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Abstract

In this study, we investigated associations between the characteristics of the neighborhoods in which young adults live and their feelings of loneliness, using data from different sources. Participants were drawn from the Environmental Risk Longitudinal Twin Study. Loneliness was measured via self-reports at ages 12 and 18 years and also by interviewer ratings at age 18. Neighborhood characteristics were assessed between the ages of 12 and 18 via government data, systematic social observations, a resident survey, and participants' self-reports. Greater loneliness was associated with perceptions of lower collective efficacy and greater neighborhood disorder but not with more objective measures of neighborhood characteristics. Lonelier individuals perceived the collective efficacy of their neighborhoods to be lower than did their less lonely siblings who lived at the same address. These findings suggest that feelings of loneliness are associated with negatively biased perceptions of neighborhood characteristics, which may have implications for lonely individuals' likelihood of escaping loneliness.

Keywords

loneliness, social isolation, neighborhood, collective efficacy, social cohesion

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Loneliness is defined as a form of social pain that arises when individuals perceive the quality or quantity of their social connections to be wanting (Cacioppo & Hawkley, 2009). This applies to shortcomings not only in dyadic social relationships but also in the relationships between individuals and larger social entities, such as local communities (Hawkley, Browne, & Cacioppo, 2005). These relationships are embedded within and shaped by a wider social structural context that includes features of the neighborhood environment, such as urbanicity, crime, inequality, and social cohesion (Berkman, Glass, Brissette, & Seeman, 2000). For instance, high levels of crime in an area could

undermine trust between neighbors and lead them to feel alienated from each other, whereas high social cohesion could foster stronger feelings of trust and belongingness. To the extent that the characteristics of a neighborhood influence, for better or worse, the social ties that form between its residents, this may have implications for the extent to which they feel lonely

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(Kearns, Whitley, Tannahill, & Ellaway, 2015). Increasingly, initiatives to reduce loneliness have emphasized intervention at the community level, including some neighborhood-based approaches (Collins & Wrigley, 2014; Jopling, 2015). Understanding how the structural and social characteristics of the neighborhoods in which communities operate are related to feelings of loneliness can have important implications for policy and interventions.

Recent discussions have focused on the trend of migration toward urban areas (United Nations, 2014) and the implications of city living for mental health (Peen, Schoevers, Beekman, & Dekker, 2010). Despite the fact that people are increasingly living closer together, the issue of loneliness continues to grow as a public health concern (Holt-Lunstad, 2018). The notion of the “lonely city” has been the focus of much popular writing in recent years (e.g., Laing, 2016). In the scientific literature, meanwhile, research on loneliness has traditionally placed an emphasis on older adults living in rural settings (De Koning, Stathi, & Richards, 2017; Dugan & Kivett, 1994; Savikko, Routasalo, Tilvis, Strandberg, & Pitkälä, 2005). However, new findings indicate that loneliness is most common among younger adults (Mental Health Foundation, 2010; Office for National Statistics, 2018). As individuals transition from the school environment to adult life, spaces in the neighborhood such as parks, shopping malls, sports facilities, and community centers could play an increasing role as settings for social contact.

Together, these findings suggest that efforts to reduce loneliness in modern society can be strengthened by extending the focus of research to include young people and those living in urban settings. Some features of the neighborhood, meanwhile, may increase loneliness irrespective of rurality versus urbanicity. For instance, feelings of loneliness among individuals living in deprived urban areas have been associated with higher reported rates of antisocial behavior in the neighborhood, lower perceived collective efficacy (a combination of social cohesion and the willingness of residents to intervene in the behavior of other individuals for the common good), lower safety, and poorer subjective neighborhood quality (Kearns et al., 2015; Scharf & de Jong Gierveld, 2008).

In our investigation of whether neighborhood features, per se, influence loneliness or instead are simply correlated features, it was important to rule out potential sources of bias that could yield spurious associations. First, potential reporting biases associated with mental health problems such as depression and personality traits such as neuroticism—both of which are associated with loneliness in young people (Vanhalst et al., 2012)—signify a need to control for these confounders. Second, although the objective characteristics

of the neighborhood may exert an effect on individuals’ feelings of loneliness, it is also possible that loneliness itself may dispose individuals to perceive their neighborhood in a more negative light. Loneliness is associated with biases in cognition, including negative appraisals of social interactions and exaggerated vigilance for threat (Cacioppo & Hawkley, 2009). It is possible, therefore, that individuals who feel alienated from those around them may evaluate the closeness or safety of their neighborhood in a negatively biased manner. If this is the case, relying solely on self-reported data on loneliness and neighborhood characteristics could be misleading, and interventions targeted at the neighborhood level may not be effective at reducing loneliness.

