In a Lonely Place: Investigating Regional Differences in Loneliness

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Abstract

Loneliness has traditionally been studied on the individual level. This study is one of the first to systematically describe and explain differences in loneliness on a fine-grained regional level. Using data from the nationally representative German Socioeconomic Panel Study ($N = 17,602$), we mapped the regional distribution of loneliness across Germany and examined whether regional differences in loneliness can be explained by both individual and regional characteristics. Perceived neighborhood relation, perceived distance to public parks and sport/leisure facilities as well as objective regional remoteness and population change were positively related to loneliness. Individual-level characteristics, however, appeared to be more important in explaining variance in loneliness. In sum, loneliness varies across geographical regions, and these differences can partly be linked to characteristics of these regions. Our results may aid governments and public health care services to identify geographical areas most at risk for loneliness and resulting physical and mental health issues.

Keywords: loneliness, social isolation, geographical psychology

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A substantial proportion of today's Western populations is lonely (Beutel et al., 2017). Loneliness has serious negative consequences for cognition, behavior, emotion, both physical and mental health (Hawkley & Cacioppo, 2010), and may eventually even result in earlier mortality (Holt-Lunstad, Smith, Baker, Harris, & Stephenson, 2015). As loneliness clearly is a public health issue, several political campaigns and debates across various countries have recently focused on the prevention and reduction of loneliness (Christlich Demokratische Union Deutschlands/Christlich-Soziale Union in Bayern (CDU/CSU) and Sozialdemokratische Partei Deutschlands (SPD), 2018; Government of the United Kingdom, 2018).

Generally, loneliness is defined as the perceived discrepancy between an individual's desired and actual social relationships (Cacioppo & Hawkley, 2009). Traditionally, individual-level predictors of loneliness were investigated. For example, subjective health, relationship status, frequency of contacts to friends and family, or socioeconomic status were found to be negatively associated with loneliness (for a meta-analysis see Pinquart & Sörensen, 2003). However, complex psychological phenomena—such as loneliness—are unlikely to be fully explained by a few strong (individual-level) predictors (Matz, Gladstone, & Stillwell, 2017). Recent studies have shown that regional characteristics play a distinct role for individual-level psychological functioning (e.g., Jokela, Bleidorn, Lamb, Gosling, & Rentfrow, 2015; Götz, Ebert, & Rentfrow, 2018). We therefore suggest broadening the perspective on loneliness. Specifically, we suggest looking beyond the individual level and also examining predictors of loneliness at the regional level. From a scientific perspective, uncovering regional-level characteristics as a widely overlooked class of predictors of loneliness would advance our understanding of loneliness. From a more applied perspective, uncovering regional predictors of loneliness may allow the identification of at-risk

populations and has important implications for the political debate on macro-level strategies to prevent and tackle loneliness.

A Socioecological Perspective on Loneliness

Taking a socioecological perspective on loneliness means to investigate how objective social and physical environments, not just the subjective perception or construal of these environments, affects one's thinking, feeling and behaviors (Oishi, 2014). The underlying idea of the socioecological theory is that macro-level contextual factors shape the type and course of processes at the individual level. For example, rapid social change in certain regions could lead to individuals no longer feeling that they fit into the society in which they live. This conceptual argument is supported by numerous empirical studies showing that regional characteristics are important for psychological outcomes such as health (Yen, Michael, & Perdue, 2009), life satisfaction (Luhmann, Murdoch, & Hawkey, 2015), depression (Airaksinen et al., 2015), prosocial behavior (Nai, Narayanan, Hernandez, & Savani, 2018), or empathy (Bach, Defever, Chopik, & Konrath, 2017).

How might objective social and physical environments be associated with loneliness? Whereas numerous studies have focused on identifying individual-level characteristics associated with loneliness, only a handful of studies investigated how loneliness is distributed geographically or took regional characteristics such as neighborhood variables into account when studying loneliness (Beer et al., 2016; Matthews et al., 2019; Menec, Newall, Mackenzie, Shoostari, & Nowicki, 2019; Rönkä, Rautio, Koiranen, Sunnari, & Taanila, 2014; Scharf & De Jong Gierveld, 2008). The few existing studies report inconsistent findings but their comparability is restricted due to different investigated variables, different age groups and nations, and comparably small sample sizes. Beer et al. (2016) studied the geographical distribution of social isolation in Australia's older adults and found that social isolation was most acute in both the largest urban centers (i.e., Sydney and Melbourne) and

