Is Loneliness in Emerging Adults Increasing Over Time? A Preregistered Cross-Temporal MetaAnalysis and Systematic Review

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Abstract

Judged by the sheer amount of global media coverage, loneliness rates seem to be an increasingly urgent societal concern. From the late 1970s onward, the life experiences of emerging adults have been changing massively due to societal developments such as increased fragmentation of social relationships, greater mobility opportunities, and changes in communication due to technological innovations. These societal developments might have coincided with an increase in loneliness in emerging adults. In the present preregistered cross-temporal meta-analysis, we examine whether loneliness levels in emerging adults have changed over the last 43 years. Our analysis is based on 449 means from 345 studies with 437 independent samples and a total of 124,855 emerging adults who completed the UCLA loneliness scale between 1976 and 2019. Averaged across all studies, loneliness levels linearly increased with increasing calendar year (β = 0.224, 95% CI [0.138, 0.309]). This increase corresponds to 0.56 standard deviations on the UCLA loneliness scale over the 43-year period of study. Overall, the results imply that loneliness can be a rising concern in emerging adulthood. Although the frequently-used term "loneliness epidemic" seems exaggerated, emerging adults should therefore not be overlooked when designing interventions against loneliness.

Keywords: loneliness, social isolation, emerging adult, young adult, cross-temporal meta-analysis

Public Significance Statement

The present cross-temporal meta-analysis suggests that loneliness in emerging adults slightly increased over historical time from 1976 until 2019. Consequently, emerging adults should not be overlooked when designing future interventions or public health campaigns against loneliness.

Introduction

Judged by the sheer amount of global media coverage, loneliness rates seem to be an increasingly urgent societal concern. The heightened public awareness of loneliness has led to the perception that loneliness is a new phenomenon of our time, which is illustrated by headlines like "Millennials And The Loneliness Epidemic" published in Forbes (Howe, 2019) or "Let's Wage a War on Loneliness" published in the New York Times (Kristof, 2019).

Although the narrative of a loneliness epidemic sounds compelling to many, it is highly speculative. Thus far, the empirical results on whether a loneliness epidemic does or does not exist are inconclusive. Some studies reported increases in average loneliness levels in recent years (Twenge et al., 2019; for a meta-analysis, see Xin & Xin, 2016), and others reported decreases (for a meta-analysis, see Clark et al., 2015; Trzesniewski & Donnellan, 2010). To resolve this inconsistent picture of previous research, we conducted a preregistered cross-temporal meta-analysis. In this meta-analysis, we statistically aggregated loneliness scores from several hundreds of samples over the last 40 years to empirically investigate whether loneliness levels in emerging adults have changed over historical time. Using this meta-analytic technique allows examining changes in loneliness over time with large samples from around the globe and yearly assessments of loneliness over very long periods for which no longitudinal data exist. Moreover, we were able to examine study-level and regional-level moderators of this effect.

Psychological research defines loneliness as an aversive state that arises when people perceive a mismatch between their desired and their actual social relationships in terms of both quantity and quality (Perlman & Peplau, 1981). Across many different countries, a substantial proportion of people have been reported to feel lonely (Beutel et al., 2017; Matthews et al., 2018; Victor & Yang, 2012), with prevalence rates varying between 10-30% between studies. Several studies have

identified emerging adulthood (the time between age 18 and 29; Arnett et al., 2014) as a period in life where levels of loneliness reach a peak (Barreto et al., 2020; Hawkley et al., 2020; Luhmann & Hawkley, 2016). In this period of life, forming intimate partnerships, establishing secure identities, and managing other close relationships such as friendships are important goals (Barry et al., 2009) and developmental tasks emerging adults have to accomplish (Hutteman et al., 2014). Consequently, emerging adults may experience loneliness when their actual social relationships do not meet their relationship goals.

Loneliness in emerging adults is associated with several serious health issues such as depressive symptoms and other mental health problems (Matthews et al., 2018; Vanhalst et al., 2012), maladaptive physical health behavior (e.g., smoking, lower levels of physical activity), and the use of negative coping strategies under stress (e.g., socially withdraw, obsess about problems; Matthews et al., 2018). These findings led others to classify loneliness as a "significant public health concern" (Gerst-Emerson & Jayawardhana, 2015, p. 1). Moreover, lonely emerging adults were less confident about their occupational future and were more likely to be unemployed than their non-lonely peers (Matthews et al., 2018). Consequently, loneliness in emerging adults co-occurs with a wide range of problems that have severe negative implications for health and well-being in later life. Therefore, it is especially important to empirically test the narrative of the loneliness epidemic for this age group to derive possible implications for action.

Negative Perspectives of Previous Research on Recent Generations of Emerging Adults

The skepticism regarding characteristics of emerging adults in upcoming generations has a long history. In the 1920s, magazines and newspapers were deploring the characteristics of the "flappers". In the 1960s, complaints were raised about the "hippies" (Paulsen et al., 2014). Also, several empirical studies have portrayed more recent generations of emerging adults in a fairly

negative light. For instance, cohorts of America's emerging adults born in the 1970s, 1980s, and 1990s have been labeled the "Generation Me" because they seem to have a heightened sense of narcissism, self-esteem, and expectations for their future (Twenge, 2008; Twenge et al., 2008).

Further, these generations seem to show increased forms of psychopathology (Twenge et al., 2010) and perfectionism (Curran & Hill, 2017). The most recent generation of America's emerging adults (born between 1995 and 2002) has been termed "iGen" (Twenge, 2017), characterized as being less confident, more anxious, and even more individualistic than previous generations. Continuing the trend of increased psychopathology described for the "Generation Me", people from "iGen" have been reported to be more depressed, less happy, and to more often commit suicide than previous cohorts of emerging adults (Twenge, 2017). The narrative of a loneliness epidemic among emerging adults fits this context.

Historical Changes for Emerging Adults in Contemporary Societies and its Relation to Loneliness

Why would loneliness levels have changed over historical time? And why potentially for emerging adults in particular? Most sociologists, psychologists, and other social scientists generally agree that the nature of (emerging) adulthood is different now from what it was several decades ago (Paulsen et al., 2014). Therefore, it is particularly interesting to investigate whether changes in loneliness accompany these changes in the nature of (emerging) adulthood.

Five principles of emerging adulthood

Pahl and Pevalin (2005) argue that "many sociologists are now in general agreement that there is something distinctively new in contemporary society that impinges, moulds, modifies or restructures our personal relationships" (pp. 434-435). The authors argue that identity today is a more

changeable and fluid social property than it was in the past, resulting in more flexible, fragmented, and uncertain tendencies of building social relationships (Pahl & Pevalin, 2005). They argue that the degree of permanency in individuals' lifestyles that existed in previous times no longer holds to the same degree in more recent years.

Pahl and Pevalin (2005) describe these ideas without a specific focus on certain age groups. However, their idea of a decreasing degree of permanency in individuals' lifestyles is especially relevant for emerging adults. In the middle of the 20th century, young adulthood was largely defined by leaving home, finishing school, stable employment, marriage, and children (the "Big Five" traditional markers of adulthood; Settersten, 2011). However, today's young and emerging adults rank these role-based criteria relatively low in terms of what it means to be an adult (Paulsen et al., 2014). In his *theory of emerging adulthood*, Arnett (2004) characterizes emerging adulthood in contemporary societies by five other principal features. He argues that emerging adulthood is the age of identity exploration, the age of instability, the age of feeling in-between, the age of self-focus, and the age of possibilities (Arnett, 2004).

Regarding loneliness in emerging adulthood, the features of identity exploration and instability seem particularly relevant. An important developmental goal of emerging adults is to develop an understanding of who they are, what they value, and how they fit into the society around them. If this process is not proceeding well, emerging adults may feel lonely because the feeling of being out of place in society is a characteristic of loneliness (Hawkley et al., 2005; Kaniušonytė et al., 2019). Whereas in 1950, Erikson discussed identity exploration as an issue in adolescence, today, it is mainly seen as an issue in emerging adulthood (Côté, 2006). Emerging adults of today try out various futures in work and love to establish a secure identity and gradually move towards making enduring commitments. This feature of identity exploration is closely linked to the feature of instability.

Emerging adulthood is described as a period in life with frequent changes in educational paths, jobs, love partners, and living situations (Cohen et al., 2003). Thus, this period in life may be vulnerable to loneliness due to many changes and discontinuities in individuals' social networks.

Occupational instability in emerging adulthood

At least in today's Western societies, emerging adulthood is not a time of entering stable work as suggested by the traditional markers of adulthood. Emerging adulthood is a time of immense occupational instability. For example, in the United States, the average number of jobs held between age 18 and age 32 is eight (U.S. Bureau of Labor Statistics, 2020). The proportion of people working full-time is lower among emerging adults than among individuals from any other adult age group (Smeeding & Phillips, 2002). The occupational and financial insecurity might even have accelerated after the worldwide economic crisis starting around 2008 (Lübke & Erlinghagen, 2014). This occupational and financial insecurity can also be accompanied by social changes and puts emerging adults at increased risk of loneliness (Bosma et al., 2015).

Instability of (romantic) relationships in emerging adulthood

Further, it has been argued that the extent to which people are embedded in longer-lasting relationships and institutional memberships has decreased over historical time (Pescosolido & Rubin, 2000). This change can be seen, for example, in the increased number of people working in temporary jobs, the increased freedom of choice regarding multiple- and parallel-group memberships (e.g., societies, peer groups, workgroups) with a lower commitment, in less overlapping social contacts among friends and family, and in a decrease in sibship size. Pescosolido and Rubin (2000) argue that these developments result in more but weaker social ties that are rather temporary, transient, and contingent. This is especially relevant for emerging adulthood,

which is characterized by moving between committed relationships and sporadic romantic interactions (Cohen et al., 2003). In the years following emerging adulthood, when people typically commit to stable romantic relationships, loneliness levels have been found to be lower (Hawkley et al., 2020; Luhmann & Hawkley, 2016).

Empirical research demonstrates striking growth in single-person households, with young adults being the fastest-growing group of people who live alone (e.g., Snell, 2017). While this growth may partly explain possible increases in loneliness, it has to be noted that living alone does not necessarily conduce to loneliness (e.g., Luhmann & Hawkley, 2016). Moreover, the steady increase of enrolment in higher education has been accompanied by increases in the number of emerging adults living away from home (Pahl & Pevalin, 2005). Further evidence from the British Household Panel Survey shows that almost 50% of the emerging adults living away from home and not in a partnership move each year (Pahl & Pevalin, 2005). As increases in the physical distance between network partners have been associated with decreases in emotional closeness (Borschel et al., 2019), this increased mobility of emerging adults can challenge building stable social networks, which may result in increased loneliness.

Technological innovations and other structural changes

Another relevant historical change is the steady increase in individuals using the internet since 1990 (International Telecommunication Union, 2021). At the turn of the millennium, the internet was widespread throughout the Western world. In 2001, the proportion of people using the internet in OECD countries was around 50 percent (Räsänen, 2006). It has been argued that easy access to the internet "has changed the nature of peoples connection to others in their social world" (Tyler, 2002, p. 195). As young people constitute the biggest group of frequent internet users worldwide

(OECD, 2020), this development might be especially relevant for the communication behavior of emerging adults.

Related to the development of the internet, Twenge et al. (2019) argued that an increase in U. S. adolescents' and emerging adults' loneliness could be due to increases in social media usage and decreases in in-person contacts. Social media emerged during the early 2000s (Boyd, 2014), which might explain a potential increase in loneliness since that time. It is an ongoing debate whether social media use causally affects loneliness and well-being, with some authors arguing for strong negative effects of social media use (e.g., Hunt et al., 2018; Twenge et al., 2019) and others arguing for weak to no effects of social media use (e.g., Orben & Przybylski, 2019) or for the distinction between different conditions of social media use with some being harmful and others being beneficial for loneliness (e.g., Nowland et al., 2017).