Our aim in the present study was to investigate how aspects of the neighborhoods that young adults live in relate to their feelings of social disconnection, using a contemporary, nationally representative cohort of UK residents. By integrating multiple sources of data on neighborhood characteristics, we scrutinized the robustness and specificity of associations between loneliness and different characteristics of the neighborhood. These data allow for novel and valuable insights into the purported epidemic of loneliness and suggest targets for policy initiatives to tackle loneliness in society.

Method

Participants

Participants were members of the Environmental Risk (E-Risk) Longitudinal Twin Study, which tracks the development of a birth cohort of 2,232 British children. The sample was drawn from a larger birth register of twins born in England and Wales in 1994 and 1995 (Trouton, Spinath, & Plomin, 2002). Full details about the sample are reported elsewhere (Moffitt & E-Risk Study Team, 2002). Briefly, the E-Risk sample was constructed in 1999 and 2000, when 1,116 families (93% of those eligible) with same-sex 5-year-old twins participated in home-visit assessments. This sample comprised 56% monozygotic and 44% dizygotic twin pairs; sex was evenly distributed within zygosity (49% male). Ninety percent of participants were of White ethnicity.

Families were recruited to represent the UK population with newborns in the 1990s to ensure adequate numbers of children in disadvantaged homes and to avoid an excess of twins born to well-educated women using assisted reproduction. The study sample represents the full range of socioeconomic conditions in Great Britain, as reflected in the families’ distribution on a neighborhood-level socioeconomic index (A Classification of Residential Neighbourhoods, or ACORN, developed by CACI for commercial use; Odgers, Caspi, Bates, Sampson, & Moffitt, 2012; Odgers, Caspi, Russell,

et al., 2012). Specifically, E-Risk families' ACORN distribution matches that of households nationwide: 25.6% of E-Risk families live in wealthy-achiever neighborhoods compared with 25.3% nationwide; 5.3% versus 11.6%, respectively, live in urban-prosperity neighborhoods; 29.6% versus 26.9%, respectively, live in comfortably-off neighborhoods; 13.4% versus 13.9%, respectively, live in moderate-means neighborhoods; and 26.1% versus 20.7%, respectively, live in hard-pressed neighborhoods. E-Risk underrepresents urban-prosperity neighborhoods because families in such areas are likely to be childless.

Follow-up home visits were conducted when the children were 7 years of age (98% participation), 10 years (96%), 12 years (96%), and 18 years (93%). There were 2,066 individuals who participated in the E-Risk assessments at age 18, and the percentages of monozygotic twins (56%) and male same-sex twins (47%) were almost identical to those found in the original sample at age 5 years. The average age of the twins at the time of the assessment was 18.4 years ($SD = 0.36$); all interviews were conducted after their 18th birthdays. There were no differences between twins who did and did not take part at age 18 in terms of socioeconomic status (SES) assessed when the cohort was initially defined, $\chi^2(2, N = 2,232) = 0.86, p = .65$; age-5 IQ scores, $t(2208) = 0.98, p = .33$; or age-5 emotional or behavioral problems, $t(2230) = 0.40, p = .69$, and $t(2230) = 0.41, p = .68$, respectively. Forty-nine percent of participants at age 18 were educated to A-Level (the school-leaving qualification in the United Kingdom), whereas 29% had general certificates of secondary education at grades A* to C as their highest qualification (obtained at ~14–16 years). Seventy-one percent of participants were currently completing some type of education program, 57% were working, and 12% were neither completing any education program nor working at the time of the assessment.

Home visits at ages 5, 7, 10, and 12 years included assessments with participants as well as their mother (or primary caretaker). The home visit at age 18 included interviews only with the participants. The joint South London and Maudsley–Institute of Psychiatry, Psychology & Neuroscience Ethics Committee approved each phase of the study. Parents gave informed consent and twins gave assent between 5 and 12 years and then informed consent at age 18 years.