the most sparsely settled regions of South and West Australia. Menec et al. (2019) studied individual-level (i.e., sex, income, relationship status) and regional-level (i.e., rural/urban, sociodemographic factors) predictors of social isolation and loneliness in Canada. They showed that socially isolated individuals were clustered into areas with lower-income older adults, but no relations for regional-level predictors and loneliness were found. Note that social isolation and loneliness are related but distinct constructs (Cacioppo & Hawkley, 2009), with social isolation referring to the objective characteristics of an individual's circumstances (i.e., the objective absence of relationships with others) and loneliness referring to a subjective and negative experience of an unfulfilled need.

A currently under-researched issue of great public interest is whether there are urban/rural differences in loneliness. Densely inhabited regions or regions with a growing population may offer more opportunities to interact with other people and thus, show generally lower levels of loneliness. These regions, however, may also be characterized by anonymity, social transformations, or a lower degree of social cohesion and thus, show generally higher levels of loneliness. In addition, regional remoteness (i.e., greater distance to major cities) might be associated with worse infrastructure needed to stay connected. Among Finnish adolescent girls, living in rural areas was associated with more loneliness than living in urban areas. However, for boys no similar association was found (Rönkä et al., 2014). In line with this finding, in an Austrian study, living in a densely populated neighborhood was associated with more social satisfaction (Delmelle, Haslauer, & Prinz, 2013). In contrast, Matthews et al. (2019) found in a British study that loneliness was unrelated to objective indicators of urbanicity, population density, deprivation, or crime but was related to some perceived neighborhood characteristics. The urban density level was also not predictive for loneliness or social isolation in the Netherlands (van den Berg, Kemperman, de Kleijn, & Borgers, 2016).

Individuals living in socioeconomically disadvantaged regions may suffer from restricted access to leisure activities (Crawford et al., 2008) or restricted access to health care (Kirby & Kaneda, 2005). Whereas the socio-economic status on the regional level was significantly associated with loneliness in a Dutch sample, this was not the case in a British sample (Scharf & De Jong Gierveld, 2008). Note, however, that individual-level socio-economic status was not controlled for in these analyses. Moreover, in a Dutch representative sample, loneliness was associated with living in an environment with less green space (Maas, van Dillen, Verheij, & Groenewegen, 2009).

Together, some regional characteristics may hinder social integration, the shaping of positive interpersonal relationships, and the formation of an engaged community, all of which can result in feelings of loneliness. At a society-wide level, loneliness can have profound consequences including neighborhood and community deterioration, increased use of health services with corresponding financial costs, and an increased burden of care for relatives. On the basis of existing research, however, it is not possible to draw clear conclusions if and how regional characteristics matter for loneliness. To better understand the role of regional characteristics for loneliness, large samples that are representative of the total population are needed.

The Current Study

To examine whether loneliness is associated with macro-contextual characteristics, we conducted two analytical steps. First, we examined whether average levels of loneliness vary across different geographic regions in Germany. The British charity *Campaign to End Loneliness* has urgently called for “loneliness maps” in order to identify where lonely individuals are clustered (Goodman, Adams, & Swift, 2015). The current study provides the first high-resolution loneliness map examining regional differences in loneliness within a country. Indeed, it only appears useful to examine the relationship between macro- contextual

characteristics and loneliness if people in different regions actually differ in loneliness. According to the socioecological perspective (Oishi, 2014) and our previous theoretical reflections, it is very likely that regional variation in loneliness generally exists. However, given the lack of previous studies on regional differences in loneliness, we took an exploratory approach and did not make any predictions about the actual regional distribution.

Second, loneliness research has almost exclusively focused on identifying individual-level predictors of loneliness. A recent study by Menec et al. (2019) that looked on few individual-level and few regional-level predictors of loneliness found that geographic variables (i.e., rural/urban area) were not associated with loneliness. However, their geographic unit of analysis was rather broad and the set of individual- and regional-level predictors were limited. We therefore used a wider range of regional characteristics that are often assumed to build one's social structural context (i.e., residential region, type of space, socioeconomic deprivation, population change and density, age composition, and geographic remoteness; Berkman, Glass, Brissette, & Seeman, 2000).