Moreover, loneliness is related to characteristics at the regional level, such as the degree of urbanization (MacDonald et al., 2020; Yan et al., 2014), population change (Buecker, Ebert, et al., 2020), and social inequality (Yan et al., 2014), which have changed worldwide over historical time, but at different rates depending on the country. All these historical changes may contribute to a better understanding of changes in emerging adults' loneliness over historical time. However, the fact that these trends did not occur at the same rate or in the same way in all countries suggests that the change in loneliness may exhibit spatial differences over historical time.

The Relevance of Changes in Emerging Adult's Loneliness Levels Over Historical Time

More than 20 years ago, a non-psychological research article entitled "Loneliness: an epidemic in modern society" (Killeen, 1998) was published. Back then, the author states that "loneliness is arguably far more prevalent in today's society than it has been in previous generations" (Killeen,

1998, p. 763). However, Killeen (1998) did not present empirical evidence or a theoretical rationale for this statement, leaving it an open question of whether loneliness has indeed increased and why this could be the case. As we mentioned earlier, many historical changes that occurred during the last decades may especially affect how emerging adults form social relationships—such as increases in computer-mediated communication, worldwide crises that affect the daily lives of adults, and increases in individual mobility. And yet, for this age group, the empirical evidence on changes in loneliness over historical time is inconclusive (see below for more details).

To examine whether loneliness in emerging adults has changed—with special consideration of possible increases—is important for several reasons. First, there has been much speculation about loneliness in the public, politics, and the media. An empirical investigation of these speculations is essential to inform future directions in research and political efforts to address loneliness. The present meta-analysis provides clarity to the otherwise highly heterogeneous literature on the change in loneliness over historical time. Second, whereas temporary and mild feelings of loneliness are considered normal, chronic and severe loneliness has serious negative physical and mental health consequences resulting in a higher risk for early mortality (e.g., Hawkley & Cacioppo, 2010; Holt-Lunstad et al., 2015; Jaremka et al., 2014; Leigh-Hunt et al., 2017; Matthews et al., 2018; Vanhalst et al., 2012). Thus, if loneliness levels in emerging adults have increased, this increase might build up to a growing public health issue with burdens for the individual and health care systems. Third, given that loneliness shows a relatively high rank-order stability over the life span (Mund, Freuding, et al., 2020; Mund, Lüdtke, et al., 2020), those with high levels of loneliness at a young age may remain lonelier than others over time. Thus, the previously mentioned health consequences might accumulate over the life span and result in long-term societal problems. For example, von Soest et al. (2020) found that adolescents and young adults who reported feeling lonely were

consistently at a higher risk for disability and lower income in midlife than their non-lonely peers.

To reduce the public health burden of loneliness in later life, loneliness in emerging adulthood therefore merits special consideration.

Previous Evidence on Changes in Loneliness Over Historical Time

Several psychological constructs related to loneliness have been found to change over historical time. However, whereas some of these findings would suggest that loneliness has decreased (e.g., increasing trends of self-esteem and extraversion; Twenge, 2001; Twenge & Campbell, 2001), others would suggest that loneliness has increased (e.g., decreasing trend in attachment security and dispositional empathy; Konrath et al., 2011, 2014). However, in these reflections on changes over historical time in other psychological constructs associated with loneliness, at least two considerations should be kept in mind: First, loneliness and constructs such as extraversion, attachment security, or empathy are correlated but distinct constructs that share about 10-15% of the variance (estimated based on the correlations reported in Beadle et al., 2012; Buecker et al., 2020; Helm et al., 2020). Second, loneliness and constructs such as extraversion, attachment security, and empathy can be cross-sectionally related in different historical years. However, that does not necessarily mean that they develop in the same direction and with the same pace over historical time. Accordingly, based on results on changes in these correlated constructs over historical time, no definitive statement can be made about changes in loneliness over historical time.

Does previous empirical research on loneliness resolve this issue? Unfortunately not, since the findings are very heterogeneous. For emerging adults, some authors reported *decreases* in U. S. college students' loneliness from 1978 to 2009 (for a meta-analysis, see Clark et al., 2015) and in U. S. high-school seniors' loneliness from 1976 to 2006 (for a longitudinal study, see Trzesniewski &

Donnellan, 2010). Other authors reported *increases* in U. S. adolescents' loneliness from 1976 to 2017 (for a longitudinal study, see Twenge et al., 2019) and in Chinese college students' loneliness from 2002 to 2011 (for a meta-analysis, see Xin & Xin, 2016). For old age, some studies from Europe and the U. S. found loneliness to be stable (Dahlberg et al., 2018; Eloranta et al., 2015; Hawkley et al., 2019; Nyqvist et al., 2017; Victor et al., 2002) or to decrease (Hülür et al., 2016), whereas a study from China found increases in loneliness (Yan et al., 2014). For childhood, loneliness levels in Finland have remained relatively stable from 1981 until 2004 (Lempinen et al., 2018). Table 1 presents an overview of the period of investigation, the study design, the sample characteristics, and the results of previous studies on changes in loneliness over time.

There could be many reasons for these contradictory findings. First, it should be noted that the studies mentioned above covered very different (historical) time intervals, used different study designs (i.e., longitudinal study vs. cross-temporal meta-analysis), and included different samples. Second, it becomes apparent that the previous studies refer to populations from different countries, with most studies focusing on emerging adults, either included U. S. or Chinese student samples. These facts limit the comparability among the studies. In the present meta-analysis, we aggregate studies that collected data on loneliness in emerging adults from 1976 until 2019 from all around the world, thereby largely extending previous attempts to examine changes in emerging adults' loneliness over historical time.

The Present Study

A well-established method to examine whether a psychological outcome has changed over historical time is cross-temporal meta-analysis. The basic idea of this method is to compute the association between the average scale score of a psychological questionnaire (e.g., personality traits) and the year of data collection in samples with restricted variability in age. Previous cross-temporal

meta-analyses (e.g., Curran & Hill, 2017; Konrath et al., 2011; Twenge, 2001; Twenge et al., 2010; Twenge & Campbell, 2001) investigated mostly college students samples as they are assumed to be the same age. These convenience samples, however, are often generated using nonprobability sampling techniques. Thus, these samples are not representative concerning a defined population of interest (e.g., emerging adults in general). Consequently, previous cross-temporal meta-analyses are limited in their ability to generalize the results to other populations. In the present meta-analysis, we address this issue by not only including samples explicitly described as college student samples but also other samples that include emerging adults within the age range of 18-29 years. Further, Rudolph et al. (2019) have criticized cross-temporal meta-analyses for ignoring the dependence of effect sizes that occurs because studies are nested in years of data collection. To address this issue, we used robust variance estimation (RVE; Hedges et al., 2010; Tanner-Smith et al., 2016) in the present study, as this method adjusts the standard errors of the effect sizes to account for dependency (Tanner-Smith et al., 2016; Tanner-Smith & Tipton, 2014).

Moreover, many previous cross-temporal meta-analyses—especially those on loneliness—did not report that they have requested unpublished data for inclusion (e.g., Clark et al., 2015; Xin & Xin, 2016). However, some cross-temporal meta-analyses on other constructs included unpublished dissertations and own unpublished data (e.g., Konrath et al., 2011, 2014; Twenge, 2001). Thus, the results of previous meta-analyses may have been threatened by publication bias issues, which were, however, typically not assessed in previous cross-temporal meta-analyses. To address these issues, in this meta-analysis, we included published studies, unpublished dissertations, own unpublished data and unpublished data that were requested from other researchers via mailing lists and social media (see below for more details). Additionally, most previous studies on changes in loneliness over historical time included samples from one country only (e.g., only from China or the United

States). Consequently, these studies were not able to examine spatial differences in the change in loneliness over historical time, and their results may not be generalizable to other countries. Taken together, this meta-analysis resolves several theoretical and methodological issues of previous cross-temporal meta-analyses and, consequently, provides a more robust picture of changes in loneliness among emerging adults over historical time.

In this study, we statistically aggregated data of several hundreds of samples that were collected over the last 40 years. Cross-temporal meta-analyses test the correlation of the mean loneliness scores from the most frequently used loneliness measure with the year of data collection, weighted for sample size. The most frequently used measure of loneliness in (emerging) adults was introduced in the late 1970s: The University of California Los Angeles (UCLA) loneliness scale. The UCLA loneliness scale is a 20-item questionnaire measuring the general perception of social isolation and dissatisfaction with one's social interactions (Russell et al., 1978). Over the years, different revised or short versions of this scale have been developed (e.g., Hughes et al., 2004; Russell, 1996; Russell et al., 1980). Revisions of the UCLA loneliness scale were devised to improve psychometric features such as measurement invariance and especially the more recently developed short forms (e.g., Hays & DiMatteo, 1987; Hughes et al., 2004; Richter & Weinhardt, 2013; Wu & Yao, 2008) selected items that worked particularly well in contemporary samples. In the present meta-analysis, we included all different versions of the UCLA loneliness scale. Thus, we aimed to tackle possible variations in the psychometric features of different loneliness measures by also including the most recent scale versions.

Methods

The literature search, inclusion criteria, coding, and meta-analytic procedure used in this meta-analysis were preregistered via the Open Science Framework (OSF): https://osf.io/eu3c7.

Literature Search

Standardized Literature Search

We conducted a standardized literature search using the electronic search engines PsycINFO and ERIC in May 2019. The following search terms were applied in abstracts, titles, table of contents, tests, measures, key concepts, and age groups: (Lonel* AND (student* OR college OR university OR undergrad* OR "emerging adult*" OR "young adult*")). The starred search terms allowed us to identify variants of the respective keyword; for example, by using the term Lonel*, we could identify studies using the terms loneliness, lonely, lonelier, or loneliest. In sum, the standardized literature search identified 4,580 studies.

Requesting Unpublished Data

To avoid publication bias issues, we additionally solicited unpublished work and appropriate published work that might not be found by our keywords via email (i.e., by contacting *Society for Personality and Social Psychology* (SPSP) and *Deutsche Gesellschaft für Psychologie* (DGPs) researchers) and Twitter. Our request for unpublished data sets resulted in another 39 studies that met our inclusion criteria.

Inclusion Criteria

The search was restricted to empirical studies published in English or German. Studies with college student samples and those with non-student samples, whose participants were within the age range of 18 to 29 years, were included. Only studies measuring loneliness with the UCLA loneliness scale (Russell, 1996; Russell et al., 1980) were included in our main analyses. We statistically assessed the robustness of the change in loneliness over historical time across the different scale versions and whether the reliability of the scales and the number of items is related

to the loneliness means. We preregistered to also examine whether loneliness scores obtained from the De Jong Gierveld loneliness scale (De Jong Gierveld & Kamphuis, 1985) have changed over historical time. However, only a small number of included studies used this scale ($k = 16^{1}$). Hence, we were not able to conduct reliable analyses for this scale. Our final database, therefore, refers to the studies that used the UCLA loneliness scale.

Studies were excluded if they selected participants based on criteria relating to the loneliness scale (e.g., scoring high or low in loneliness) or experimentally manipulated loneliness. For longitudinal studies, only the loneliness values of the first measurement point were included. If the same sample was used in different studies, only the study with a larger sample size was included. Only studies that provided the sample size, loneliness score, standard deviation, and theoretical range of the respective loneliness scale were included. If one or more of those values were missing, the corresponding authors were invited via email to provide this information. There was no selection for the mental health status of the sample.

Coding Procedure

Screening for Eligibility (Step 1a and 1b)

In Step 1a, we pre-screened the abstracts of all 4,580 studies found during the standardized literature search for eligibility. During pre-screening, only those studies were excluded that clearly did not meet the inclusion criteria based on the abstract and title. In total, 2,618 studies were excluded during pre-screening. An overview of the frequencies of the reasons for exclusions can be found in Table S1 (supplementary material). The remaining 1,962 studies were again consulted in Step 1b.