Measures

Self-reported loneliness in young adulthood. Loneliness was assessed when participants were 18 years old using four items from the UCLA Loneliness Scale (Version 3; Russell, 1996): “How often do you feel that you lack companionship?” “How often do you feel left out?” “How

often do you feel isolated from others?” and “How often do you feel alone?” A very similar short form of the UCLA Loneliness Scale has previously been developed for use in large-scale surveys and correlates strongly with the full 20-item version (Hughes, Waite, Hawkey, & Cacioppo, 2004). The scale was administered as part of a computer-based self-completed questionnaire. Interviewers were blind to participants' responses. The items were rated *hardly ever* (0), *some of the time* (1), or *often* (2). Items were summed to produce a total loneliness score from 0 to 8 ($\alpha = .83$).

Interviewer ratings of loneliness in young adulthood. After the age-18 home visits, interviewers completed a set of questions about their impressions of the participants on the basis of observations made during the interview. Three items from these questionnaires related to feelings of loneliness (“seems lonely,” “feels that no one cares for them,” and “has trouble making friends”) and were used to derive interviewer ratings of loneliness. Items were coded *no* (0), *a little/somewhat* (1), and *yes* (2) and summed to create a scale ($\alpha = .70$). Interviewers were blind to participants' responses to the self-completed loneliness measure.

Self-reported loneliness in childhood. A measure of loneliness in childhood was derived using three items from the Children's Depression Inventory (CDI; Kovacs, 1992), which participants completed at the age of 12 years. Each item was presented as a set of three statements, and participants were instructed to select the statement that described them best: (a) “I do not feel alone,” “I feel alone many times,” or “I feel alone all the time”; (b) “I have plenty of friends,” “I have some friends but I wish I had more,” or “I do not have any friends”; and (c) “Nobody really loves me,” “I am not sure if anybody loves me,” or “I am sure that somebody loves me.” Items were coded 0 to 2 and summed to produce a scale from 0 to 6 ($\alpha = .48$). The correlation (r) between loneliness measured at age 12 and at age 18 was .25 (95% confidence interval = [.20, .30]; $N = 1,994$).

Because the items used in this measure originated from an instrument designed to assess depression, the remaining items of the CDI were summed to produce a depressive-symptoms scale ($\alpha = .75$). This scale was entered as a covariate in analyses using the childhood-loneliness measure to account for the shared variance between them.

Neighborhood characteristics. Extremely high-resolution data on neighborhood characteristics were collected when participants were between the ages of 12 and 18 years (Newbury et al., 2017). All neighborhood measures were linked to the postcodes of participants' current home addresses, meaning that participants were truly

embedded in the neighborhood milieu represented by the measures. Neighborhoods were coded as urban, intermediate, or rural on the basis of the Office for National Statistics' 2011 Rural-Urban Classification (RUC2011) for small-area geographies. At age 18, 32% of participants lived in urban areas, 48% in intermediate areas, and 20% in rural areas. Measures of neighborhood characteristics were grouped into the following four categories on the basis of the source of the data.

Government data included neighborhood SES (based on ACORN category), population density (number of people in a 0.5-mile radius from the home address, according to Office for National Statistics figures), and violent crime rates within a 1-mile radius from the home address (obtained via an online data-sharing resource operated by the UK police; <https://data.police.uk>).

Systematic social observations were carried out by trained raters using Google's Street View tool to conduct a virtual walk around participants' neighborhoods when participants were ages 15 to 16 years (Odgers, Caspi, Bates, et al., 2012). Using systematic social observation measures adapted for the virtual context, raters coded the neighborhood for physical decay, physical disorder, and street safety, each on a 5-point scale. Intraclass correlation coefficients (showing interrater agreement) ranged from .48 to .84, and correlations (r_s) with ACORN ranged from .30 to .47.

A *resident survey* was carried out when participants were between the ages of 13 to 14 years, among households with the same postcode area as the participants' homes. Surveys were distributed via mail to all households in the postcode area that were registered on the electoral roll (with the exception of participants' households). On average, five completed surveys were returned per neighborhood. At least three surveys were returned for 80% of neighborhoods, and at least two surveys were returned for 95% of neighborhoods. Survey measures included residents' ratings of neighborhood safety, neighborhood disorder, and collective efficacy. Scores were averaged across respondents within each neighborhood to create summary scores for each participant.