In this study, we control for a broad variety of individual-level predictors in order to investigate whether regional-level predictors provide a genuine explanatory contribution to loneliness beyond what is already known. Specifically, we employed multi-level modeling to analyze whether the revealed regional differences in loneliness are tied to macro-contextual characteristics or merely a by-product of individual differences in loneliness. That is, some commonly found individual level predictors of loneliness, such as socioeconomic status, vary across regions (Ross, 2000). In this study, we therefore accounted for a rich set of individual-level characteristics, namely demographic variables, socioeconomic status variables, social relationships, subjective health, and self-reported neighborhood characteristics.

Methods

Participants

The individual-level data came from the German Socio-Economic Panel Study (SOEP; Goebel et al., 2018). The SOEP is representative for the German population in terms of age, gender, sociodemographic status, and geographic region (for details, see Goebel et al., 2018). The core regional-level data came from the INKAR (indicators and maps on spatial and urban development in Germany and Europe) database compiled by Germany's Federal Institute for Research on Building, Urban Affairs and Spatial Development (<https://www.inkar.de>).

The SOEP is conducted annually. In the present study, we used the data collected in 2013, the first SOEP-wave in which loneliness was measured. We used this wave because most of the individual-level predictors of loneliness that we were interested in were also collected in this wave. In year 2013, the total sample size was $N = 25,481$. We used listwise exclusion of cases in all our models to allow model comparison. A total of $N = 17,602$ provided valid data on all variables analyzed. Table S1 shows descriptive statistics for the finally included and the excluded individuals. In the final sample, the mean age was 50.35 years ($SD = 16.52$) ranging from 18 years to 103 years, with 54% being female. The included individuals were nested within 10,751 households. Of these households, 14% consisted of one participant, 38% encompassed two participants, and 48% encompassed three or more participants.

Measures

Loneliness. The German three-item version of the UCLA Loneliness Scale (Hughes, Waite, Hawkley, & Cacioppo, 2004) was used. This version was specifically developed for the use in the SOEP (Hawkley, Duvoisin, Ackva, Murdoch, & Luhmann, 2015). On a 5-point scale ranging from 0 = *never* to 4 = *very often*, participants indicated how often they miss the

company of other people, feel left out, and feel socially isolated. In the present sample, internal consistency was $\alpha = .78$.

Individual-level characteristics. The predictors of loneliness at the individual level were grouped in the following sets: (1) demographic variables (age, age², gender, migration status), (2) socioeconomic status (income, education, work status), (3) social relationships (relationship status, frequency of contact with relatives and friends), (4) overall subjective health, (5) self-reported neighborhood characteristics (walking distance to public transportation, public parks, sport and leisure facilities, distance to nearest city center, perceived relationship of neighbors to each other). Predictor sets were built based on the most commonly examined individual-level predictors of loneliness. Whenever possible, we used information from 2013 as this was the year in which loneliness was assessed. However, in the rare cases in which data on an individual-level predictor of loneliness were not available in 2013 but in surrounding years, this information was used. For a detailed description of the assessment years of each construct, see Table S2 included in the online supplementary material (OSM; <https://osf.io/n6pzu/>).

Objective regional and neighborhood characteristics. To consider objective regional and neighborhood characteristics as predictors of loneliness at the individual level, we included the data from the INKAR database. We explored the following regional level predictors: age composition (region-level mean age), socioeconomic deprivation (German Index of Socioeconomic Deprivation; Kroll, Schumann, Hoebel, & Lampert, 2017), population change (rate of growth or decline of a region's population size), population density (inhabitants per km²), and regional remoteness (distance to nearest regional centers of regions). The German Index of Socioeconomic Deprivation (GISD; Kroll et al., 2017) includes weighted indicators for the three dimensions of education, occupation, and income. In addition, residential region (East vs. West Germany) and type of space (urban vs. rural)

were taken into account using dummy-coded macro-level variables available in the SOEP data (Goebel et al., 2018).

Data Analysis

Mapping Approach

To visualize the spatial distribution of loneliness within Germany, we applied an *actor-based clustering* approach—a mapping technique that allows revealing distributional patterns without aggregating data to a higher spatial level first (Brenner, 2017; Ebert, Gebauer et al., 2019). In this approach, we based our analyses on the finest spatial information available in our data (i.e., in which of the 11,165 German municipalities a person lives). In a first step, we calculated the spatial distance (bee line distance) for each of the $11,165 \times 11,165$ pairs of municipalities. In a second step, for each municipality, we then used these distances to calculate a loneliness estimate that is based on all participants in the sample. In this calculation, we weighted participants according to their distance to the referring municipality. Thereby, participants that are close to the referring municipality will get a higher weight than participants that are more distant to the referring municipality. For a more detailed description of this methodology and further robustness checks please see the OSM.

