy of our IPT intervention may be a bit premature, though the current design of the study does not allow for any causal attributions of either condition in the change in loneliness beyond the treatment phase.

In sum, the results for the CBT condition were in line with those found in **Study II**, while the IPT condition underperformed relative to our expectations. Also contrary to our hypothesis, we did see a significant difference between the active conditions, with CBT producing greater reductions in loneliness than IPT. In accordance with calls for comparisons between active treatments (Cuijpers & Cristea, 2016), this strengthens the ability to draw conclusions about the benefits of the SOLUS intervention in reducing loneliness. The CBT condition also saw reductions in symptoms of depressive symptoms and generalized anxiety while both active conditions improved in terms of quality of life. At the follow-up, the gains were maintained and the gap between the treatments in reducing loneliness had closed somewhat. Given the design of the trial, the strongest conclusions to be drawn are those from the treatment phase, which in line from the findings from **Study II** suggest that internet-based CBT can be an efficacious way of reducing loneliness. The results do suggest a potential for long-term benefits of internet based IPT, though these findings should be viewed as tentative given the lack of an untreated control group to compare against.

Discussion of the findings

The studies that served as the basis of this thesis aimed to evaluate the efficacy of internet-based interventions for loneliness. As a complement to this primary aim, we also hoped to provide a look at the heterogeneity within the sample seeking help in our projects. Below I go over the main messages from these four studies.

Clinical levels of psychiatric symptoms are a common, but not essential, feature of people seeking help for their loneliness

While this thesis primarily deals with the efficacy of internet-based interventions targeting loneliness, the lack of prior studies sampling from this population makes certain aspect interesting beyond the presumed effects of the treatments. Of particular interest are the psychiatric characteristics of the sample and how these cluster among the prospective participants. The results from **Study I** can be of help with this. As suggested by the latent profile analysis, approximately 50 % of the sample belonged to a subgroup with clinical symptom levels for one or more of the measures used to capture the presence of psychiatric disorders. The severity of these symptoms was the biggest factor setting the subgroups apart, though there was also a clear divide between profiles with clinical levels of social anxiety and those with lower levels. While neither the number of indicators nor the heterogeneity in kind of psychopathology was comprehensive from the perspective of the common diagnostic manuals (e.g., DSM-5), it does give some insight into the prevalence of common mental health problem in the group seeking help for their loneliness. The results do suggest the need to inquire about psychiatric symptoms that have been linked to loneliness in past investigations, more specifically symptoms of major depressive disorder and social anxiety disorder (e.g., Cacioppo et al., 2010; Danneel et al., 2020). This would in turn allow for a thorough investigation into what problem to prioritise and how the different symptoms affect the experience of loneliness and vice versa. The latter question remains an interesting one, especially in populations with more severe symptom levels than what is commonly the case when this relationship is investigated. As of right now, what can be said based on the results from the first study is that there do

seem to exist specific subgroups in this group of people seeking help for their loneliness.

Study I is not the first to study the prevalence of these symptoms in relation to loneliness, that has been done both in the general population (e.g., Beutel et al., 2017) and by use of similar statistical methods (e.g., Hyland et al., 2019). However, what our study brings to the table is a sample with a very valuable characteristic, namely the severity of their loneliness. The fact that participants seeking help within our project did so because of their loneliness (as inferred by the fact that the recruitment materials specifically targeted loneliness, along with the distress criterion for inclusion visible when applying) provides data from a range on the loneliness spectrum that has rarely been the subject of study. As mentioned in the introduction, a frequent problem in loneliness studies is the reliance on population-based samples with either no specific criterion for loneliness frequency/duration or rather arbitrarily applied criteria that may or may not be good way of demarcating the "common" form of loneliness from the form that considered to be clinically relevant. If the ambition is to provide interventions to reduce loneliness, an understanding of the psychological characteristics of individuals seeking out this help is of great importance. Because of this, the results from a treatment-seeking sample in the first study provides novel information about an understudied group and provides an initial indication of what commonalities may exist in terms of symptom profiles.