¹ One article reported values for both the UCLA loneliness scale and the De Jong Gierveld loneliness scale. In the final analyses, only the UCLA loneliness scale scores from this article were included.

In Step 1b, full texts were consulted to decide about the inclusion and exclusion of studies. Half of the studies were double-coded by a trained independent coder. The intercoder agreement was good (IA = 92%), calculated as 100*(number of consistently included studies/number of all double coded studies). In Step 1b, we further excluded 1,230 studies resulting in 732 studies that were again consulted in Step 2. Added to these studies were the 39 unpublished studies that were retrieved via email. The final database for Step 2 coding was, accordingly, 771 studies. An overview of the frequencies of the reasons for exclusions in Step 1b can be found in Table S2 (supplementary material).

Coding of Full-Text Articles (Step 2)

In Step 2, we coded the mean, the corresponding standard deviation (*SD*), the sample size (*N*), the year of publication, or, if reported, the year of data collection. As preregistered, for studies in which the year of data collection was not reported, we estimated it using the year of publication minus two years. A similar procedure has been used elsewhere (Curran & Hill, 2017). Moreover, the study characteristics presented in Table 2 were coded as covariates and for further subgroup analyses.

In Step 2, all studies were coded by the first author. Due to a large number of included studies, the double coding was split between three trained coders (one postdoctoral researcher, one postgraduate student, and one undergraduate student). Intercoder agreement between each of the double-coders and the first author was above 90% for study inclusion. Intercoder agreement for all coded characteristics was between 77% and 97%, depending on the specific characteristic. The disagreement between the coders was resolved by consulting the original article and by discussion.

We excluded 426 studies in Step 2 for the following reasons: 333 studies for not providing the mean, the *SD*, or the *N* neither in the article nor via email, 66 studies for using a sample that has been

used in another included study, 16 studies for measuring loneliness with the DJG-LS instead of the UCLA loneliness scale, seven studies for using an inappropriate sample (i.e., not within the age range of 18-29 years if it was no college student sample), three studies for using an inappropriate scale scoring procedure (i.e., coding higher values on the scale as lower loneliness), and 1 study for experimentally manipulating loneliness. In cases in which necessary information for inclusion of an article (i.e., missing mean, *SD*, *N*, or year of publication/data collection) was not available in the published article, the corresponding authors were contacted via email. In total, we requested information regarding 356 studies. For 112 studies, we received the requested information and were able to include these studies. The final database comprised 449 means from 345 studies with 437 independent samples and a total of 124,855 participants. A flow diagram demonstrating the assessment of study eligibility is provided in Figure 1. We provide an overview of all study characteristics for each included study via the OSF: https://osf.io/mp5xh/.

Data Preparation

The UCLA loneliness scale was scored differently across studies. To obtain scores that were comparable across studies, mean loneliness scale scores and their corresponding standard deviation (*SD*) were converted into the percent of maximum possible (POMP) scores (Cohen et al., 1999; Johnson & Eagly, 2014):

$$POMP_{Mean} = \frac{\text{(observed score - possible minimum score of scale)}}{\text{(possible maximum score of scale - possible minimum score of scale)}} \times 100$$

$$POMP_{SD} = \frac{SD}{\text{(possible maximum score of scale - possible minimum score of scale)}} \times 100$$

POMP scores are linear transformations of the original scores. Thus, the test statistics resulting from statistical analysis and the differences in *SD* remain constant across transformations. To test

the robustness of our findings, we also estimated a model that was based only on studies using the original 20-item version of the UCLA loneliness scale (see supplementary material).

Meta-Analytic Procedure

We followed the meta-analytical procedure used in previous cross-temporal meta-analyses (e.g., Clark et al., 2015; Curran & Hill, 2017; Konrath et al., 2011). As preregistered, we first plotted the loneliness scale POMP scores against the year of data collection using a LOESS curve (Figure 2). The visualization showed that the relation between the loneliness scale scores and the year of data collection was nearly linear. We, therefore, estimated a linear meta-regression model in which loneliness scores were predicted by the year of data collection. To receive a better estimate of the population score, we weighted scores by sample size.

As some of the included studies reported multiple relevant effect sizes (e.g., loneliness scores separately by gender) and studies were nested in years of data collection, effect sizes were statistically dependent (Hedges et al., 2010). Random-effects meta-regression models rely on the assumption that all included effect sizes are independent. Hence, RVE was used for adjusting the standard errors of the effect sizes and accounted for dependency (Tanner-Smith et al., 2016). We used random-effects meta-regression models to allow for between-sample residual heterogeneity. The magnitude of heterogeneity between study-average effects was assessed with τ^2 (Deeks et al., 2008). Additionally, I^2 was used to indicate the proportion of variance due to variability in true effects rather than sampling error (Borenstein et al., 2017). We used the *robu* function available in the R package "robumeta" (Fisher et al., 2017) to account for the dependency of effect sizes.

Estimation of Changes in Loneliness Over Historical Time

To estimate changes in loneliness over historical time, we used the predicted loneliness scores derived from the following regression equation: $y = \beta x + c$, where y is the predicted loneliness score, β is the unstandardized regression coefficient, c is the regression intercept, and x is the year of data collection. To examine the magnitude of change, we used this equation to compare predicted loneliness levels from 1976 (the earliest available study) with predicted loneliness levels from 2019 (the most recent available study). We divided changes in loneliness by the average standard deviation reported in the studies to represent the effect size (Cohen's d) in standard deviation units. Similar cross-temporal meta-analytic procedures have been used in previous studies (e.g., Clark et al., 2015; Curran & Hill, 2017; Twenge, 2000).

Controlling for Covariates and Estimation of Subgroup Analyses

The partly contradictory results of previous cross-temporal meta-analyses regarding the change in loneliness over historical time might be explained by differences among the included samples. We used continent as a rough approximation for regional differences in norms, values, socialization histories, and other factors to adjust for the possibility that changes in loneliness are explained by such culturally shared experiences. Aggregation at the continental level was the only feasible regional unit. Otherwise, there would have been too few studies per regional unit. To test whether the change in loneliness over historical time differs among samples from different continents, we first conducted subgroup analyses. We estimated the above-mentioned meta-regressions in the subgroup of studies conducted with American, European, and Asian samples. As the total number of included studies with African (k = 4) and Oceanian (i.e., Australia and New Zealand; k = 16) samples were too small to estimate robust meta-regression coefficients, these studies were not included in

the subgroup analyses. Furthermore, we examined whether loneliness is related to the sample type (student sample vs. other samples). Other samples included clinical, forensic, and community samples. These categories were combined for the analysis because only a few studies used clinical and forensic samples. Moreover, we examined whether loneliness is related to the proportion of females, the number of items in the loneliness measure, and article type (journal article, dissertation, unpublished study). We performed these analyses by adding these variables as control variables to our random-effects meta-regression models.

Moderator analyses

To test whether the change in loneliness over historical time is moderated by study or sample characteristics, we estimated meta-regression models in which loneliness was predicted by the year of data collection, a specific study or sample characteristic, and the interaction term between the year of data collection and the respective study or sample characteristic. A statistically significant interaction term would indicate a moderating effect of the study or sample characteristic. These moderator analyses were not preregistered.

As mentioned earlier, it is conceivable that the change in loneliness over historical time did not occur in the same way in all parts of the world, leading to high heterogeneity in the effects. Including relevant spatiotemporal information can help explaining heterogeneity in effect sizes that could not be explained by other study or sample characteristics considered in this meta-analysis (Johnson et al., 2017). In our cross-temporal meta-analysis, we coded the year of data collection as an indicator of the historical time as well as the country of origin of the sample. The coding of these two variables (space and time) allowed us to merge our study-level meta-analytic dataset with further external information retrieved from a spatiotemporal database of environmental conditions. Thus, we were

able to explore whether environmental conditions (i.e., regional-level characteristics) affect the change in loneliness over historical time. We used the spatiotemporal database of Gapminder (https://www.gapminder.org/data/) as recommended in Johnson et al. (2017). The database is freely available and especially suited for our purposes as it contains nearly complete data on the environmental conditions of interest over the historical period examined in this meta-analysis. We used the regional-level population growth, degree of urbanization, and income inequality as spatiotemporal moderators in our analysis because these variables have been found to explain variance in loneliness in previous research (Buecker, Ebert, et al., 2020; MacDonald et al., 2020; Yan et al., 2014). Population growth was measured in annual percent, the degree of urbanization per nation was operationalized by the percent of the urban population of the total population, and the income inequality was indexed by the Gini coefficient. Note that these analyses were suggested during the peer review process and thus were not preregistered. Because the existing body of research on the relation between regional-level characteristics (specifically between-nations rather than within-nations) is still very sparse, we treated these analyses as exploratory and did not formulate a priori hypotheses.

Results

Descriptive Statistics

In total, we included k_E = 449 means from k = 345 studies with N = 124,855 participants measuring loneliness with the UCLA loneliness scale in emerging adults. Due to a large number of included studies, a full reference list of these studies is provided in the supplementary material. The data of the included studies were collected from 1976 until 2019. We included data from 307 peer-reviewed studies, 12 dissertations, and 26 unpublished data sets. The average proportion of females across all independent samples was 60.61% (SD = 28.68), ranging from 0% to 100%. The average

age of the samples was 20.81 years (SD = 1.96), ranging from 17.62 to 31.64. About 90% of the included samples were comprised of students. About 3% were clinical samples, about 5% were community samples, and one study used a forensic sample. The majority of the studies included in this meta-analysis were conducted with (North) American (k = 192), followed by Asian (k = 93), European (k = 64), Oceanian (k = 16), and African (k = 4) samples.

Overall Results

We first estimated a simple random-effects meta-regression model including the year of data collection (time) as a single covariate for all studies using the UCLA loneliness scale (k = 345). The meta-regression coefficient for time was positive (β = 0.224, 95% CI [0.138, 0.309]), which is consistent with the interpretation that emerging adults become lonelier over historical time (see Figure 3). The unstandardized β = 0.224 represents the change in loneliness POMP scores per calendar year. Heterogeneity in effect sizes was large (I^2 = 99.29, τ^2 = 121.26). The observed increase in loneliness over historical time corresponds to an effect size of 0.56 standard deviations on the UCLA loneliness scale over the 43-year period of study (from 1976 to 2019) and to an approximate increase of 0.14 standard deviations every ten years.

It is also apparent that the majority of all data were collected after the year 2000 (k_E = 365 means across all continents). The estimation of the change in loneliness before the year 2000 (k_E = 81 means across all continents) is, therefore, less reliable, which can be seen in the larger confidence intervals for the predicted values prior to this year (Figure 3). For studies that collected their data before 2000, the meta-regression coefficient for time was negative but not statistically significant (β = -0.104, 95% CI [-0.348, 0.139]). For studies that collected their data after 2000, however, the meta-regression coefficient for time was positive and statistically significant (β = 0.430, 95% CI [0.172,

0.687]). The relatively flat loneliness curve from 1976 until 2000 and the following increase from 2000 onwards is also depicted in the LOESS curve in Figure 2. Because others have argued that loneliness may have increased when the smartphone (i.e., a mobile phone with Internet access) has gained market saturation around 2012 (Twenge et al., 2018), we repeated our analysis using studies that collected their data after 2012 ($k_E = 178$). No significant increase in loneliness was found for studies that collected their data after 2012 ($\beta = -0.061$, 95% CI [-1.160, 1.030]), indicating that although an overall increase in loneliness since 1976 has been detected, loneliness remained relatively stable during the last years.

Controlling for Demographic Variables

To control for demographic and study-specific variables, we estimated separate random-effects meta-regression models of loneliness by including continuous or dummy-coded covariates in addition to the year of data collection. To receive a meaningfully interpretable zero point, we centered the year of data collection on the mean year (M = 2007.52, SD = 9.79) in these models. The following effects, therefore, always apply to studies with a mean year of data collection.