Linear Mixed-Effects Models

To account for the hierarchical structure of our data (individuals on Level 1 nested in households on Level 2 and regions on Level 3) we used sequential linear mixed-effects models to examine predictors of loneliness at the individual and the regional level. We used deviance tests and established goodness-of-fit indices such as Akaike information criterion (AIC) and Bayesian information criterion (BIC) for the model comparisons. In the first model, loneliness was predicted by the individual-level demographic variables only (Model A). Next, we sequentially expanded Model A by entering the following additional sets of

individual level predictors: socioeconomic status variables (Model B), social relationships variables (Model C), subjective health (Model D), self-reported neighborhood characteristics (Model E). Last, we included residential region and type of space as dummy-coded macro-level variables (Model F).

After having set up the individual-level models, we further expanded Model F by separately including the following objective regional predictors: region-level average age as indicator of the age composition (Model G1), socioeconomic disadvantage (Model G2), population change and population density (Model G3), and distance to nearest regional centers of regions (Model G4). The final Model H included all individual-level and regional-level predictors of loneliness. We applied cross-sectional sample weights in all analyses to ensure that our findings are generalizable to the total German population. For all analyses, we used the lme4 package (Bates, Maechler, Bolker, & Walker, 2015; Version 1.1.21) in R. Our R code is available via the Open Science Framework: <https://osf.io/3y86x/>.

Results

Descriptive Statistics

In Table 1, we present the mean levels and standard deviations of loneliness in the final sample ($N = 17,602$), and separately split by residential region (East vs. West) and type of space (urban vs. rural). A full zero-order correlation matrix with all individual-level variables including means and standard deviations is displayed in Table S3 (OSM).

Table 1

Means, Standard Deviations, and Sample Size for Loneliness in Different Subsets

Subsets	<i>M</i>	<i>SD</i>	<i>N</i>
Total sample	1.02	0.75	25,481
Final sample ¹	1.00	0.75	17,602
Residential region ²			
West	0.97	0.74	13,406
East	1.09	0.75	4,196
Type of space ²			
Urban	0.98	0.75	11,144
Rural	1.02	0.74	6,458

*Note.*¹ In the final sample all individuals with missing values on one of the predictor variables were excluded.

²Based on the final sample.

Geographical Distribution of Loneliness in Germany

Figure 1 visualizes the regional distribution of loneliness in Germany in 2013.

Overall, the figure points to a distinct East-West gradient: almost the entirety of East Germany showed above-average loneliness (dark grey). In contrast, the West of Germany was much less homogeneous and reveals systematic spatial patterns, whereby particularly rural areas in the Southeast, the Southwest, the Northwest and in Central Germany showed above average loneliness scores. In contrast, participants in the West of Germany as well as in and around the metropolitan areas (i.e., Stuttgart, Munich, Nuremberg, and Hamburg) on average reported less loneliness (light grey).

Figure 1. Cartographic visualization of regional loneliness in Germany on the basis of the SOEP-Core wave 2013. Darker colors indicate geographical clustering of high loneliness scores, lighter colors indicate geographical clustering of low loneliness scores. Black lines indicate the borders of the 16 German federal states. When zooming into the digital version of this map, light-gray lines are visible. Light-gray lines indicate the borders of the 11,165 municipalities.

Predictors of Loneliness at the Individual and the Regional Level

First, we looked at loneliness predicted by a variety of individual-level variables (for the hierarchically nested Models A-E see Table S4; OSM). Deviance statistics, AIC, and BIC