A future question to be answered is whether the different profiles found in the analysis from **Study I** is of importance for the outcome of in the treatment of loneliness. Because we used different kinds and iterations of the treatments in **Study II** and **IV** this question could not be tested in our dataset. Extending the analysis to include change over time (e.g., a latent class growth curve model) would allow for a look into whether profile membership predicts treatment response. Another way of doing this without relying on person-centred analytics would be using some version of a moderation analysis (Kraemer et al., 2002). Though we are very early in the process of developing interventions for loneliness (and internet-based psychological treatments for this group in particular), the question about for whom this way of receiving help works the best may eventually become relevant. For example, it is possible that the subgroups with clinical ratings of social anxiety

would benefit from a specific focus on these symptoms like it has been proposed in the past (Lim et al., 2016; Maes, Nelemans, et al., 2019). Though the content of the ICBT programme did provide this to some extent, the findings about reductions in these symptoms are inconsistent across **Study II** and **IV**, at least in terms of the inferences from the significance testing.

ICBT can be a helpful tool for reducing loneliness…

The main question in **Study II** through **IV,** and for this thesis in general, was whether internet-based psychological treatments could help reduce loneliness for people who considered this their primary problem. A consistent finding in both RCTs was that ICBT produced a significantly larger reduction in loneliness compared to people in the wait-list condition. In **Study IV** it also outperformed another active psychological treatment, internet-based IPT. These findings are in line with prior suggestions of CBT as a potent option for reducing loneliness (Cacioppo, Grippo, et al., 2015). Furthermore, this effort also serves as the first to test an CBT intervention more than once and against another active condition, both of which strengthens the inferences regarding the efficacy of our intervention. Like Cuijpers and Cristea (2016) described in their tongue-in-cheek paper *How to prove that your therapy is effective, even when it is not: a guideline*, the latter is a much more severe test of treatment efficacy compared to using a passive control condition.

An important part of establishing the efficacy of a new treatment/intervention is to establish whether the effects are lasting or not. This has traditionally been found to be the case for CBT in general (Cuijpers, Hollon, et al., 2013), as well as for ICBT more specifically (Andersson et al., 2018). The findings from **Study III**, and partially from **Study IV**, do point to the effects of the ICBT programme being lasting. Two years after the conclusion of the initial treatment period of **Study II** the participants rated their loneliness slightly lower than at the post-treatment assessment. With regards to **Study IV**, the timeframe was considerably shorter (four months compared to two years), but the non-significant change during this period is also indicative of sustained treatment gains.

Though the field of interventions targeting loneliness is still sparsely populated and heterogeneous in terms of its theoretical pluralism, the effects of our ICBT treatment do compare favourably to most other

interventions found in the recent meta-analysis of psychological interventions targeting loneliness (Hickin et al., 2021). The average effect in the meta-analysis, d = 0.42, is lower than the estimates found in **Study II** and **Study IV**, d = 0.77 and 0.71, respectively. The effects of the ICBT intervention used in this thesis is also higher than the average effect of the CBT-based interventions included in the analysis, d = 0.49 (though it should be noted that **Study II** is included in that estimate). In fact, our intervention outperforms all but the one employed by Alaviani et al. (2015) which found a massive standardised mean difference of 3.04 in their study. Compared to other kinds of interventions, our ICBT estimates compare favourably as well. Using the observed means to allow for easy comparisons against the results reported in Hickin et al. (2021), the results from **Study IV** rank among the top candidates along with the social identity intervention by Haslam et al. (2019) and the reminiscence therapy by Chiang et al. (2010). Though the results from the meta-analysis by Masi et al. (2011) that suggested that interventions targeting maladaptive social cognition was one of few promising candidates has not held up in recent years, the findings in this thesis do indicate that the suggested potential of using CBT for this problem holds true.

As an important addition to these conclusions, two other metrics can complement the effect sizes from the studies. These are the module completion rates and the percentage of participants experiencing reliable clinical change. Both could be interpreted as indicating room for improvement. The proportion of modules completed in **Study II** and **Study IV** was identical, 4.89 out of the 8 modules (61 %) for **Study II** and 5.46 out of the 9 modules (61 %) for **Study IV**. However, these numbers are both lower than the percentage presented by van Ballegooijen et al. (2014) in their meta-analysis of adherence rates of ICBT for depression. Comparisons to other studies should factor in the lack of clear definitions for completion and adherence among internet-based interventions (Sieverink et al., 2017), but the fact that the percentage of completion in **Study II** and **IV** was identical despite using different definitions could point to this finding being somewhat robust across our studies. Increasing the perceived relevance could be a way of increasing the adherence and rates of completion, and a potential way of doing this would in turn be to conduct qualitative investigations into whether some parts of the intervention was consistently identified as less relevant than others across the samples.