Loneliness scores were, on average, significantly lower in European samples (β = -7.450, 95% CI [-10.691, -4.209]) than in American samples (reference category). We did not find significant differences between American samples (reference category) and Asian samples (β = 0.001, 95% CI [-2.813, 2.816]). Due to the low number of studies using samples from Africa or Oceanian, we did not compare their loneliness scores with the reference category. Moreover, we found no statistically significant difference between student samples and other samples, including clinical, forensic, and community samples (β = 0.679, 95% CI [-3.576, 4.934]). We grouped these samples together as the number of studies using such samples was very small.

The proportion of females (β = -0.001, 95% CI [-0.030, 0.029]), the average mean age of the sample (β = 0.075, 95% CI [-0.676, 0.825]), the number of items in the loneliness measure (β = 0.090, 95% CI [-0.103, 0.284]), and the scale reliability (β = 0.214, 95% CI [-23.425, 23.853]) were not significantly related to the loneliness scores. Additionally, no differences between loneliness scores from journal articles (reference category) and dissertations (β = 0.021, 95% CI [-4.960, 5.006]) or unpublished studies (β = -1.818, 95% CI [-7.020, 3.379]) were found. In all models, the meta-regression coefficient of time on loneliness scores remained significant after including covariates.

Subgroup Analyses

We examined whether the change in loneliness over historical time is present in samples from different continents via subgroup analyses (also see Figure 4). In American samples (β = 0.301, 95% CI [0.179, 0.422]), the change in loneliness over historical time was positive and statistically significant. In European samples (β = 0.133, 95% CI [-0.179, 0.445]) and Asian samples (β = 0.233, 95% CI [-0.014, 0.480]), the change in loneliness over historical time was also positive but not significantly different from zero. However, the change in loneliness over historical time did not significantly differ between continents, which is indicated by the overlapping 95% CIs (for more details see the next section on moderating effects).

Estimating Potential Moderating Effects

To estimate moderator effects, we ran meta-regression models including the interaction term between the year of data collection and various sample characteristics (i.e., continent, sample type, the proportion of females, age characteristics) to predict loneliness. These models were estimated separately for each potential moderator. The full model results of these meta-regressions are presented in the supplementary material. The change in loneliness over historical time in Asian

samples ($\beta_{time *Asia} = -0.046$, 95% CI [-0.325, 0.232]) and European samples ($\beta_{time *Europe} = -0.168$, 95% CI [-0.491, 0.155]) did not differ significantly from the change in loneliness over historical time in American samples (reference category). No statistically significant differences in the change in loneliness over historical time were found for student vs. other samples ($\beta_{time *sample} = -0.545$, 95% CI [-1.124, 0.035]). With an increasing proportion of females in the sample, the increase in loneliness over historical time got slightly stronger ($\beta_{time *females} = 0.002$, 95% CI [< 0.001, 0.004]). The average mean age of the sample did not affect the change in loneliness over historical time ($\beta_{time *mean age} = 0.041$, 95% CI [-0.040, 0.123]). We repeated this analysis for the minimum ($\beta_{time *age min} = 0.080$, 95% CI [-0.084, 0.243]) and maximum of the age range ($\beta_{time *age max} = 0.006$, 95% CI [-0.006, 0.017]) and for the *SD* corresponding to the average mean age of the sample ($\beta_{time *age SD} = 0.001$, 95% CI [-0.040, 0.042]). None of these further age characteristics did significantly affect the change in loneliness over historical time.

To examine whether spatiotemporal factors moderated the change in loneliness over historical time, we estimated separate meta-regression models for each spatiotemporal factor. In these models, loneliness was predicted by the year of data collection (grand-mean centered), the spatiotemporal factor (i.e., population growth in annual percent, percentage of the urban population, Gini coefficient; mean-centered within nations), and the interaction term between the year of data collection and the spatiotemporal factor. We report a sample equation of this meta-regression and the full model results in the supplementary material. The regression coefficient for the year of data collection was statistically significant and positive in all meta-regression models. This finding indicates that the increase in emerging adults' loneliness over historical time is robustly found after controlling for changes in the regional-level population growth, degree of urbanization, and income inequality that can vary by nation. None of the interaction terms were statistically significant,

indicating that the change in emerging adults' loneliness over historical time was not moderated by the spatiotemporal factors.

Publication Bias Analyses

Publication bias occurs whenever the studies that appear in the published literature are systematically unrepresentative of the population of all studies. To the best of our knowledge, traditional procedures to account for publication bias used in classic meta-analyses do not work for cross-temporal meta-analyses. In classic meta-analyses, the effect sizes of interest are typically mean differences or correlations. However, in cross-temporal meta-analyses like the present study, one is interested in changes in means over historical time. Thus, in the present study, the effect size of interest is a regression coefficient, reflecting the effect of year of data collection on loneliness. In traditional publication bias analyses that are suitable for dependent effect sizes (e.g., PET-PEESE using robust variance estimation; see Buecker, Simacek, et al., 2020), one would estimate a "basic" meta-regression model in which the effect size of interest (e.g., d or z-transformed r) is predicted by the standard error or the variance. One would then consider the intercept of the meta-regression an estimate of the unbiased effect size. In our case, however, this is not possible, because our "basic" cross-temporal meta-regression model necessarily already contains the year of data collection as a predictor. For this reason, other cross-temporal meta-analyses have not performed any formal publication bias analyses at all (e.g., Clark et al., 2015; Curran & Hill, 2017; Yan et al., 2014). We improve on this approach by including unpublished studies and controlling for study type in our analyses.

More specifically, we included the article type (journal article, dissertation, unpublished study) as a covariate in a meta-regression model, in which the loneliness score was predicted by the year

of data collection. As reported earlier, no significant differences between loneliness scores from journal articles (reference category) and dissertations or unpublished studies were found. The regression coefficient of the year of data collection (which represents the effect size in cross-temporal meta-analyses) remained statistically significant and unchanged compared to a model without the article type as a covariate. Moreover, we estimated a model that included an interaction term between the year of data collection and the article type. We found that the association between the loneliness score and the year of data collection did not differ significantly between journal articles and dissertations (β = 0.005, 95% CI [-1.178, 1.189]) or journal articles and unpublished studies (β = 0.090, 95% CI [-1.140, 1.320]). Note that journal articles were the reference category for the variable article type.

Moreover, publication bias issues are rather unlikely in cross-temporal meta-analyses. We do not assume that studies end up in the file drawer because the mean value for loneliness is systematically different from other studies. The mean is usually a "by-product" reported to describe a sample or to support other analyses that were the focus of the respective paper. We use this by-product in the present cross-temporal meta-analysis to investigate a new research question, that has not been addressed by any single study included in our meta-analysis. Taken together, we conclude that publication bias does not seem to be a major concern in the present cross-temporal meta-analysis.

Comparison With Previous Cross-Temporal Meta-Analyses on Loneliness

The results of the present meta-analysis show, on average, increasing levels of loneliness in emerging adults from 1976 until 2019. When looking at the continent level, loneliness increased in American samples, but no significant change in loneliness was found for Asian and European samples. These results contradict previous findings from earlier cross-temporal meta-analyses on

loneliness. Clark et al. (2015) found decreasing loneliness over time in U. S. emerging adults. Xin and Xin (2016) found increasing loneliness over time in Chinese emerging adults. However, both meta-analyses looked at different historical periods than the present meta-analysis. To test whether our meta-analytical database can replicate the findings from previous cross-temporal meta-analyses, we selected only those studies that collected their data within the time frame of the previous cross-temporal meta-analyses. Moreover, we selected only studies that used the 20-item UCLA loneliness scale because the other meta-analyses only included those. In the U. S. samples, the time frame in a previous cross-temporal meta-analysis was from 1978 until 2009 (Clark et al., 2015). In the Chinese samples, the time frame was from 2002 until 2011 (Xin & Xin, 2016).

Restricting our database to data collected between 1978 and 2009, using the 20-item UCLA loneliness scale in U. S. samples, we found no significant changes in loneliness over time (β = 0.034, 95% CI [-0.169, 0.236]). Although our estimated meta-regression coefficient was not statistically significant and the one found by Clark et al. (2015) was, the 95% CI reported in Clark et al. (2015) (95% CI [-0.160, -0.004]) fully overlapped with our 95% CI, indicating that the parameter estimates from the present study and the study by Clark et al. (2015) do not differ from each other. Note that our database comprised ten more samples than the original database by Clark et al. (2015), likely because we included unpublished data and requested missing information from authors. Moreover, our meta-analytical technique differed from the one used by Clark et al. (2015) as we handled the dependency of effect sizes using RVE. These differences may explain why our estimation and the one reported in Clark et al. (2015) differed in terms of statistical significance.

Unfortunately, we were not able to compare our database to the database used by Xin and Xin (2016), as the original paper did not report which articles were included (i.e., no reference list of the included articles was provided). In our database, only six studies measured loneliness using the 20-

item UCLA loneliness scale in Chinese samples from 2002 until 2011. This number of studies was too small to test whether loneliness has changed over historical time in this time frame.

Discussion

This preregistered cross-temporal meta-analysis provides a rigorous and systematic examination of changes in loneliness in emerging adults from the late 1970s until 2019. Our results showed that across continents, loneliness in emerging adulthood linearly increased over the last 43 years. In contrast to previous cross-temporal meta-analyses, we did not limit our samples to college students from a specific country but included emerging adults from all over the world. Moreover, we use a statistical approach that allowed the inclusion of different versions of the UCLA loneliness scale. Previous cross-temporal meta-analyses only included studies using one specific scale version, which limits the number of included studies and, consequently, the statistical power.

When looking at changes in emerging adults' loneliness by continent, significant increases were found for North American samples but not for European and Asian samples, where the regression coefficient was also positive but not significantly different from zero. However, when explicitly testing whether the change in loneliness over historical time differs between North American samples and European or Asian samples, these moderator analyses were non-significant. Since the number of studies with European or Asian samples was substantially lower than the number of studies with American samples, there was probably not enough power to detect the change in loneliness over historical time. However, there may also be cultural or societal differences between different countries and continents that could be further examined in future research, and that might explain different change patterns in loneliness over historical time.

Contrary to the idea that loneliness has sharply increased since smartphones gained market saturation (in about 2012; Twenge et al., 2018), our data showed that loneliness in emerging adults

remained relatively stable since 2012 but gradually increased when looking at longer periods (i.e., from 1976 until 2019). It, therefore, seems unlikely that the increased smartphone use has led to increases in emerging adults' loneliness. However, other societal developments since the late 1970s, such as greater mobility and fragmentation of social networks, may explain increases in emerging adults' loneliness over historical time. Since our meta-analysis cannot provide information on other age groups such as children and adolescents, the role of smartphone use on loneliness could be different in other age groups.

Moreover, the widespread use of the internet more generally since the turn of the millennium could be a factor that is relevant for changes in loneliness since that time (as depicted in Figure 2). However, due to these different, partly related historical developments, it is difficult to pinpoint the exact mechanisms explaining the changes in loneliness over historical time. For example, there has been a tremendous amount of discussion on potential beneficial or harmful effects of the internet as a driver for changes in different facets of social life (e.g., Appel et al., 2020; Gross et al., 2002; Kraut et al., 1998; Song et al., 2014; Tyler, 2002). However, it has also been argued that the internet has "created a new way of doing old things, rather than being a technology that changes the manner in which people live their lives" (Tyler, 2002, p. 195). Moreover, the phenomenon of cyberbullying concerned the popular press, the research community, educators, and parents since the internet exists (Olweus, 2012). However, in school students, empirical evidence suggests that cyberbullying is a low-prevalence phenomenon that did not increase over time (Olweus, 2012). Future research may examine whether cyberbullying in emerging adults has changed in a similar way as loneliness over historical time.