Self-reports of neighborhood characteristics were collected via face-to-face interviews with participants at age 18. Collective efficacy was determined via a 10-item measure of social control and social cohesion (Sampson, Raudenbush, & Earls, 1997). This measure included questions about the likelihood that neighbors would intervene if, for example, "children were spray-painting graffiti on a local building" and the level of agreement with statements such as "mine is a close-knit" neighborhood (coded 1–5). Neighborhood problems were measured by asking participants whether certain types of disorder were a problem in their area, such as "litter, broken glass, rubbish in public places" and "groups of

young people hanging out and causing trouble" (coded 0–2). Items were summed to produce scales of perceived collective efficacy and neighborhood disorder. Summary statistics for the loneliness and neighborhood measures are shown in Table 1.

Covariates. Participants were assessed for symptoms of depression at age 18 years via a structured interview based on the criteria in the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (American Psychiatric Association, 2013). Neuroticism was measured via a child version of the Big Five Inventory, which was completed by interviewers after the home visit (John & Srivastava, 1999). Because the sample consisted of twin pairs, participants were also asked whether they were currently living with their cotwin at the time of the interview. This information was used to control for the potential effect of being separated in adulthood on loneliness (which could be stronger in twins than in conventional sibling pairs) and also to derive a subgroup of cohabiting twins for the cotwin control analyses.

Data analysis

Associations between loneliness and neighborhood characteristics. To test associations between loneliness and neighborhood characteristics, we conducted regression analyses in Stata (Version 15; StataCorp, 2017), using the *vce(cluster)* option to adjust for the nonindependence of observations in twin data (Williams, 2000). In the first step, we regressed loneliness on each neighborhood characteristic individually, controlling for sex and SES. In the second model, we additionally controlled for depression, neuroticism, and whether the participant lived with his or her cotwin. The neighborhood measures were collected at various time points between the ages of 12 and 18 years, during which time, 591 (29%) participants interviewed at age 18 had moved home at least once. This high rate of mobility may be partially explained by some participants having already moved away to university at age 18. Consequently, for these participants, some of the measures collected between the ages of 12 and 18 referred to different neighborhoods. Therefore, in the third model, we controlled for whether the participants had moved between the ages of 12 and 18. Finally, in the fourth model, we restricted the analyses to a subset of participants who had lived at the same address throughout this period ($N = 1,475$). Residential mobility was correlated with low SES, female sex, childhood externalizing problems, and young adult loneliness, and therefore, the excluded participants differed from this subset in terms of several important risk factors. Therefore, inverse probability weighting was used in Model 4 to correct for bias introduced by excluding these participants.

Table 1. Descriptive Statistics for All Variables Included in the Present Study

Variable	Participant's age (in years) at measurement	<i>n</i>	Mean or percentage (<i>SD</i>)	Range
Loneliness				
Self-report	18	2,051	<i>M</i> = 1.57 (<i>SD</i> = 1.94)	0–8
Interviewer report	18	2,063	<i>M</i> = 0.68 (<i>SD</i> = 1.19)	0–6
Self-report	12	2,130	<i>M</i> = 0.48 (<i>SD</i> = 0.86)	0–6
Neighborhood characteristics				
Government data				
Low neighborhood SES	12	2,138	26.10%	1–5
Population density	12	2,134	<i>M</i> = 17.54 (<i>SD</i> = 24.50)	0.25–219.94
Violent crime	16–17	2,094	<i>M</i> = 29.24 (<i>SD</i> = 36.48)	1–257.42
Systematic social observations				
Physical decay	15–16	2,026	<i>M</i> = 1.18 (<i>SD</i> = 1.22)	0–4
Physical disorder	15–16	2,024	<i>M</i> = 0.93 (<i>SD</i> = 1.00)	0–4
Unsafe neighborhood	15–16	2,004	<i>M</i> = 2.29 (<i>SD</i> = 1.10)	1–5
Residents survey				
Neighborhood safety	13–14	2,148	<i>M</i> = –0.03 (<i>SD</i> = 0.48)	–2.67 to 0.69
Neighborhood disorder	13–14	2,152	<i>M</i> = 0.49 (<i>SD</i> = 0.34)	0–1.93
Collective efficacy	13–14	2,152	<i>M</i> = 2.35 (<i>SD</i> = 0.51)	0–3.7
Self-report				
Collective efficacy	18	2,062	<i>M</i> = 35.81 (<i>SD</i> = 6.64)	10–50
Neighborhood disorder	18	2,062	<i>M</i> = 3.12 (<i>SD</i> = 2.96)	0–12
Covariates				
Depression	18	2,063	<i>M</i> = 1.81 (<i>SD</i> = 2.97)	0–9
Neuroticism	18	2,065	<i>M</i> = 1.73 (<i>SD</i> = 1.72)	0–10
Living with cotwin	18	2,044	80.3%	0–1

Note: SES = socioeconomic status.