As for reliable clinical change, the numbers indicated that 37 % of respondents in the CBT condition of **Study IV** had achieved reliable reductions in loneliness after the conclusion of the treatment phase. **Study III** indicated that this number was up to 60 % two years after the conclusion of the first RCT. The percentage of reliably improved respondents in **Study IV** is lower than the roughly 60 % found in a meta-analysis of the effects of psychotherapeutic interventions on depression by Cuijpers et al. (2021). It is worth mentioning that the calculation of reliable clinical change made use of the one-year test-retest coefficient for the ULS-3 (0.73) which is rather low. This was used because it is the only available test-retest reliability estimate for the measure in question. While this is not necessarily a problem in of itself, a low test-retest estimate increases the threshold needed to be classified as reliably improved, thus potentially making the estimate more conservative that what would be the case had a more appropriate test-retest coefficient been available (i.e., a test-retest coefficient measured with the same timeframe as the treatment phase and in a similar population). Regardless of whether the percentage classified as reliably improved in the CBT conditions is conservative or not, this metric and the relatively low average number of completed modules points to a variability in treatment response and adherence that should be considered alongside the indications provided by the effect sizes.

…while internet-based IPT did not produce the same results

While the ICBT programme produced a decrease in loneliness compared to the control group, the IPT programme did not. Why the hypothesised reduction in loneliness did not materialise remains unclear. Below I examine some possible explanations.

One of the possible reasons for different results produced by the interventions is that only one of the proposed ways of alleviating loneliness actually does just this. With the IPT programme we targeted other mechanisms and elements than in the ICBT equivalent, namely interpersonal factors. ICBT in turn had a greater focus on intrapersonal factors such as maladaptive cognitions and behavioural tendencies. Due to the different targets the results from **Study IV** could be interpreted as indicating an edge for the intrapersonal approach compared to the interpersonal way of reducing loneliness. There are of

course caveats to this statement. The dichotomisation into an interpersonal and an intrapersonal intervention is strictly based on our understanding of the theoretical underpinnings of the two approaches, rather than some verified procedure. Comparisons between different approaches of alleviating loneliness are ultimately an empirical question that remains to be answered with actual data. At this time, we do not know whether the treatments work through their proposed mechanisms (i.e., whether the change in loneliness in the ICBT condition happens by way of reducing the maladaptive processes and behaviours noted in the literature). **Study IV** allows us to conclude that not just any kind of internet-based intervention produces the results seen in **Study II**, but beyond that, the possibilities of inferring why this was the case are limited.

Furthermore, **Study IV** served as only the third time that internet-based IPT has been tested in a randomised controlled trial. The two earlier attempts have produced mixed results; Donker et al. (2013) found a non-significant difference between the CBT and IPT condition while Dagöö et al. (2014) described findings similar to **Study IV** with IPT performing worse than ICBT. Because of the lack of studies, it remains an open question whether IPT can work when delivered via the internet. From a theoretical standpoint, this ought to be possible. For one, IPT has a clear focus on factors related to between-session aspects of a client's situation rather than any processes observed in the therapy room such as transference (Weissman et al., 2017). In this way IPT is reminiscent of CBT which has been successfully administered via the internet against a wide range of problems related to mental health (Andersson, 2016). Secondly, while IPT may rely less on pure psychoeducation than CBT, providing information about the problem in question (most commonly depression) and helping the client reach an informed decision on how to tackle the situation are both aspects that can be done via the internet (Reins et al., 2019; Soucy et al., 2021). That being said, certain aspects that Weissman et al. (2017) describe as important parts of IPT could also be hard to do via this method of dissemination, such as the therapist helping the client elicit affect. Because of this, the hypothesis that the method of administration served to reduce the efficacy of IPT for loneliness will only get its answer if and when internet-based IPT is tested on more occasions and against other problems than loneliness.

An aspect to consider is the fact that a majority of the participants that choose a focus as part of the IPT condition in **Study IV** picked the *interpersonal deficits* focus. This is not necessarily surprising. The focus has been described as specifically targeting loneliness and social isolation (Weissman et al., 2017). However, this focus area has also been suggested to predict worse results than the other foci (Elkin et al., 1989), potentially related to the fact that this focus is chosen by individuals with severe and chronic difficulties (Weissman et al., 2017). The potential absence of the relationships and interpersonal events would also make it hard to work with the mechanisms proposed to produce the results noticed in other instances of IPT (Lipsitz & Markowitz, 2013). Because of this, the treatment programme may actually provide a quite poor fit with parts of the population that could seek help within the framework of our studies. The results from **Study IV**, or rather the lack thereof, should be interpreted with this in mind.