As we mentioned earlier, recent cohorts of emerging adults have been characterized by a higher prevalence of depression and suicidality (Twenge, 2017). The observed increase in loneliness in the

present meta-analysis could also be driven by increases in depression. However, loneliness is often a prelude to depression and not a consequence of depression (Cacioppo et al., 2006, 2010). Therefore, the causal direction of this effect could be the other way around. Future research may explicitly examine the coupled change in loneliness and depression in emerging adults over historical time.

The majority of studies on changes in older adult's loneliness found rather stable loneliness levels over historical time (see Table 1). For emerging adults, our meta-analysis showed that, overall, loneliness levels linearly increased over time. As the results for older adults and emerging adults are opposing, it raises the question of what is particularly characteristic of emerging adulthood in terms of social relationships. Has it become more difficult to build meaningful and fulfilling relationships in emerging adulthood, but not in old age? It goes beyond the scope of this meta-analysis to answer this question conclusively. However, whatever the reason, it appears that today's emerging adults perceive their social relationships as less fulfilling, which is reflected in increased levels of loneliness. This finding has practical implications for policymakers, who tend to view loneliness as an issue that only affects older people. Although the results of this meta-analysis do not support the notion that contemporary societies are facing a loneliness epidemic, the rising trend in emerging adults' loneliness should nevertheless be seen as a warning. Our meta-analysis clearly shows that emerging adults are also affected by loneliness and that loneliness could even become an increasing problem in this age group. Although a recent meta-analysis has summarized intervention studies used among young people below age 25 (Eccles & Qualter, 2020), the authors state that those interventions rarely target youth who actually report being lonely but instead those viewed to be at risk, for example, youth with health concerns. Moreover, those interventions for young people were rarely designed specifically for loneliness, and thus, loneliness was mostly a secondary outcome in these

studies. Loneliness in emerging adults is a public health issue due to its numerous negative health consequences (Matthews et al., 2018; Vanhalst et al., 2012). In combating this public health issue, campaigns and interventions against loneliness should therefore not exclusively focus on loneliness in old age but rather understand loneliness as an issue that can occur in different phases of life. Moreover, interventions for emerging adults should target loneliness as an independent and important issue rather than a by-product of other conditions or problems (Eccles & Qualter, 2020).

Methodologically, it should be noted that heterogeneity in effect sizes was large. This is a common finding in cross-temporal meta-analyses (e. g., Curran & Hill, 2017) and was likely due to (a) the broad period of data retrieval (43 years) and (b) data collected from different research groups on different continents using different UCLA scale versions. A significant moderator in this cross-temporal meta-analysis was the proportion of females in the sample. Our results showed that the higher the proportion of females in the sample, the greater the increase in loneliness over historical time. Future research may focus more closely on whether a change in the social role of (young) women over the last decades or other factors are involved here. Moreover, whereas most studies included in this meta-analysis considered gender identity as binary, future research should incorporate more nuanced assessments of gender identity and investigate its relationship with loneliness.

Moreover, we included relevant spatiotemporal factors that have the potential to explain variability in the study results that could not be explained by other sample or study characteristics. However, it has to be noted that these spatiotemporal analyses are not without problems. First, in our meta-analytic database and in the spatiotemporal database of Gapminder, information was coded at the national level, and therefore, these databases lack spatial precision. Within-country variations in the change in loneliness over historical time and in the spatiotemporal factors could

not be considered. Second, the spatiotemporal database of Gapminder is more limited temporally compared to the studies on loneliness included in this meta-analysis. Especially for the Gini index, fewer data points were available in the Gapminder database than in our meta-analytic database. Third, the possibilities to include further spatiotemporal factors in the analysis are almost endless. In the present study, we focused on three spatiotemporal factors that were found to be related to loneliness in previous research. However, future research might explore other spatiotemporal factors associated with loneliness based on the meta-analytic database we made publicly available via the OSF.

Moreover, this study used the year of publication minus two years as an approximation of the year of data collection. This is not always accurate, which may affect the results of the present meta-analysis. Whenever the actual survey year was reported, we used this information. We encourage scientists to indicate in their articles when and where the data was collected to make analyses like the one in this study more accurate.

Limitations and Future Directions

Although the current cross-temporal meta-analysis had multiple strengths, such as a large sample including unpublished data, using robust variance estimation for accounting for the dependency of effect sizes, and examining change over historical time in different subgroups, the present work has several limitations that may guide future research.

First, an increase in loneliness levels in emerging adults could be explained by both cohort and period effects. Generally, *cohort effects* (sometimes also referred to as "generation effects" or "secular trends") are conceptualized as variations in the risk of the occurrence of an outcome according to the year of birth (Keyes et al., 2010). *Period effects* are conceptualized as variations among individuals based on the impact of historical events that affect people across ages. As a

loneliness-related example, one might imagine that the availability and accessibility of new communication technology increased in the general population leading to changes in loneliness (e.g., Twenge, 2017) in all people across age (period effect). However, the effect of new communication technology could also only affect emerging adults' loneliness in recent years because of higher consumption rates among this age group relative to other age groups (cohort effect). In this meta-analysis, we did not aim to separate cohort and period effects due to the confounding of the two. It remains a task for future research to compare changes in loneliness in emerging adults over historical time with changes in other age groups over a similar period to examine whether the trend found in this meta-analysis describes changes in all people across age (period effect) or changes that are specific for cohorts of emerging adults (cohort effect).

Second, our finding of an overall increasing trend in emerging adults' loneliness is rather descriptive, and we were unable to explore all relevant mechanisms explaining the increasing trend in loneliness in this meta-analysis. It is difficult to empirically test whether developments such as increasing smartphone use or the trend towards more mobility in everyday life explain increases in loneliness. Our results show that loneliness does not develop parallelly to a rather abrupt increase in exhaustive smartphone use from 2012 onwards. However, even a parallel development of the two constructs would not be a robust test for the fact that one causes the other. Since the question of causality in the relation between smartphone use and loneliness has not yet been clarified at the individual level (Nowland et al., 2017; Orben & Przybylski, 2019; Twenge et al., 2018), no statement can be made as to whether this is a mechanism of the found increase in loneliness over historical time. Overall, further research on factors contributing to and maintaining loneliness is needed. Moreover, while this meta-analysis focused on overall loneliness, future research may differentiate

between social and emotional well-being or may focus on specific social relationships such as the dissatisfaction with one's friendships vs. the dissatisfaction with one's romantic relationships.

Third, we compared the change in loneliness over historical time among continents. This continental comparison is the first important step to better understand which societal changes are associated with changes in loneliness because society has changed differently (e.g., in different tempos) in different parts of the world. However, continental comparisons are very broad. In future studies, it might be worthwhile to conduct country-level comparisons or to apply an emic approach by looking at differences within countries (e.g., Stankov & Lee, 2009). For example, future research may examine whether loneliness levels have changed differently in urban compared to rural areas within and across countries.

Fourth, future research should test whether the different UCLA loneliness scale variants show measurement invariance over historical time (for an example on measurement invariance testing for a narcissism measure over historical time, see Wetzel et al., 2017) and across different countries or continents. In our meta-analysis, such measurement invariance testing is impossible. It is important to reflect on whether emerging adults fill out the loneliness items of the UCLA scale differently today than in the past. We argue that for the overall interpretation of our findings, it is not likely that we should be concerned about this issue. Admittedly, it is possible that social desirability or stigma, for example, have decreased over historical time resulting in people scoring higher on loneliness today than in the past. In the present meta-analysis, we cannot completely eliminate this possibility. However, we argue that the other explanations for an increase in emerging adults' loneliness over historical time described in this manuscript are more likely. Especially when considering that in other age groups no such increases have been found.

Moreover, we argue that if people are filling out loneliness measures in different ways in recent history compared to decades ago, for example, because they interpret items differently, the nomological network of loneliness should have been changed over historical time. To address this issue, we looked at the data available on the OSF from a recently published meta-analysis on loneliness and broader personality traits by Buecker, Maes, et al. (2020; https://osf.io/gt7qa/). Although historical changes in the nomological network of loneliness were not discussed in this published meta-analysis, we used their publicly available data for this purpose. From this database, we selected studies that examined the relation between neuroticism and overall loneliness. We then correlated the year of publication of the article (ranging from 1982 to 2018) with the effect size coded in that meta-analysis. The correlation was not statistically significant (r = -.11, p = .19). We repeated the analysis for the other Big Five personality traits. All other analyses were also not statistically significant with p-values > .05, indicating no systematic relationship between the year of publication and the correlations between loneliness and broader personality traits (which we used as indicators of the nomological network of loneliness). Future research could examine further indicators of changes in the nomological network of loneliness over historical time or use longitudinal data from different cohorts of emerging adults to test for measurement invariance across cohorts (Hawkley et al., 2016).

Conclusion

This meta-analysis showed that across 345 included studies, loneliness in emerging adults gradually increased from 1976 to 2019. Over these 43 years, loneliness scores measured with the UCLA loneliness scale increased by 0.56 standard deviations. As there is no doubt that loneliness is a serious health risk on the individual level and associated with high economic costs on the society level (Mihalopoulos et al., 2020), the increasing loneliness levels in emerging adults are a warning

signal. Emerging adults of today seem to be lonelier than emerging adults several decades ago. Consequently, the results of the present meta-analysis imply that emerging adults should not be overlooked when designing interventions against loneliness. Having said that, the frequently-used term *loneliness epidemic* seems exaggerated as the change in loneliness over historical time was rather small.

References

- Appel, M., Marker, C., & Gnambs, T. (2020). Are social media ruining our lives? A review of meta-analytic evidence. Review of General Psychology, 24(1), 60–74. https://doi.org/10.1177/1089268019880891
- Arnett, Jeffrey J. (2004). Emerging adulthood: The winding road from the late teens through the twenties.

 Oxford University Press.
- Arnett, Jeffrey J, Žukauskienė, R., & Sugimura, K. (2014). The new life stage of emerging adulthood at ages 18–29 years: Implications for mental health. *The Lancet Psychiatry*, *1*(7), 569–576. https://doi.org/10.1016/S2215-0366(14)00080-7
- Barreto, M., Victor, C., Hammond, C., Eccles, A., Richins, M. T., & Qualter, P. (2020). Loneliness around the world: Age, gender, and cultural differences in loneliness. *Personality and Individual Differences*, 110066. https://doi.org/10.1016/j.paid.2020.110066
- Barry, C. M., Madsen, S. D., Nelson, L. J., Carroll, J. S., & Badger, S. (2009). Friendship and romantic relationship qualities in emerging adulthood: Differential associations with identity development and achieved adulthood criteria. *Journal of Adult Development*, *16*(4), 209–222. https://doi.org/10.1007/s10804-009-9067-x
- Beadle, J. N., Keady, B., Brown, V., Tranel, D., & Paradiso, S. (2012). Trait empathy as a predictor of individual differences in perceived loneliness. *Psychological Reports*, 110(1), 3–15. https://doi.org/10.2466/07.09.20.PR0.110.1.3-15
- Beutel, M. E., Klein, E. M., Brähler, E., Reiner, I., Jünger, C., Michal, M., Wiltink, J., Wild, P. S., Münzel, T., Lackner, K. J., & Tibubos, A. N. (2017). Loneliness in the general population: Prevalence, determinants and relations to mental health. *BMC Psychiatry*, 17(1), 1–7. https://doi.org/10.1186/s12888-017-1262-x