Cotwin control analyses. To test for a potential response bias in the self-report neighborhood measures, we used a sibling control method to compare the reports of twins who lived together in the same home, thus holding the effects of the neighborhood constant by design. This involved computing a within-twin-pair difference score by subtracting one twin's loneliness score from that of the cotwin and doing the same for their ratings of collective efficacy and neighborhood disorder. These difference scores

represent variance explained by genetic differences and unique environmental exposures but not by environmental effects that are shared between siblings (such as the neighborhood). Thus, if within-twin-pair differences in loneliness correlate with within-pair differences in their ratings of these neighborhood characteristics, this association cannot be explained by the neighborhood itself but by other factors that influence individuals' perceptions of the neighborhood.

Sensitivity analyses. Differential reporting of neighborhood characteristics by lonely versus nonlonely siblings living in the same home would be consistent with a bias being present in self-report data. However, this would not in itself convey whether loneliness itself is the source of bias or whether other, methodological sources of bias are responsible. For instance, the association between self-reports of loneliness and neighborhood perception could be inflated by shared method variance. This can be partially addressed by assessing loneliness via sources other than self-reports. Independent observers have been shown to rate other people's loneliness with reasonable accuracy (Luhmann, Bohn, Holtmann, Koch, & Eid, 2016), indicating that there is potential value in taking a multi-informant approach to measuring loneliness. Therefore, to test whether associations between the self-reported neighborhood characteristics and loneliness are inflated by shared-reporter method variance, we repeated the regression analyses of these associations using interviewer reports of participants' loneliness.

A further source of bias could be the time lag between measures. Loneliness and self-rated neighborhood perceptions were collected concurrently, whereas other measures of the neighborhood were collected up to 6 years earlier. This could lead to unfair comparisons, with stronger effects emerging for the cross-sectional associations and more temporally distal associations being underestimated. One way to address this is by using data on loneliness collected on different occasions to test whether the cross-sectional associations were replicated when using measures administered at different times. Therefore, as a further sensitivity analysis, the associations between loneliness and neighborhood characteristics were tested again with early adolescence loneliness (age 12) substituted for the age-18 measure.

Results

Associations between loneliness and neighborhood characteristics

Mean scores of loneliness did not differ significantly between individuals living in urban, intermediate, and rural neighborhoods (1.53, 1.60, and 1.59, respectively; $p = .84$). Furthermore, measures of neighborhood characteristics captured via independent sources such as government data, systematic social observations, and resident surveys were not associated with loneliness in young adulthood (see Table 2, Model 1). In contrast, self-reports of neighborhood social conditions were significantly associated with loneliness: Higher self-reported collective efficacy was associated with lower loneliness ($\beta = -0.18, p < .001$), and higher self-reported

neighborhood disorder was associated with higher loneliness ($\beta = 0.16, p < .001$).

Loneliness was associated with greater depressive symptoms ($\beta = 0.41, p < .001$) and higher neuroticism ($\beta = 0.27, p < .001$). Furthermore, participants who lived with their cotwins were less lonely ($\beta = -0.08, p = .003$). When these covariates were controlled for, self-reported collective efficacy and neighborhood disorder remained significantly associated with loneliness ($\beta = -0.14, p < .001$ and $\beta = 0.08, p < .001$, respectively; see Table 2, Model 2). Tables S1 and S2 in the Supplemental Material available online show the attenuation of the associations when each individual covariate was added to the model.

Participants who had moved home between the ages of 12 and 18 were also lonelier on average ($\beta = 0.07, p = .008$). Controlling for this did not attenuate the associations between self-reports of neighborhood characteristics and loneliness (see Table 2, Model 3). When the sample was restricted to participants who had lived in the same neighborhood between the ages of 12 and 18, the associations between self-reported collective efficacy and loneliness remained significant ($\beta = -0.13, p < .001$), as did the association between self-reported neighborhood disorder and loneliness ($\beta = 0.06, p = .03$).