Limitations

Some general limitations should be kept in mind when interpreting the results from the four studies. This includes the sample which served as the basis for the inferences. First and foremost, it is hard to know whether the sample is or is not representative of the population given the lack of any normative data to compare against. While there are non-Swedish community samples to use as a comparison (e.g., Beutel et al., 2017), we purposefully attempted to recruit participants for whom loneliness was a major concern, meaning that conclusions about trends in the general population might not accurately represent the group we were interested in studying. With this in mind, some characteristics of the samples throughout the thesis are potentially troublesome. One of these is the gender imbalance. Women made up 74.4 % of the overall sample, which is not in line with the meta-analytic findings by Maes, Qualter, et al. (2019) that suggested that differences between genders in the prevalence of loneliness are generally small and insignificant. Similarly, most of the sample also had a university degree, pointing to the fact that the educational level is above that of the general population in Sweden (Statistiska Centralbyrån, 2021). Both the overrepresentation of women and university-educated participants have been noted previously in studies on internet interventions (Titov et al., 2010), and suggest a potential difficulty in generalising our findings to other contexts where the group seeking treatment are more representative of the population at large. If the plan is to disseminate our interventions

or similar ways of helping the lonely more broadly, factors such as these could be important to consider.

The lack of a standardised loneliness criterion to use when including/excluding participants is also a source of uncertainty when considering the representativeness of the sample. The reliance on the participant's own experience, rather than any standardised metric does introduce an element of arbitrariness into the equation. With diagnoses such as major depressive disorder or social anxiety disorder, a set of criteria can be used for this purpose. This is not something that is available in the case of loneliness. However, it is important to recognise that in a field without clear guidelines regarding the demarcation of lonely/non-lonely individuals, arbitrariness is bound to appear at some step in the process. One option would have been to keep a cut-off for the primary outcome measure in **Study IV**, similar to **Study II**. In the case of many psychiatric disorders, a cut-off from a validated questionnaire (e.g., GAD-7; Spitzer et al., 2006) can serve as a way of demarcating participants with a clinical level of the symptoms of interest from a non-clinical group. In the case of ULS-3, this is difficult to do in a meaningful way. For one, the norms made available during the validation of the instrument do not derive from a representative sample of the general population (Russell, 1996). Secondly, the established link between loneliness and adverse somatic and psychological outcomes often relies on a single-item rating, rather than a continuous measure. Because of this, it is hard to use other studies to infer when loneliness becomes a problem from a quantitative perspective and to use this as a guideline for decisions on inclusion/exclusion. For these reasons, we choose to rely exclusively on the participants' experience which we considered fitting given the subjective nature of the phenomenon in question. We also hope the procedure of asking the participants to indicate their primary problem could have served to standardise the sample in terms of their loneliness. However, an even more standardised way to make this decision would likely be helpful both in intervention research and for the field in general. Candidates for this could include assessment of other aspects than the frequency of loneliness, including distress related to this experience and chronicity.

Future directions

Research on loneliness and interventions for this problem is still in a relatively early stage. Though recent advances on the theoretical aspects of this problem (e.g., Cacioppo & Cacioppo, 2018b; Käll et al., 2020) have helped summarise the knowledge and allowed for testable predictions, the road ahead looks to be a long one. Looking into the crystal ball, I predict that future topics involve aspects that focus both on the overarching construct of loneliness, interventions for loneliness in general, and internet-based interventions for this population more specifically.

First and foremost, when does loneliness become a problem? The common view echoed in some publications on the topic (Asher & Paquette, 2003; McWhirter, 1990) is that loneliness is not a sign of anything pathological and wrong in of itself, much like how people can experience lowered mood without being classified as depressed. At the same time, reports of increasing loneliness or an estimated prevalence in the double digits are sure to raise the alarm both in the scientific community (Cacioppo & Cacioppo, 2018a) and in the public eye (Gil, 2014, July 1). To be perfectly clear: both viewpoints can be valid conclusions and the latter is indeed a justification for putting greater effort into dealing with this problem. However, the reliance on a terminology with fuzzy boundaries and the lack of knowledge about when and how it poses a health risk may prevent progress. Some steps could be of help with this. As mentioned above, assessment of loneliness could take other aspects than the frequency into account, such as impact (e.g., distress) and chronicity (e.g., is the loneliness related to a specific event or something that has been a problem for a long time?). Furthermore, when studying loneliness from the angle of a potential contributor to distress and adverse outcomes, recruitment ought to involve respondents and participants for whom loneliness is a concern. Most of the studies to date report the link between loneliness and, for example, symptoms of psychiatric disorders in samples where loneliness is likely rare and "only" concerns a few percentages of the population. Focusing more on the end of the distribution where loneliness is a common and potentially chronic experience would provide better insight into the part of the population likely to have need for the help we aim to offer. I do recognise that a substantial problem for this kind of approach is that we currently do not know how to best reach and assess this group specifically. However, if we are to develop