- Borenstein, M., Higgins, J. P. T., Hedges, L. V., & Rothstein, H. R. (2017). Basics of meta-analysis: 12 is not an absolute measure of heterogeneity. *Research Synthesis Methods*, 8(1), 5–18. https://doi.org/10.1002/jrsm.1230
- Borschel, E., Zimmermann, J., Crocetti, E., Meeus, W., Noack, P., & Neyer, F. J. (2019). Me and you in a mobile world: The development of regional identity and personal relationships in young adulthood. *Developmental Psychology*, 55(5), 1072–1087. https://doi.org/10.1037/dev0000677
- Bosma, H., Jansen, M., Schefman, S., Hajema, K. J., & Feron, F. (2015). Lonely at the bottom: A cross-sectional study on being ill, poor, and lonely. *Public Health*, *129*(2), 185–187. https://doi.org/10.1016/j.puhe.2014.11.016
- Boyd, D. (2014). It's complicated: The social lives of networked teens. Yale University Press.
- Buecker, S., Ebert, T., Götz, F. M., Entringer, T. M., & Luhmann, M. (2020). In a Ionely place:

 Investigating regional differences in Ioneliness. *Social Psychological and Personality Science*,

 194855062091288. https://doi.org/10.1177/1948550620912881
- Buecker, S., Maes, M., Denissen, J. J. A., & Luhmann, M. (2020). Loneliness and the Big Five personality traits: A meta-analysis. *European Journal of Personality*. https://doi.org/10.1002/per.2229
- Buecker, S., Simacek, T., Ingwersen, B., Terwiel, S., & Simonsmeier, B. A. (2020). Physical activity and subjective well-being in healthy individuals: A meta-analytic review. *Health Psychology Review*, I–19. https://doi.org/10.1080/17437199.2020.1760728
- Cacioppo, J. T., Hawkley, L. C., & Thisted, R. A. (2010). Perceived social isolation makes me sad: Five year cross-lagged analyses of loneliness and depressive symptomatology in the Chicago Health, Aging, and Social Relations Study. *Psychology and Aging*, 25(2), 453–463. https://doi.org/10.1037/a0017216.Perceived

- Cacioppo, J. T., Hughes, M. E., Waite, L. J., Hawkley, L. C., & Thisted, R. A. (2006). Loneliness as a specific risk factor for depressive symptoms: Cross-sectional and longitudinal analyses.

 *Psychology and Aging, 21(1), 140–151. https://doi.org/10.1037/0882-7974.21.1.140
- Clark, D. M. T., Loxton, N. J., & Tobin, S. J. (2015). Declining loneliness over time: Evidence from American colleges and high schools. *Personality and Social Psychology Bulletin*, 41(1), 78–89. https://doi.org/10.1177/0146167214557007
- Cohen, P., Cohen, J., Aiken, L. S., & West, S. G. (1999). The problem of units and the circumstance for POMP. *Multivariate Behavioral Research*, 34(3), 315–346. https://doi.org/10.1207/S15327906MBR3403
- Cohen, P., Kasen, S., Chen, H., Hartmark, C., & Gordon, K. (2003). Variations in patterns of developmental transmissions in the emerging adulthood period. *Developmental Psychology*, 39(4), 657–669. https://doi.org/10.1037/0012-1649.39.4.657
- Côté, J. E. (2006). Emerging adulthood as an institutionalized moratorium: Risks and benefits to identity formation. In Jeffrey Jensen Arnett & J. L. Tanner (Eds.), *Emerging adults in America:*Coming of age in the 21st century. (pp. 85–116). American Psychological Association.

 https://doi.org/10.1037/11381-004
- Curran, T., & Hill, A. P. (2017). Perfectionism is increasing over time: A meta-analysis of birth cohort differences from 1989 to 2016. *Psychological Bulletin*. https://doi.org/10.1037/bul0000138
- Dahlberg, L., Agahi, N., & Lennartsson, C. (2018). Lonelier than ever? Loneliness of older people over two decades. *Archives of Gerontology and Geriatrics*, 75(75), 96–103. https://doi.org/10.1016/j.archger.2017.11.004
- De Jong Gierveld, J., & Kamphuis, F. (1985). The development of a Rasch-type Ioneliness scale. *Applied Psychological Measurement*, 9(3), 289–299. https://doi.org/10.1177/014662168500900307

- Deeks, J. J., Higgins, J. P. T., & Altman, D. G. (2008). Analysing data and undertaking meta-analyses. In J. P. T. Higgins & S. Green (Eds.), Cochrane Handbook for Systematic Reviews of Interventions:

 Cochrane Book Series (pp. 243–296). Wiley.
- Eccles, A. M., & Qualter, P. (2020). Review: Alleviating loneliness in young people a meta-analysis of interventions. *Child and Adolescent Mental Health*, camh.12389.

 https://doi.org/10.1111/camh.12389
- Eloranta, S., Arve, S., Isoaho, H., Lehtonen, A., & Viitanen, M. (2015). Loneliness of older people aged 70: A comparison of two Finnish cohorts born 20 years apart. *Archives of Gerontology and Geriatrics*, 61(2), 254–260. https://doi.org/10.1016/j.archger.2015.06.004
- Fisher, Z., Tipton, E., & Zhipeng, H. (2017). Robumeta: Robust variance meta-regression. R package version 2.0. https://cran.r-project.org/package=robumeta
- Gerst-Emerson, K., & Jayawardhana, J. (2015). Loneliness as a public health issue: The impact of loneliness on health care utilization among older adults. *American Journal of Public Health*, 105(5), 1013–1019. https://doi.org/10.2105/AJPH.2014.302427
- Gross, E. F., Juvonen, J., & Gable, S. L. (2002). Internet use and well-being in adolescence. *Journal of Social Issues*, 58(1), 75–90. https://doi.org/10.1111/1540-4560.00249
- Hawkley, L. C., Browne, M. W., & Cacioppo, J. T. (2005). How can I connect with thee? Let me count the ways. *Psychological Science*, *16*(10), 798–804. https://doi.org/10.1111/j.1467-9280.2005.01617.x
- Hawkley, L. C., Buecker, S., Kaiser, T., & Luhmann, M. (2020). Loneliness from young adulthood to old age: Explaining age differences in loneliness. *International Journal of Behavioral Development*, 016502542097104. https://doi.org/10.1177/0165025420971048

- Hawkley, L. C., & Cacioppo, J. T. (2010). Loneliness matters: A theoretical and empirical review of consequences and mechanisms. *Annals of Behavioral Medicine*, 40(2), 218–227. https://doi.org/10.1007/s12160-010-9210-8
- Hawkley, L. C., Duvoisin, R., Ackva, J., Murdoch, J. C., & Luhmann, M. (2016). Loneliness in older adults in the USA and Germany: Measurement invariance and validation. *NORC Working Paper Series*. https://www.norc.org/PDFs/Working%20Paper%20Series/WP-2015-004.pdf
- Hawkley, L. C., Wroblewski, K., Kaiser, T., Luhmann, M., & Schumm, L. P. (2019). Are U.S. older adults getting lonelier?: Age, period, and cohort differences. *Psychology and Aging*.
- Hays, R. D., & DiMatteo, M. R. (1987). A short-form measure of loneliness. *Journal of Personality*Assessment, 51(1), 69–81.
- Hedges, L. V., Tipton, E., & Johnson, M. C. (2010). Robust variance estimation in meta-regression with dependent effect size estimates. Research Synthesis Methods, 1(1), 39–65. https://doi.org/10.1002/jrsm.5
- Helm, P. J., Jimenez, T., Bultmann, M., Lifshin, U., Greenberg, J., & Arndt, J. (2020). Existential isolation, loneliness, and attachment in young adults. *Personality and Individual Differences*, 159, 109890. https://doi.org/10.1016/j.paid.2020.109890
- Holt-Lunstad, J., Smith, T. B., Baker, M., Harris, T., & Stephenson, D. (2015). Loneliness and social isolation as risk factors for mortality: A meta-analytic review. *Perspectives on Psychological Science*, 10(2), 227–237. https://doi.org/10.1177/1745691614568352
- Howe, N. (2019, May 3). Millennials And The Loneliness Epidemic. *Fobes*. https://www.forbes.com/sites/neilhowe/2019/05/03/millennials-and-the-loneliness-epidemic/#53a7f1d27676

- Hughes, M. E., Waite, L. J., Hawkley, L. C., & Cacioppo, J. T. (2004). A short scale for measuring loneliness in large surveys: Results from two population-based studies. *Research on Aging*, 26(6), 655–672. https://doi.org/10.1146/annurev.neuro.31.060407.125627.Brain
- Hülür, G., Drewelies, J., Eibich, P., Düzel, S., Demuth, I., Ghisletta, P., Steinhagen-Thiessen, E., Wagner, G. G., Lindenberger, U., & Gerstorf, D. (2016). Cohort differences in psychosocial function over 20 years: Current older adults feel less lonely and less dependent on external circumstances. *Gerontology*, 62(3), 354–361. https://doi.org/10.1159/000438991
- Hunt, M. G., Marx, R., Lipson, C., & Young, J. (2018). No more FOMO: Limiting social media decreases loneliness and depression. *Journal of Social and Clinical Psychology*, 37(10), 751–768. https://doi.org/10.1521/jscp.2018.37.10.751
- Hutteman, R., Hennecke, M., Orth, U., Reitz, A. K., & Specht, J. (2014). Developmental tasks as a framework to study personality development in adulthood and old age. *European Journal of Personality*, 28(3), 267–278. https://doi.org/10.1002/per.1959
- International Telecommunication Union. (2021). *Individuals using the Internet (% of population)*. https://data.worldbank.org/indicator/IT.NET.USER.ZS
- Jaremka, L. M., Andridge, R. R., Fagundes, C. P., Alfano, C. M., Povoski, S. P., Lipari, A. M., Agnese, D. M., Arnold, M. W., Farrar, W. B., Yee, L. D., Carson III, W. E., Bekaii-Saab, T., Martin Jr., E. W., Schmidt, C. R., & Kiecolt-Glaser, J. K. (2014). Pain, depression, and fatigue: Loneliness as a longitudinal risk factor. *Health Psychology*, 33(9), 948–957. https://doi.org/10.1037/a0034012
- Johnson, B. T., Cromley, E. K., & Marrouch, N. (2017). Spatiotemporal meta-analysis: Reviewing health psychology phenomena over space and time. Health Psychology Review, 11(3), 280–291. https://doi.org/10.1080/17437199.2017.1343679

- Johnson, B. T., & Eagly, A. H. (2014). Meta-analysis of socialpersonality psychological research. In Handbook of research methods in social and personality psychology (2nd ed., pp. 675–707). Cambridge University Press.
- Kaniušonytė, G., Truskauskaitė-Kunevičienė, I., Žukauskienė, R., & Crocetti, E. (2019). Knowing Who You Are for Not Feeling Lonely? A Longitudinal Study on Identity and Loneliness. *Child Development*, 90(5), 1579–1588. https://doi.org/10.1111/cdev.13294
- Keyes, K. M., Utz, R. L., Robinson, W., & Li, G. (2010). What is a cohort effect? Comparison of three statistical methods for modeling cohort effects in obesity prevalence in the United States, 1971-2006. Social Science & Medicine (1982), 70(7), 1100–1108.
 https://doi.org/10.1016/j.socscimed.2009.12.018
- Killeen, C. (1998). Loneliness: An epidemic in modern society. *Journal of Advanced Nursing*, 28(4), 762–770. https://doi.org/10.1046/j.1365-2648.1998.00703.x
- Konrath, S. H., Chopik, W. J., Hsing, C. K., & O'Brien, E. (2014). Changes in adult attachment styles in American college students over time: A meta-analysis. *Personality and Social Psychology Review*, 18(4), 326–348. https://doi.org/10.1177/1088868314530516
- Konrath, S. H., O'Brien, E. H., & Hsing, C. (2011). Changes in dispositional empathy in American college students over time: A meta-analysis. *Personality and Social Psychology Review*, 15(2), 180–198. https://doi.org/10.1177/1088868310377395
- Kraut, R., Patterson, M., Lundmark, V., Kiesler, S., Mukophadhyay, T., & Scherlis, W. (1998). Internet paradox: A social technology that reduces social involvement and psychological well-being?