all indicate that Model F including all individual-level predictors fits our data best (Table 2). Women reported greater loneliness than men, controlling for all other predictors. Loneliness has been found to show a non-linear relation with age in the SOEP (Luhmann & Hawkley, 2016). To control for such a non-linear relation between age and loneliness, we included both age and age² in our analyses. Individuals with migration background reported higher loneliness than individuals without migration background. Next, we found that some aspects of the socioeconomic status were associated with loneliness: The higher the household net income of an individual, the lower was the loneliness score. Moreover, employed individuals reported lower loneliness than unemployed individuals. Meanwhile, the number of education years was not significantly associated with loneliness. Regarding the relationship status as predictor of loneliness, we found that singles reported higher loneliness than individuals living together with their partner. No significant difference in loneliness was found between individuals living together with their partner and those having a partner but not living together with them. The more contact individuals had with both friends and relatives, the less lonely they felt. Additionally, self-reported general health was negatively associated with loneliness. Individuals who reported that their walking distance to public parks or leisure and sporting facilities is long (e.g., more than 20 min on foot or not reachable on foot) reported higher levels of loneliness. Neither walking distance to public transportation, nor self-reported distance to the nearest city center (in kilometer brackets) were significantly associated with loneliness in our model. Relations with one's neighbors seemed to play a role for loneliness: the more positively individuals perceived their relation to their neighbors, the less lonely they felt. Last, we included residential region (East vs. West Germany) and type of space (rural vs. urban) as additional predictors of loneliness. Type of space (i.e., urban or rural region) was not significantly associated with loneliness. However, despite the extensive set of individual level controls, we found that individuals living in East Germany still

reported higher loneliness scores than those living in West Germany. This finding suggests that the revealed spatial variation might indeed be tied to macro-contextual factors rather than being a by-product of individual differences. For full model results see Table 2.

Table 2

Final Linear Mixed Effects Model Including all Predictors of Loneliness (Standardized) at the Individual Level

<i>Predictors</i>	Model F	
	<i>Estimates</i>	<i>p</i>
Intercept	0.12 [0.06, 0.17]	< .001
Gender: Female	0.07 [0.04, 0.09]	< .001
Age	-0.19 [-0.21, -0.17]	< .001
Age ²	-0.05 [-0.06, -0.03]	< .001
Migration background: No	-0.08 [-0.11, -0.04]	< .001
Income	-0.10 [-0.12, -0.08]	< .001
Education	-0.00 [-0.02, 0.01]	.878
Work status: Other occupations	-0.14 [-0.18, -0.10]	< .001
Work status: Working full-time	-0.17 [-0.21, -0.13]	< .001
Relationship status: not living with partner	0.03 [-0.03, 0.08]	.376
Relationship status: Single	0.21 [0.17, 0.25]	< .001
Contact frequency with friends	-0.12 [-0.14, -0.11]	< .001

Contact frequency with relatives	-0.06 [-0.08, -0.05]	< . .001
General health	-0.21 [-0.23, -0.20]	< . .001
Distance to public transport	0.01 [-0.01, 0.03]	.286
Distance to public parks	0.03 [0.01, 0.05]	< . .001
Distance to sport/leisure facilities	0.03 [0.02, 0.05]	< . .001
Distance to nearest city center	-0.01 [-0.03, 0.01]	.564
Relation to neighbors	-0.05 [-0.07, -0.04]	< . .001
Type of space: Rural	0.00 [-0.05, 0.06]	.979
Residential region: East	0.06 [0.00, 0.12]	.037
Random Effects		
σ^2	0.56	
τ_{00}	0.28 households	
	0.03 regions	
ICC	0.36	
N	10,751 households	
	401 regions	
Observations	17,602	
Marginal R ² / Conditional R ²	0.133 / 0.442	

Note. All continuous variables are *z*-standardized. We used sample weights in all analyses. Values in square brackets indicate the 95% confidence interval, DV = dependent variable, ICC = intraclass correlation coefficient. *p*-values below .05 are presented in bold indicate statistical significance.

Concerning the regional-level predictors, we found that the age composition (i.e., regional-level average age) and socioeconomic deprivation were not significantly associated with loneliness beyond the included individual-level predictors (Model H, Table 3).

Regarding the social environment, population change was positively associated with loneliness beyond all individual-level predictors, but population density was not. This implies that whereas the total density of the population is unrelated to loneliness, the greater the population change (i.e., the more positive the growth rate of a region's population size) in a region, the higher the average level loneliness. Moreover, regional remoteness (distance to nearest regional centers of regions) was positively associated with loneliness, controlling for all other predictors. The significance of all individual-level predictors from Model F remained unchanged in Model H with one exception: the dummy-variable representing differences between East and West Germany did not reach our significance threshold. Accordingly, East Germany's higher levels of loneliness might be partly due to its sparser settlement structure and the referring greater distance to regional centers for parts of the East German population. For a table showing separate models including only one regional-level construct at a time, see Table S5 in the OSM.

