



# Comparisons of the discrepancy between loneliness and social isolation across Ireland and Sweden: findings from TILDA and SNAC-K

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## Abstract

**Purpose** Loneliness may have different cultural meanings in different countries. This may manifest as differing levels of Social Asymmetry—the discrepancy between loneliness and social isolation. Since loneliness is thought to be low in Sweden relative to more southerly countries, we hypothesised that more number of individuals would also fall into the “discordant robust” category of Social Asymmetry, i.e. that more individuals in Sweden would have lower loneliness levels relative to social isolation than in Ireland. We also explored the clinical relevance of Social Asymmetry in both countries, by examining its association with cognitive functioning.

**Methods** We derived Social Asymmetry metrics in two representative cohort studies: the Irish Longitudinal Study on Ageing (TILDA) and the Swedish National Study on Aging and Care in Kungsholmen (SNAC-K). Data pertaining to a dementia-free sample of 4565 Irish participants and 3042 Swedish participants, all aged over 60 years, were analysed using a multilevel modelling approach, with country as a higher-order variable.

**Results** Contrary to the expected, more individuals in Ireland were “discordant robust” than in Sweden. We also found evidence for superior performance in global cognitive functioning among those in the “discordant robust” category relative to those in the discordant susceptible (i.e. those with higher levels of loneliness than social isolation) category,  $\beta = 0.61$ ,  $p < .001$ , across both countries.

**Conclusions** Irish older adults may be more robust to the impact of social isolation on loneliness than those in the Swedish cohort. Social Asymmetry was related to cognitive functioning in both countries, suggesting that Social Asymmetry is a clinically relevant construct.

**Keywords** Loneliness · Social isolation · Cognitive functioning · Multilevel modelling · Cross-cultural

## Introduction

Loneliness, the subjective insufficiency of one’s social connections [1], may be in part contingent upon cultural and social norms. For instance, since social norms in collectivist

cultures may lead to expectations of higher levels of social engagement, older adults in these cultures may be more prone to experiencing loneliness in the absence of sufficient social engagement [2–7]. Loneliness has been said to reflect “the individual’s relationship to the community” [8], p174. Johnson and Mullins describe the “loneliness threshold” as being a culturally determined minimum of social interaction required to avoid loneliness [3]. While loneliness is found in all cultures [9], it may create different types or forms of loneliness [10] via mechanisms such as social norms, political context [11], and distribution of wealth [12].

That said, more often than not, existing definitions of loneliness [13] fail to take culture into account [14]. This failure exists despite the fact that empirical findings indicate that loneliness differs cross-culturally [15–18], such that nationality outperformed even age in predicting loneliness [19]. Specifically, patterns of cross-cultural differences

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in loneliness are evident such that levels increase moving from north to south in Europe [4], reportedly because social norms dictate that living alone is common in northern European countries, meaning that individuals are less likely to experience loneliness if they live alone. To illustrate this, loneliness is more likely to be reported by older adults in Italy than in the Netherlands or Canada [20]. However, previous findings do not always corroborate the theory that collectivistic cultures have higher levels of loneliness than individualistic countries.

Loneliness is thought to be dependent on the level of social isolation one can expect to experience, which is partly influenced by social norms [4]. If it is the case that loneliness differs cross-culturally because of social norms related to social engagement, then it is of interest to explore how the relationship between social engagement and loneliness varies in different cultures too. If the discrepancy between loneliness and more objective measures of social engagement differs across countries, then this could be taken as support for the idea that culture shapes social norms in relation to feelings of loneliness.

Previously, we hypothesised that Social Asymmetry, or the discrepancy between loneliness and social isolation, may differ cross-culturally because it describes individual propensity to loneliness given a specific state of social isolation, thus reflecting cultural differences in social norms [21]. These norms might be of little consequence if they are unrelated to clinical outcomes. However, loneliness has been found to be closely associated with depressive symptoms [22, 23] and as such warrants clinical attention. Another clinical outcome of interest is cognitive functioning. Since dementia is increasing in prevalence worldwide, projected to reach 132 million cases by 2050 [24], it is of critical importance to understand the predictors of cognitive functioning in the ageing population, for both clinical and economic purposes.