 American Psychologist, 53(9), 1017–1031. https://doi.org/10.1037/0003-066X.53.9.1017
- Kristof, N. (2019, November 9). Let's Wage a War on Loneliness. *The New York Times*. https://www.nytimes.com/2019/11/09/opinion/sunday/britain-loneliness-epidemic.html

- Leigh-Hunt, N., Bagguley, D., Bash, K., Turner, V., Turnbull, S., Valtorta, N., & Caan, W. (2017). An overview of systematic reviews on the public health consequences of social isolation and loneliness. *Public Health*, *152*, 157–171. https://doi.org/10.1016/j.puhe.2017.07.035
- Lempinen, L., Junttila, N., & Sourander, A. (2018). Loneliness and friendships among eight-year-old children: Time-trends over a 24-year period. *Journal of Child Psychology and Psychiatry*, 59(2), 171–179. https://doi.org/10.1111/jcpp.12807
- Lübke, C., & Erlinghagen, M. (2014). Self-perceived job insecurity across Europe over time: Does changing context matter? *Journal of European Social Policy*, 24(4), 319–336. https://doi.org/10.1177/0958928714538215
- Luhmann, M., & Hawkley, L. C. (2016). Age differences in loneliness from late adolescence to oldest old age. *Developmental Psychology*, 52(6), 943–959. https://doi.org/10.1037/dev0000117
- MacDonald, K. J., Willemsen, G., Boomsma, D. I., & Schermer, J. A. (2020). Predicting loneliness from where and what people do. *Social Sciences*, 9(4), 51. https://doi.org/10.3390/socsci9040051
- Matthews, T., Danese, A., Caspi, A., Fisher, H. L., Goldman-Mellor, S., Kepa, A., Moffitt, T. E., Odgers,
 C. L., & Arseneault, L. (2018). Lonely young adults in modern Britain: Findings from an epidemiological cohort study. *Psychological Medicine*.
 https://doi.org/10.1017/S0033291718000788
- Mihalopoulos, C., Le, L. K.-D., Chatterton, M. L., Bucholc, J., Holt-Lunstad, J., Lim, M. H., & Engel, L. (2020). The economic costs of loneliness: A review of cost-of-illness and economic evaluation studies. Social Psychiatry and Psychiatric Epidemiology, 55(7), 823–836.
 https://doi.org/10.1007/s00127-019-01733-7

- Mund, M., Freuding, M. M., Möbius, K., Horn, N., & Neyer, F. J. (2020). The stability and change of loneliness across the life span: A meta-analysis of longitudinal studies. *Personality and Social Psychology Review*, 1–29. https://doi.org/10.1177/1088868319850738
- Mund, M., Lüdtke, O., & Neyer, F. J. (2020). Owner of a lonely heart: The stability of loneliness across the life span. *Journal of Personality and Social Psychology*, 119(2), 497–516. https://doi.org/10.1037/pspp0000262
- Nowland, R., Necka, E. A., & Cacioppo, J. T. (2017). Loneliness and social internet use: Pathways to reconnection in a digital world? *Perspectives on Psychological Science*, 1–18. https://doi.org/10.1177/1745691617713052
- Nyqvist, F., Cattan, M., Conradsson, M., Näsman, M., & Gustafsson, Y. (2017). Prevalence of loneliness over ten years among the oldest old. *Scandinavian Journal of Public Health*, 45(4), 411–418. https://doi.org/10.1177/1403494817697511
- OECD. (2020). OECD Digital Economy Outlook 2020. OECD. https://doi.org/10.1787/bb167041-en
- Olweus, D. (2012). Cyberbullying: An overrated phenomenon? *European Journal of Developmental Psychology*, 9(5), 520–538. https://doi.org/10.1080/17405629.2012.682358
- Orben, A., & Przybylski, A. K. (2019). The association between adolescent well-being and digital technology use. *Nature Human Behaviour*, 3(2), 173–182. https://doi.org/10.1038/s41562-018-0506-1
- Pahl, R., & Pevalin, D. J. (2005). Between family and friends: A longitudinal study of friendship choice.

 The British Journal of Sociology, 56(3), 433–450. https://doi.org/10.1111/j.1468-4446.2005.00076.x

- Paulsen, J. A., Syed, M., Trzesniewski, K., & Donnellan, M. B. (2014). *Generational perspectives on emerging adulthood* (Jeffrey Jensen Arnett, Ed.; Vol. 1). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199795574.013.11
- Perlman, D., & Peplau, L. A. (1981). Toward a Social Psychology of Loneliness. In *Personal Relationships:*3. Relationships in Disorder (pp. 31–56). Academic Press.
- Pescosolido, B. A., & Rubin, B. A. (2000). The web of group affiliations revisited: Social life, postmodernism, and sociology. *American Sociological Review*, 65(1), 52–76. https://doi.org/10.2307/2657289
- Räsänen, P. (2006). Information society for all? Structural characteristics of internet use in 15

 European countries. European Societies, 8(1), 59–81.

 https://doi.org/10.1080/14616690500491423
- Richter, D., & Weinhardt, M. (2013). LS-S: Loneliness Scale-SOEP. In Psychologische und sozialwissenschaftliche Kurzskalen: Standardisierte Erhebungsinstrumente für Wissenschaft und Praxis (1st ed.). Mwv Medizinisch Wissenschaftliche Verlagsges.
- Rudolph, C. W., Costanza, D. P., Wright, C., & Zacher, H. (2019). Cross-temporal meta-analysis: A conceptual and empirical critique. *Journal of Business and Psychology*. https://doi.org/10.1007/s10869-019-09659-2
- Russell, D. W. (1996). UCLA Loneliness Scale (Version 3): Reliability, validity, and factor structure.

 Journal of Personality Assessment, 66(1), 20–40. https://doi.org/10.1207/s15327752jpa6601_2
- Russell, D. W., Peplau, L. A., & Cutrona, C. E. (1980). The revised UCLA loneliness scale: Concurrent and discriminant validity evidence. *Journal of Personality and Social Psychology*, 39(3), 472–480. https://doi.org/10.1037//0022-3514.39.3.472

- Russell, D. W., Peplau, L. A., & Ferguson, M. L. (1978). Developing a measure of loneliness. *Journal of Personality Assessment*, 42(3), 290–294.
- Settersten, R. A., Jr. (2011). Becoming adult: Meanings and markers for young Americans. In M. C. Waters, M. J. Carr, & J. Holdaway (Eds.), *Coming of age in America: The transition to adulthood in the twenty-first century* (pp. 169–190). University of California Press.
- Smeeding, T. M., & Phillips, K. R. (2002). Cross-National Differences in Employment and Economic Sufficiency. The ANNALS of the American Academy of Political and Social Science, 580(1), 103–133. https://doi.org/10.1177/000271620258000105
- Snell, K. D. M. (2017). The rise of living alone and loneliness in history. *Social History*, 42(1), 2–28. https://doi.org/10.1080/03071022.2017.1256093
- Song, H., Zmyslinski-Seelig, A., Kim, J., Drent, A., Victor, A., Omori, K., & Allen, M. (2014). Does Facebook make you lonely?: A meta analysis. *Computers in Human Behavior*, 36, 446–452. https://doi.org/10.1016/j.chb.2014.04.011
- Stankov, L., & Lee, J. (2009). Dimensions of cultural differences: Pancultural, ETIC/EMIC, and ecological approaches. *Learning and Individual Differences*, 19(3), 339–354. https://doi.org/10.1016/j.lindif.2008.09.003
- Tanner-Smith, E. E., & Tipton, E. (2014). Robust variance estimation with dependent effect sizes:

 Practical considerations including a software tutorial in Stata and SPSS. Research Synthesis

 Methods, 5(1), 13–30. https://doi.org/10.1002/jrsm.1091
- Tanner-Smith, E. E., Tipton, E., & Polanin, J. R. (2016). Handling complex meta-analytic data structures using robust variance estimates: A tutorial in R. *Journal of Developmental and Life-Course Criminology*, 2(1), 85–112. https://doi.org/10.1007/s40865-016-0026-5

- Trzesniewski, K. H., & Donnellan, M. B. (2010). Rethinking "Generation Me": A Study of Cohort Effects from 1976-2006. Perspectives on Psychological Science, 5(1), 58–75. https://doi.org/10.1177/1745691609356789
- Twenge, J. M. (2000). The age of anxiety? Birth cohort change in anxiety and neuroticism, 1952-1993.

 Journal of Personality and Social Psychology, 79(6), 1007–1021.

 https://doi.org/10.1097/MNH.0000000000000066
- Twenge, J. M. (2001). Birth cohort changes in extraversion: A cross-temporal meta-analysis, 1966-1993. Personality and Individual Differences, 30, 735–748.
- Twenge, J. M. (2008). Generation Me, the Origins of Birth Cohort Differences in Personality Traits, and Cross-temporal Meta-analysis. *Social and Personality Psychology Compass*, 2(3), 1440–1454. https://doi.org/10.1111/j.1751-9004.2008.00094.x
- Twenge, J. M. (2017). iGEN: Why today's super-connected kids are growing up less rebellious, more tolerant, less happy— and completely unprepared for adulthood and (what this means for the rest of us). Atria Books.
- Twenge, J. M., & Campbell, W. K. (2001). Age and birth cohort differences in self-esteem: A cross-temporal meta-analysis. *Personality and Social Psychology Review*, *5*(4), 321–344. https://doi.org/10.1207/S15327957PSPR0504_3
- Twenge, J. M., Gentile, B., DeWall, C. N., Ma, D., Lacefield, K., & Schurtz, D. R. (2010). Birth cohort increases in psychopathology among young Americans, 1938-2007: A cross-temporal meta-analysis of the MMPI. *Clinical Psychology Review*, 30(2), 145–154. https://doi.org/10.1016/j.cpr.2009.10.005
- Twenge, J. M., Joiner, T. E., Rogers, M. L., & Martin, G. N. (2018). Increases in depressive symptoms, suicide-related outcomes, and suicide rates among U.S. adolescents after 2010 and links to

- increased new media screen time. *Clinical Psychological Science*, *6*(1), 3–17. https://doi.org/10.1177/2167702617723376
- Twenge, J. M., Konrath, S., Foster, J. D., Campbell, W. K., & Bushman, B. J. (2008). Egos inflating over time: A cross-temporal meta-analysis of the narcissistic personality inventory. *Journal of Personality*, 76(4), 875–902. https://doi.org/10.1111/j.1467-6494.2008.00507.x
- Twenge, J. M., Spitzberg, B. H., & Campbell, W. K. (2019). Less in-person social interaction with peers among U.S. adolescents in the 21st century and links to loneliness. *Journal of Social and Personal Relationships*, 36(6), 1892–1913. https://doi.org/10.1177/0265407519836170
- Tyler, T. R. (2002). Is the internet changing social life? It seems the more things change, the more they stay the same. *Journal of Social Issues*, 58(1), 195–205. https://doi.org/10.1111/1540-4560.00256
- U.S. Bureau of Labor Statistics. (2020). Employment experience of youths: Results from a longitudinal survey news release. https://www.bls.gov/news.release/nlsyth.htm
- Vanhalst, J., Klimstra, T. A., Luyckx, K., Scholte, R. H. J., Engels, R. C. M. E., & Goossens, L. (2012).
 The interplay of loneliness and depressive symptoms across adolescence: Exploring the role of personality traits. *Journal of Youth and Adolescence*, 41(6), 776–787.
 https://doi.org/10.1007/s10964-011-9726-7
- Victor, C. R., Scambler, S. J., Shah, S., Cook, D. G., Harris, T., Rink, E., & De Wilde, S. (2002). Has loneliness amongst older people increased? An investigation into variations between cohorts.