Table 3

Final Linear Mixed Effects Model Including all Predictors of Loneliness (Standardized) at the Individual and the Regional Level

<i>Predictors</i>	Model H	
	<i>Estimates</i>	<i>p</i>
Intercept	0.12 [0.07, 0.18]	< 0.001
Gender: Female	0.07 [0.04, 0.09]	< 0.001
Age	-0.19 [-0.21, -0.17]	< 0.001
Age ²	-0.05 [-0.06, -0.03]	< 0.001
Migration background: No	-0.08 [-0.11, -0.04]	< 0.001

Income	-0.10 [-0.12, -0.08]	< 0.001
Education	-0.00 [-0.02, 0.01]	.890
Work status: Other occupations	-0.14 [-0.18, -0.10]	< 0.001
Work status: Working full-time	-0.17 [-0.21, -0.13]	< 0.001
Relationship status: not living with partner	0.03 [-0.03, 0.08]	.373
Relationship status: Single	0.21 [0.17, 0.25]	< 0.001
Contact frequency with friends	-0.12 [-0.14, -0.11]	< 0.001
Contact frequency with relatives	-0.06 [-0.08, -0.05]	< 0.001
General health	-0.21 [-0.23, -0.20]	< 0.001
Distance to public transport	0.01 [-0.01, 0.02]	.331
Distance to public parks	0.03 [0.02, 0.05]	< 0.001
Distance to sport/leisure facilities	0.03 [0.02, 0.05]	< 0.001
Distance to nearest city center	-0.01 [-0.03, 0.01]	.274
Relation to neighbors	-0.05 [-0.07, -0.04]	< 0.001
Type of space: Rural	-0.02 [-0.08, 0.04]	.581
Residential region: East	0.07 [-0.00, 0.14]	.064
Age composition	0.01 [-0.04, 0.06]	.642

Socioeconomic deprivation	0.02 [-0.01, 0.06]	.153
Population change	0.08 [0.03, 0.12]	.001
Population density	-0.02 [-0.07, 0.03]	.424
Regional remoteness	0.04 [0.01, 0.08]	.019
Random Effects		
σ^2	0.56	
τ_{00}	0.28 households	
	0.03 regions	
ICC	0.35	
N	10,751 households	
	401 regions	
Observations	17,602	
Marginal R^2 / Conditional R^2	0.136 / 0.442	

Note. All continuous variables are z -standardized. We used sample weights in all analyses. Values in square brackets indicate the 95% confidence interval, DV = dependent variable, ICC = intraclass correlation coefficient. p -values below .05 are presented in bold indicate statistical significance.

Discussion

Political and public attention to loneliness has significantly increased in the last few years, leading to a greater demand for data on the regional distribution of loneliness. The present research provides a high-resolution account of this regional distribution of loneliness within a nation. Moreover, it examines both an individual's perception of the environment and objective environmental characteristics gathered from public official statistics as predictors of loneliness beyond commonly used individual-level characteristics. In our study, we used a new mapping technique that allowed us to explore spatial patterns based on a database that is nationally representative but considerably smaller than those databases typically used in the study of regional differences in psychological phenomena (usually

several hundred thousand observations; Ebert, Götz, Obschonka, Zmigrod, & Rentfrow, 2019; Rentfrow et al., 2013). Earlier research for example depicted the percentage of older adults socially isolated by broader regions in Australia (i.e., on state level; Beer et al., 2016). However, this approach might overlook relevant factors associated with details of individual localities. Using our mapping approach, we were able to depict spatial patterns of loneliness within Germany that are not diluted by prefixed spatial boundaries.

Our loneliness map showed that most regions with above-average levels of loneliness were located in East Germany. One reason for this finding could be an unequal distribution of individual-level characteristics that are associated with loneliness. For example, people living in East Germany were more likely to report poor subjective health (Schöllgen, Huxhold, & Tesch-Römer, 2010). Subjective health, in turn, was negatively associated with loneliness in our study. However, our analyses showed that the East-West difference is statistically significant even after controlling for many individual-level characteristics.