Cotwin control analyses

Among cohabiting twin pairs, within-pair differences in loneliness were significantly associated with differences in self-reported collective efficacy ($\beta = -0.11, p = .006$), indicating that lonelier individuals perceived lower collective efficacy in their neighborhoods than did their less lonely siblings who lived in the same neighborhood. That is, loneliness was associated with lower perceived levels of collective efficacy even after actual neighborhood conditions were held constant by design. This association remained robust when analyses controlled for twin differences in depression ($\beta = -0.12, p = .004$) and in neuroticism ($\beta = -0.11, p = .006$). However, twin differences in loneliness were not associated with differences in self-reported neighborhood disorder ($\beta = 0.06, p = .12$). That is, lonely and nonlonely siblings perceived comparable levels of disorder in the same neighborhood, suggesting that the correlation between these variables is partly explained by environmental exposures shared by siblings in a family (including the neighborhood).

Sensitivity analyses

The interviewer ratings of participants' loneliness were not associated with the independently measured

Table 2. Regression Results for the Associations Between Neighborhood Characteristics and Loneliness

Data source and variable	Model 1			Model 2			Model 3			Model 4		
	<i>b</i>	β	<i>p</i>	<i>b</i>	β	<i>p</i>	<i>b</i>	β	<i>p</i>	<i>b</i>	β	<i>p</i>
Government data												
Low neighborhood SES	-0.09	-0.02	.56	-0.17	-0.04	.22	-0.17	-0.04	.22	-0.09	-0.02	.58
Population density	-0.00	-0.03	.19	-0.00	-0.02	.41	-0.00	-0.02	.41	-0.00	-0.01	.71
Violent crime	0.00	0.01	.72	0.00	0.02	.59	0.00	0.02	.60	0.00	0.02	.49
Systematic social observations												
Physical decay	0.01	0.00	.87	0.01	0.00	.88	0.01	0.00	.88	0.02	0.02	.57
Physical disorder	0.02	0.01	.70	0.01	0.01	.77	0.01	0.01	.77	0.01	0.01	.82
Unsafe neighborhood	0.04	0.02	.40	0.02	0.01	.66	0.02	0.01	.66	0.03	0.01	.66
Residents survey												
Neighborhood safety	-0.05	-0.01	.63	0.05	0.01	.59	0.05	0.01	.60	0.02	0.01	.85
Neighborhood disorder	0.10	0.02	.55	-0.04	-0.01	.81	-0.04	-0.01	.80	0.02	0.00	.92
Collective efficacy	0.03	0.01	.80	0.03	0.01	.74	0.03	0.01	.74	-0.02	-0.00	.87
Self-reports												
Collective efficacy	-0.05	-0.18	< .001	-0.04	-0.14	< .001	-0.04	-0.14	< .001	-0.04	-0.13	< .001
Neighborhood disorder	0.10	0.16	< .001	0.05	0.08	< .001	0.05	0.08	< .001	0.04	0.06	.03

Note: Model 1 controlled for sex and family socioeconomic status (SES; *ns* range from 1,845 to 2,048). Model 2 additionally controlled for depression, neuroticism, and whether the participant lived with the cotwin (*ns* range from 1,823 to 2,025). Model 3 additionally controlled for change of address between ages 12 and 18 years (*ns* range from 1,823 to 2,025). Model 4 was restricted to individuals who lived at the same address between the ages of 12 and 18 years (*ns* range from 1,318 to 1,452). Analyses in Model 4 were weighted to account for bias due to factors related to residential mobility.

neighborhood characteristics (see Table 3). They were, however, associated with participants' self-reports of collective efficacy ($\beta = -0.19$, $p < .001$) and neighborhood disorder ($\beta = 0.12$, $p < .001$). This indicates that the association between self-reported loneliness and perceived collective efficacy was not due to shared method variance arising from the use of a single informant in the analyses above. These associations remained when we controlled for covariates (collective efficacy: $\beta = -0.13$, $p < .001$; neighborhood disorder: $\beta = 0.05$, $p = .02$). Similarly, loneliness at age 12 years was not associated with any of the neighborhood characteristics measured via government data, systematic social observations, or resident surveys (see Table 3). However, it was associated with lower self-reported collective efficacy at age 18 years ($\beta = -0.13$, $p < .001$). This indicates that the pattern of significant and nonsignificant associations found for loneliness at age 18 was not due to self-reported neighborhood characteristics being measured at the same age, whereas the other measures were more temporally distal from the loneliness measure. The association between childhood loneliness and perceived collective efficacy was robust to covariates ($\beta = -0.11$, $p < .001$) and to the childhood-depression