our understanding of loneliness and its role within the context of psychopathology, finding a way to do just this might be necessary.

The point about sampling also stands in relation to intervention research in general. While there are examples of studies where participants have been recruited based on some kind of loneliness criterion (Lloyd-Evans et al., 2020; Theeke et al., 2016), there are also plenty of studies where a criterion of this kind is not used, and it is unclear how big of a problem loneliness actual is considered to be for the participants. To reiterate my point above, if the aim is to benefit people specifically bothered by loneliness, the studies establishing how helpful a certain intervention is should sample participants based on this characteristic. Otherwise, we run the risk of receiving results that are difficult to interpret relative to the population we hope to help.

The number of psychological interventions tested against loneliness is still relatively sparse, as indicated by the fact the recent meta-analysis by Hickin et al. (2021) was only able to include 28 RCTs in the analysis. Nonetheless, as proponents of the process-based therapy paradigm (Hofmann & Hayes, 2018) might argue, it is never too early to focus on the processes driving the reduction in loneliness observed in some of these studies. Studying mediators of change in the context of loneliness interventions would be of help when considering through which means to target loneliness. In fact, this type of studies could be viewed as especially important given that we are in the early stages of developing interventions for this problem. Insights from this kind of research could provide directions for what to focus on from now on.

Related to the general field of interventions for loneliness, and CBT more specifically, is the potential for tailoring interventions. Like we have suggested previously, a modular design for this kind of intervention could be a way to help deal with the heterogeneity in this population (Käll et al., 2020). The numbers related to the perceived relevance and helpfulness from **Study II** points to room for improvement. Going from a sequential, one-size-fits-all approach to a more flexible format that is tailored to a participants symptom profile and cognitive-behavioural tendencies could potentially be a way to improve the average effect of the treatment and to make the content more relevant to a larger proportion of the participants. ICBT has been used for this purpose in the past. (Johansson et al., 2012; van Beugen et

al., 2016), though a meta-analysis of tailored transdiagnostic ICBT for depression and anxiety disorders did not find an improved effect of this kind of treatment over their standardised and disorder-specific counterparts (Păsărelu et al., 2017). Whether this could be the case for loneliness remains to be studied. A tailored approach to the SOLUS programme could also allow for the introduction of other techniques and strategies potentially relevant to reduce feelings of loneliness. A candidate for this is strategies targeting an overreliance on maladaptive strategies for emotional regulation, which in a recent study was found to differentiate lonely respondents from non-lonely respondents in a sample of individuals with social anxiety disorder (Eres et al., 2021).

Finally, a natural development for internet-based interventions is the dissemination into regular practice. Examples of successful treatments that have made this transition include ICBT for social anxiety disorder (El Alaoui et al., 2015) and panic disorder (Hedman et al., 2013). Though interventions for loneliness are far less studied at this point, testing the intervention in a regular clinical setting would be a good way of potentially bypassing the issue of unrepresentative sample characteristics. Introducing the intervention at a primary care level might be a good fit given that loneliness has suggested to be a common concern at this level of the health care system (Mullen et al., 2019).

Conclusions

The studies in this thesis detail an attempt of providing an understanding of the individuals seeking help for their loneliness, as well as the subsequent attempts at to offer psychological interventions to this group. The findings from the intervention studies are partially encouraging (in the case of the ICBT condition in **Study II** and **IV**), and partially a bit surprising (in the case of the IPT condition from **Study IV**). While the latter finding was not the expected outcome, it still provides important information about the specificity of the treatment effects for the ICBT condition and thus adds to our understanding of how best to help the lonely. Furthermore, the results serve as extension of prior research suggesting that CBT is a promising candidate for reducing loneliness and adds the internet-based method of delivery as another mode of achieving this. Future research should seek to understand the mechanisms of change to account for how the effect of ICBT for loneliness come about and whether the results can be replicated in a regular care setting.

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