Our results revealed a very nuanced and interesting geography of loneliness—a geography that cannot be captured by simple divisions such as urban and rural areas. In fact, our studies show that very diverse spatial categories—ranging from the cosmopolitan capital Berlin to remote areas in East Germany or Bavaria (see Figure 1)—can be breeding grounds of loneliness. Our results provide a first step to understand the underlying mechanisms behind these regional patterns. We showed that, beyond all individual-level predictors, social environment (as indicated by the population change) and regional remoteness (as indicated by the distance to the nearest regional center) significantly predicted loneliness. Of note, population density, that is, the number of potential social contacts in a region, did not predict loneliness, which is consistent with the findings by Matthews et al. (2019). Population change, on the other hand, describes social transformations in a region, for example through relocation, emigration and immigration. These transformations may make it challenging to

engage in meaningful relationships and in turn make people more likely to end up feeling lonely. This result also aligns with the individual-level findings, which show that good relations with neighbors, and frequent contact to friends and relatives can protect against loneliness. Previous work also showed that the subjective quality of neighborhood variables is significantly associated with loneliness (Scharf & De Jong Gierveld, 2008). Neither age composition nor socioeconomic context at the regional level were associated with loneliness, which is again consistent with Matthews et al. (2019). At the individual level, however, both socioeconomic status and age were significantly associated with loneliness. Consequently, these individual circumstances seem to be more strongly related to loneliness than the corresponding characteristics of the region in which they live.

The current findings are important for several reasons. Our study provides a rough quantification of the extent to which loneliness is shaped by the resources and constraints in one's environment. Our results show that individual-level predictors of loneliness explain more variance in individual-level loneliness than regional-level predictors. On the one hand one could, therefore, argue that loneliness interventions targeting individual-level characteristics (e.g., improving one's frequency of social contacts) may be more effective than interventions targeting regional-level characteristics (e.g., improving infrastructure). On the other hand, our study showed that some subjective and objective regional characteristics were uniquely associated with loneliness. For example, we found that the self-reported distance to public parks and sport/leisure facilities positively predicted loneliness, beyond many other individual-level predictors. Thus, these neighborhood characteristics might represent resources that protect from loneliness but have been largely neglected in the loneliness literature thus far. Future research should test whether these neighborhood characteristics have causal effects on loneliness. This study identified regions that are particularly lonely, suggesting that support and resources could, to some extent, be targeted in

these regions. Moreover, it is noteworthy that not all effects at the individual level can be found at the regional level. A differentiated consideration of predictors at different levels is therefore important for predicting psychological phenomena.

Some limitations of the present study have to be considered. First, the cross-sectional design of our study does not allow conclusions on whether characteristics of a region causally affect loneliness at the individual level or whether lonely individuals tend to choose regions with specific characteristics. For a comprehensive overview of bidirectional associations between individuals and the environment, see Rentfrow, Gosling, and Potter (2008). However, if the identification of at-risk populations for loneliness is an aim, the causal direction of the relation between loneliness and regional characteristics is not necessarily key. Future research should use longitudinal data to uncover potential bidirectional associations between loneliness and regional characteristics over time.

Second, the associations between regional-level predictors and loneliness were rather weak. However, instead of dismissing these small effect sizes, we argue that building a body of weak but robust predictors of loneliness has the potential to inform theory and research on loneliness, as well as government initiatives aimed at promoting healthy living (Matz et al., 2017). Furthermore, our loneliness map clearly shows that lonely people cluster, to a certain extent, regionally. This may indicate that measures against loneliness are particularly needed in certain regions.

Third, while our study provided first insights into the regional distribution of loneliness, its scope was limited to Germany. Germany has a unique history as two German states existed between 1949 and 1990. These states differed distinctly in their economic and political structure, with consequences that are still measurable today. More than two decades after the reunification of Germany, cities in East Germany continue to have on average poorer endowment with social and economic capital than most cities in West Germany (Dovern,

Quaas, & Rickels, 2014). For those reasons, future research needs to extend our findings to other countries.

Conclusion

Our results provide high-resolution insights into the regional distribution of loneliness and offer potential explanations. The present study highlights the importance of considering regional-level predictors in explaining psychological phenomena at an individual level. We conclude that, beyond a variety of individual-level predictors, regional-level population change and regional-level remoteness are associated with loneliness. However, the associations between regional-level predictors and loneliness were substantially smaller than associations with individual-level predictors. In sum, this study suggests that not only who we are, but also where we live is related to loneliness. Independent of the underlying causes (i.e., individual or regional factors), lonely individuals seem to cluster regionally. Loneliness maps may aid governments and public health care services to identify geographical areas most at risk for loneliness and resulting public health issues.

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