scale containing the remaining items of the CDI ($\beta = -0.05$, $p = .01$). An association was also found between childhood loneliness and perceived neighborhood disorder in young adulthood ($\beta = 0.10$, $p < .001$). This association was robust to the age-18 covariates ($\beta = 0.07$, $p = .01$); however, it became nonsignificant when we controlled for the childhood-depression scale ($\beta = 0.02$, $p = .30$).

Discussion

The findings of this study reveal that among young adults, loneliness occurs equally within many different types of neighborhoods, irrespective of urbanicity, population density, deprivation, or crime. This complements previous findings in this sample that indicated that loneliness among young people is an indiscriminate phenomenon that shows no sex difference and no socioeconomic gradient (Matthews et al., 2019). Despite the consistent pattern of null associations when looking at objective measures of the neighborhood, lonelier individuals viewed their neighborhoods as having lower collective efficacy (i.e., trust, cohesion, and control) and greater neighborhood disorder (i.e., physical and

Table 3. Results of Sensitivity Analyses on the Association Between Loneliness and Key Variables

Data source and variable	Interviewer-rated loneliness (age 18)	Self-reported loneliness (age 12)
Government data		
Low neighborhood SES	0.04	0.00
Population density	0.01	-0.03
Violent crime	0.05	-0.01
Systematic social observations		
Physical decay	-0.02	0.00
Physical disorder	0.02	-0.01
Unsafe neighborhood	-0.02	-0.02
Residents survey		
Neighborhood safety	-0.02	-0.01
Neighborhood disorder	0.00	0.00
Collective efficacy	0.01	0.02
Self-report		
Collective efficacy	-0.19*	-0.13*
Neighborhood disorder	0.12*	0.10*

Note: Standardized regression coefficients are shown. All analyses were adjusted for sex and family socioeconomic status (SES).

* $p < .001$.

social signs of threat), even though surveys of other residents in the neighborhood did not corroborate this perception. Prior studies have also found associations between loneliness and more negative self-reports of neighborhood characteristics (Bromell & Cagney, 2014; Kearns et al., 2015; Scharf & de Jong Gierveld, 2008). This study extended these findings by using a multi-informant approach to address the potential for a bias effect when relying only on self-report data.

The disparity between self-reports and more independent or objective sources of data suggests that lonelier individuals have more negatively skewed perceptions of their neighborhoods. This would be consistent with previous research showing that loneliness is associated with cognitive biases that include more negative expectations and appraisals of social interactions as well as heightened sensitivity to threatening social stimuli (Bangee, Harris, Bridges, Rotenberg, & Qualter, 2014; Cacioppo & Hawkey, 2009; Spithoven, Bijttebier, & Goossens, 2017). This hypothesis of a reporting bias is supported by the cotwin control analyses, which showed that even within sibling pairs who live in the same home, the lonelier siblings were more likely to perceive their neighborhoods' collective efficacy to be lower. Further, the controls for covariates showed that these perceptions were not attributable to depression or neurotic personality traits, suggesting that there is something specific to loneliness that is associated with negatively biased perceptions of collective efficacy.

On the other hand, the cotwin control analyses also indicated that the association between loneliness and perceived neighborhood disorder was partly explained by environmental effects shared by siblings within a family, which may include the neighborhood. This does not, however, explain why lonelier individuals' higher average ratings of neighborhood disorder, although corroborated by their nonlonely siblings, were not borne out by the ratings made by other residents or by the systematic social observations. This suggests that the shared environmental effects that drive the association between loneliness and perceived neighborhood disorder do not arise from the neighborhood itself but from other factors that are shared by siblings, such as family or peer-group influences. Alternatively, it may be that siblings living at the same address jointly witness more of the same examples of disorder in their neighborhood, making their reports more similar to each other, whereas the reports by other residents in the neighborhood may be more heterogeneous. Furthermore, the measure of neighborhood disorder refers to more concrete details such as physical evidence and threatening events, whereas the measure of collective efficacy is more open to interpretation.