Cognitive functioning is known to be related to both loneliness and social isolation [25–28], for reasons most clearly expanded upon by Cacioppo [29]. In addition, cognitive decline in its most concerning form, dementia, is often rated as a significant worry of later life, impacting psychological well-being [30, 31]. For these reasons, we previously investigated the association between Social Asymmetry and cognitive functioning in older Irish and English samples. When we calculated the discrepancy between loneliness and social isolation, characterising individuals as either concordantly lonely and isolated (as lonely as they were socially isolated) or discordantly lonely and isolated (either more or less lonely than socially isolated), we found that being discordant (such that loneliness was higher than social isolation) was predictive of poor cognitive functioning, both cross-sectionally and over time [21]. Thus, we argued that it was those individuals whose loneliness was worse than

one would expect relative to their isolation status who fared worse, not those who were high in both, as one would expect if the effects of loneliness and social isolation were independent or additive. Individuals who have high levels of loneliness relative to their isolation status may have high expectations of social engagement or connectedness; loneliness in this case would be the result of a perceived discrepancy between actual and desired social connectedness, as defined previously [32]. Additionally, this categorisation was also associated with cognitive functioning.

If, as it has previously been suggested, countries in the northernmost part of the world may have lower expectations when it comes to social connectedness [4], it would also make sense that this would be reflected in Social Asymmetry patterns. Individuals with low expectations of social connectedness may avoid experiencing loneliness even in the presence of high social isolation, a situation which would correspond to a categorisation of “discordant robust (to loneliness)” within Social Asymmetry.

In the previous cited research [21], data pertaining to two jurisdictions, England and the Republic of Ireland, were analysed. Comparisons of the two jurisdictions were limited because of their considerable shared history and likely similar cultures. Since little difference was found between Irish and English populations in terms of Social Asymmetry, we wanted to explore a culturally different population and compare patterns across countries. Specifically, we operationalised Social Asymmetry in data arising from the Swedish National Study on Aging and Care in Kungsholmen Study (SNAC-K). Ireland and Sweden differ in terms of held values also, since Irish populations espouse more traditional values, while Sweden has the highest rates of secularised values in the world, according to data from the World Value Survey [33]. Traditional values may drive differences in social norms underpinning loneliness and social isolation, which may manifest in different rates of Social Asymmetry in the two countries (with Ireland’s traditional values ensuring that the individual is more protected from loneliness and more likely to be discordant robust to loneliness than in the more secular Sweden, in which traits such as independence, autonomy, and self-fulfilment driven by secular individualistic values may lead to lower frequencies of desired social interactions [22]).

We hypothesised, based on previous research, that since Sweden is more secularised than Ireland and England, the prevalence of individuals categorised as discordant robust to loneliness would be higher in this population.

Additionally, we explored the clinical relevance of Social Asymmetry in both countries by analysing its association with a screen of cognitive functioning, since this is a pertinent measure of independent functioning and well-being in an ageing population. It is hypothesised that, similar to our previous findings [21], the association between Social Asymmetry

and cognitive functioning will not differ between Ireland and Sweden.

Taken together, this study aimed to explore whether the levels of Social Asymmetry differ across Ireland and Sweden, and whether it is related to cognitive functioning in both countries, or whether the association between Social Asymmetry and cognitive functioning differs across countries.

## Methods

### Design and participants

The Irish Longitudinal Study on Ageing (TILDA) is a nationally representative cohort study of ageing adults in the Irish population ( $n = 8504$ ) recruited via random sampling. To date, four waves of data (beginning in 2007–2009 and repeated every 2 years thereafter) have been collected. Data pertain to the social, psychological, economic, and health circumstances of participants [34]. For the purposes of the current analysis, we included only those participants who partook in the baseline examination in year 2007–2009. Moreover, those who were aged under 60 years ( $n = 3380$ ), and those who had likely or diagnosed dementia at baseline ( $n = 28$  of those aged over 60), were excluded, leaving a subsample of 4565 participants. The study was approved by the Faculty of Health Sciences Research Ethics Committee at Trinity College Dublin, and all participants gave their informed consent to take part in the study.