 Ageing and Society, 22(5), 585–597. https://doi.org/10.1017/S0144686X02008784
- Victor, C. R., & Yang, K. (2012). The prevalence of loneliness among adults: A case study of the United Kingdom. *Journal of Psychology: Interdisciplinary and Applied*, 146(September 2012), 85–104.

- von Soest, T., Luhmann, M., & Gerstorf, D. (2020). The development of loneliness through adolescence and young adulthood: Its nature, correlates, and midlife outcomes. *Developmental Psychology*, 56(10), 1919–1934. https://doi.org/10.1037/dev0001102
- Wetzel, E., Brown, A., Hill, P. L., Chung, J. M., Robins, R. W., & Roberts, B. W. (2017). The narcissism epidemic is dead; long live the narcissism epidemic. *Psychological Science*, 28(12), 1833–1847. https://doi.org/10.1177/0956797617724208
- Wu, C. huei, & Yao, G. (2008). Psychometric analysis of the short-form UCLA Loneliness Scale (ULS-8) in Taiwanese undergraduate students. *Personality and Individual Differences*, 44(8), 1762–1771. https://doi.org/10.1016/j.paid.2008.02.003
- Xin, S., & Xin, Z. (2016). Birth cohort changes in Chinese college students' loneliness and social support: One up, as another down. *International Journal of Behavioral Development*, 40(5), 398–407. https://doi.org/10.1177/0165025415597547
- Yan, Z., Yang, X., Wang, L., Zhao, Y., & Yu, L. (2014). Social change and birth cohort increase in loneliness among Chinese older adults: A cross-temporal meta-analysis, 1995–2011.

 International Psychogeriatrics, 26(11), 1773–1781. https://doi.org/10.1017/S1041610214000921

Tables and Figures

Table IOverview of previous literature on changes in loneliness over historical time sorted from childhood to old age

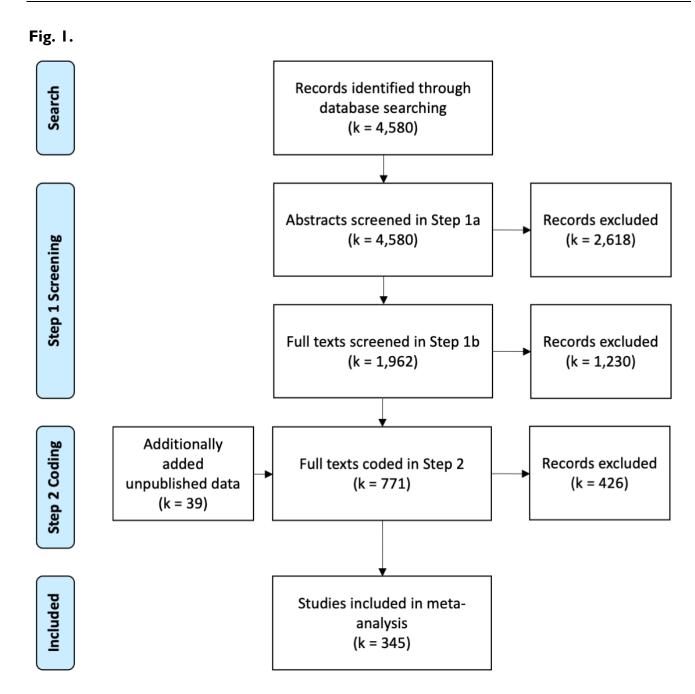
Authors	Study type	Loneliness trend	Years of investigation	Age group	Age descriptives in years	Continent
Lempinen et al. (2018)	Longitudinal study (4 assessments)	\leftrightarrow	1981-2004	Children	M = 8 (SD = 0)	Europe
Twenge et al. (2019)	Longitudinal study (yearly assessments)	↑	1976-2017	Adolescents	Range = 13-18	North America
Trzesniewski & Donnellan (2010)	Longitudinal study (yearly assessments)	\downarrow	1976-2006	Adolescents and emerging adults	N/A	North America
Clark et al. (2015)	Cross-temporal meta-analysis	\downarrow	1978-2009	Emerging adults	N/A	North America
Xin & Xin (2016)	Cross-temporal meta-analysis	1	2002-2011	Emerging adults	N/A	Asia
Dahlberg et al. (2018)	Longitudinal study (5 assessments)	\leftrightarrow	1992-2014	Older adults	77+	Europe
Eloranta et al. (2015)	Longitudinal study (2 assessments)	\leftrightarrow	1991-2011	Older adults	M = 70 (SD = 0)	Europe
Hawkley et al. (2019)	Longitudinal study (3 assessments)	\leftrightarrow	2005-2016	Older adults	Range = 57–85	North America
Nyqvist et al. (2017)	Longitudinal study (3 assessments)	\leftrightarrow	2002-2012	Older adults	85+	Europe
Victor et al. (2002)	Longitudinal study (3 assessments)	\leftrightarrow	1945-1960	Older adults	60+	Europe
Hülür et al. (2016)	Cross-cohort comparison (2 cohorts)	\downarrow	1993 - 2014	Older adults	Range = 65–89	Europe
Yan et al. (2014)	Cross-temporal meta-analysis	↑	1995–2011	Older adults	60+	Asia

Note. Data in both articles came from the Monitoring the Future study (http://www.monitoringthefuture.org). Studies differed in their measurement of loneliness. In the

third column, \downarrow represents a decrease, \uparrow represents an increase, and \leftrightarrow represents a stable trend. N/A means that no information was available.

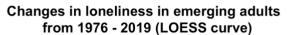
Table 2
Study Characteristics Coded in Step 2

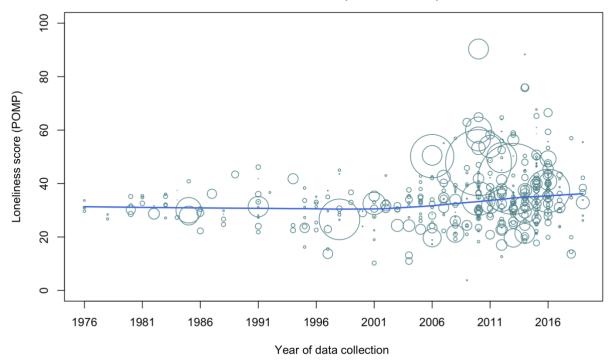
Study characteristic	Description			
Year of publication	Year of publication as indicated in the published article. We used the			
F	year of print publication if possible (i.e., not the year of advanced			
	online publication).			
Year of data	If available, year of data collection as indicated in the article or			
collection	reported by an author via email. If a range of years was reported			
	(e.g., 2013-2014), the most recent year (e.g., 2014) was coded. If the			
	exact information about the year of data collection was missing, we			
	calculated a proxy using year of publication -2 years (e.g., a paper			
	published 2000 would be coded as $2000 - 2 = 1998$).			
Type of article	Information on whether the respective loneliness score was taken			
	from a (peer-reviewed) journal article, a dissertation, or from			
N.I.	unpublished data sets.			
N D : (E I	The sample size corresponding to the loneliness score			
Proportion of Females	Proportion of females in %. If absolute numbers of males and females			
	are given, we calculated the proportion of females from these absolute numbers.			
Sample Type	Information on whether the respective loneliness score was taken			
Sample Type	from a student sample (explicitly described as such in the article), a			
	community sample, a clinical sample (i.e., people with a clinical			
	diagnosis), or a forensic sample (i.e., prisoners). This information was			
	later used to create two sample type groups: student samples vs.			
	other samples.			
Age (Min)	Minimum of the average age of the sample in years.			
Age (Max)	Maximum of the average age of the sample in years.			
Age (Mean)	Mean age of the sample in years.			
Age (SD)	Standard deviation corresponding to the mean age of the sample.			
Country	Country from which the study participants came, using the two-			
	letter country code. This information was later used to group			
	countries in continents for further analyses.			
Name of scale	Information on whether a version of the UCLA loneliness scale or			
Vancian of sols	the DeJong Gierveld loneliness scale (DJG-LS) was used.			
Version of scale Number of items	Exact version of the scale (e.g., ULS-8) Number of items of the loneliness measure			
Theoretical minimum	Theoretical endpoint of the scale (smallest value)			
Theoretical maximum	Theoretical endpoint of the scale (smallest value)			
Reliability	Cronbach's alpha of the loneliness measure in the respective sample.			
Reliability	If more than one alpha or range were reported, we coded the			
	largest value.			
Loneliness (Mean)	Average scale score (which could be a mean or a sum score)			
Loneliness (SD)	Standard deviation corresponding to the average scale score			
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Flow diagram of the assessment of study eligibility for the research synthesis. The reasons for exclusion of records are listed in the text.

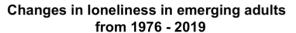
Fig. 2.

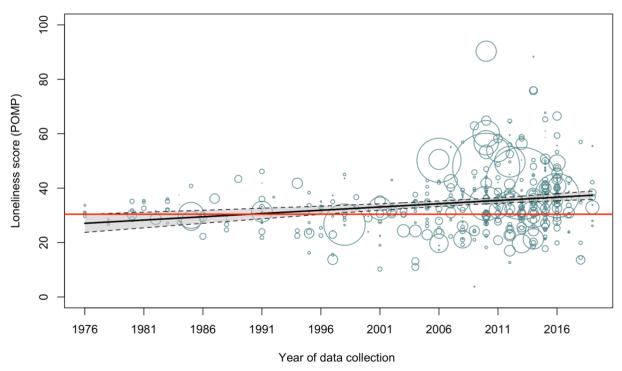




UCLA loneliness scale scores (converted into POMP scores) plotted against the year of data collection. The solid blue line represents a LOESS curve. Data-points represent study POMP scores, and the size of the data points is proportional to study (inverse variance) weighting.

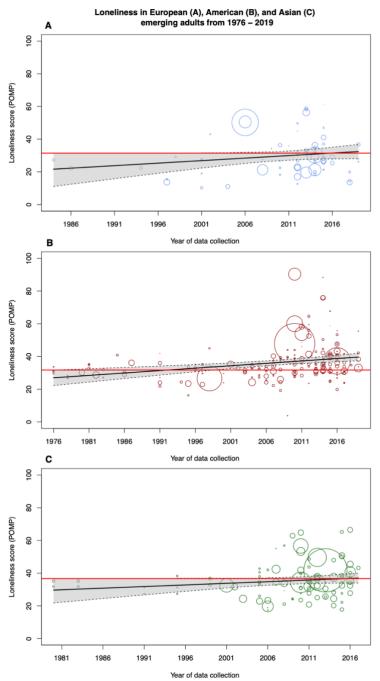
Fig. 3.





UCLA loneliness scale scores (converted into POMP scores) plotted against the year of data collection. The solid regression line is plotted through the predicted loneliness values from a simple random-effects meta-regression model, including the year of data collection as a single covariate. Data points represent study POMP scores, and the size of the data-point is proportional to the study (inverse variance) weighting. The grey area between the dashed lines depicts the 95% confidence interval for the predicted values. A change in loneliness over historical time is statistically significant if the lower bound of the 95% confidence interval for the predicted values crosses the horizontal red (solid) line.

Fig. 4.



UCLA loneliness scale scores (converted into POMP scores) of each subgroup (European, American, and Asian samples) plotted against the year of data collection. The solid regression line is plotted through the predicted loneliness values from a simple random-effects meta-regression model, including the year of data collection as a single covariate. Data points represent study POMP scores, and the size of the data point is proportional to the study (inverse variance) weighting. The grey area between the dashed lines depicts the 95% confidence interval for the predicted values. A change in loneliness over historical time is statistically significant if the lower bound of the 95% confidence interval for the predicted values crosses the horizontal red (solid) line (see Plot B).

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Open Science Statement

We preregistered this meta-analysis via the Open Science Framework (https://osf.io/eu3c7). In addition, we provide all raw data necessary to reproduce our results and provide R scripts for all data analyses reported in this manuscript (https://osf.io/mp5xh/). The authors did not receive any specific funding for this work.