The 18-year-old twins who still lived together were less lonely than those who lived apart. Moving out of the family home, potentially to a different town or city, is a significant milestone in young adults' lives, and the upheaval caused to social networks could be an isolating experience for some. Furthermore, people who had moved their home at any point during the 6-year period covered in this study were lonelier on average. Thus, although objective features of the neighborhood were not associated with loneliness, there was evidence that the stability of the neighborhood environment may still play a role. This too may reflect the pressures of moving away from friends or family and putting down roots in a new, unfamiliar location (Oishi & Talhelm, 2012).

Limitations

These findings should be interpreted in the context of some limitations. Whereas the self-report measures were collected when participants were 18 years of age, the other measures were collected between the ages of 12 and 18. In comparing their respective associations with loneliness, we did not take into account that aspects of the neighborhood could have changed over time between the different measurement points. Nonetheless, the sibling comparison analyses addressed this by cross-sectionally comparing the perceptions of individuals living in the same neighborhood at the same time. Additionally, the analyses using the measure of childhood loneliness indicated that the differential pattern of associations for self-reports versus other reports

of neighborhood characteristics was not simply an artifact of loneliness and self-reported neighborhood perceptions being measured cross-sectionally.

Second, loneliness at age 12 was measured using items from a depression scale, rather than a validated loneliness scale. These items were selected for their face validity and are similar to items in the widely used Children's Loneliness Scale (Maes, Van den Noortgate, Vanhalst, Beyers, & Goossens, 2017), which captures feelings such as being alone, lacking friends, and not being liked. Nonetheless, further work is required to validate this approach, particularly in view of the low internal consistency of the items. Moreover, the fact that loneliness was assessed using different measures at 12 and 18 could have led to underestimation of the stability of loneliness between these ages. However, the UCLA Loneliness Scale is primarily used to assess loneliness in adults and may not be age appropriate for young children.

Third, the size of the study sample was not sufficient to examine the geographic distribution of loneliness in the United Kingdom. The UK charity Campaign to End Loneliness has called for "loneliness maps" to be published to help identify where the loneliest members of society are concentrated (Goodman, Adams, & Swift, 2015). Although the E-Risk data set is a rich source of postcode-linked information, there was insufficient density of observations to generate heat maps of loneliness in the United Kingdom, and therefore, much larger sample sizes are required to identify loneliness hot spots. However, the pattern of null associations in this study indicates that loneliness is evenly distributed across diverse types of neighborhoods, and we therefore hypothesize that the geographic spread of loneliness will be similarly indiscriminate.

Implications

If lonelier individuals perceive the collective efficacy in their neighborhoods to be lower than is actually the case, the implications are threefold. First, from a research perspective, it is important to consider that relying on self-report data alone to judge features of the environment may lead to overreporting of negative experiences by lonely individuals. Using data from independent informants in conjunction with self-reports can address this potential source of bias. Second, in young adulthood, individuals begin to make decisions about where they want to live. If lonelier individuals are disposed to perceive neighborhoods more negatively, this could lead them to make biased choices and avoid areas that are in fact more cohesive than they judge them to be. Indeed, rather than seeking out more cohesive neighborhoods, lonely individuals may be

more likely to self-select into environments that match their negative mood. This in turn could limit their opportunities to join close-knit communities and escape loneliness. Third, although interventions targeted at the neighborhood or community level may convey benefits, our findings do not support neighborhoods as a cause of loneliness among young adults. Instead, these data suggest that addressing lonely individuals' perceptions could be an additional target for intervention. This is consistent with a meta-analysis showing that addressing maladaptive cognitions is more effective at reducing loneliness compared with other strategies, such as increasing social contact (Masi, Chen, Hawkey, & Cacioppo, 2011).

Action Editor

Erika E. Forbes served as action editor for this article.

Author Contributions

T. Matthews was responsible for reviewing the literature, analyzing the data, and writing the draft manuscript. All other authors reviewed the manuscript. A. Caspi and T. E. Moffitt were responsible for the conception, design, and management of the study. L. Arseneault supported data analysis and interpretation and was responsible for the conception, design, and management of the study. All the authors approved the final manuscript for submission.

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Supplemental Material

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Open Practices

This study was not formally preregistered; however, the plan of analyses was archived in advance at <https://sites.google.com/site/dunedinriskconceptpapers/e-risk-approved>. Data and materials have not been made publicly available.

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