The Swedish National Study on Aging and Care in Kungsholmen (SNAC-K) is a longitudinal study exploring health and care among ageing adults in the Kungsholmen region of Stockholm. Running since 2001, SNAC-K gathers longitudinal data describing multifactorial aspects of the ageing process among participants aged 60 years and over at baseline and living at home or in institutions. Because stratified random sampling was used at the project outset, the data are representative of older adults living in Kungsholmen. We focus our current analyses on those individuals who partook in baseline data collection in 2001–2004 ( $n = 3363$ ). For the purposes of the current analyses, participants who did not undergo the medical examination at baseline ( $n = 10$ ) or had likely or diagnosed dementia at baseline ( $n = 311$ ) were excluded from analyses, yielding a sample size of 3042. The SNAC-K study has been approved by the Regional Ethics Review Board in Stockholm, and all participants gave informed consent to participate.

### Measures

#### Social Asymmetry

Baseline loneliness and social isolation were used to derive Social Asymmetry at baseline in both studies. Within each

cohort, attempts were made to operationalize both loneliness and social isolation, and as a result, Social Asymmetry, in as similar a manner as was possible. In the SNAC-K, loneliness was measured using three questions. Question 1 inquired whether participants ever felt lonely, with response options as: “no, would like more time for myself”; “not ever lonely”; “seldom lonely”; “sometimes lonely”; and “often lonely”. This item was recoded such that a response of “often lonely” was given a score of 3, “sometimes lonely” a score of 2, “seldom lonely” a score of 1, and both “not ever lonely” and “no, would like more time for myself” a score of 0. In TILDA, the most comparable question was an item taken from the Centre for Epidemiological Studies depression (CES-D) scale [35]. This question asked participants whether they felt lonely, and the response options were “rarely or never lonely” (coded as a score of 0), “sometimes lonely” (coded as a score of 1), “moderately lonely” (coded as a score of 2), and “lonely all the time” (coded as a score of 3). Thus, in both studies, the overall loneliness score ranged between 0 and 3, where 0 indicated not being lonely and 3 as being very lonely.

In both studies, social isolation was operationalised according to the Social Network Index [36] which has four items: marital status, religiosity, group membership, and the presence of at least two individuals aside from a spouse that the individual feels close to. Sufficient data were available for each dataset to be able to calculate this index in both countries. Marital status was operationalised such that a score of zero indicated that the individual was neither married nor cohabiting, and a score of one indicated that the individual was married or cohabiting. Religiosity was operationalised such that a score of one indicated that the individual engaged in at least monthly religious services, and zero otherwise. Group membership was operationalised such that a score of zero indicated that the individual did not engage in any social group, and a score of one indicated that they did; and finally, individuals were given a score of one if they indicated that there were at least two individuals in their life (outside of the spousal relationship) that they felt close to. Thus, scores on the Social Network Index have a range of between 0 and 4 with lower scores indicating social isolation and higher scores indicating social connectedness.

Loneliness and social isolation were used to derive Social Asymmetry in both studies. Social Asymmetry and its derivation has previously been described [21] and, to summarise, entails the calculation of standardised scores of both loneliness and social isolation, the subtraction of scores of loneliness from scores of social isolation, and the categorisation of the resultant discrepancy scores into three categories. If the discrepancy falls below a standard deviation of the mean, then participants are categorised as “concordant”, i.e. their loneliness levels align with their social isolation levels. If the discrepancy is above a standard deviation of

the mean such that loneliness is higher than social isolation, they are categorised as “discordant susceptible”, that is, they are lonelier than they are socially disconnected. If, on the other hand, the discrepancy is above a standard deviation of the mean, such that loneliness is lower than social isolation, participants are labelled “discordant robust”, meaning that they are relatively low in loneliness considering their level of social isolation. In previous analyses, we further divided the “concordant” group of individuals into “concordant: high loneliness and social isolation” and a “concordant: low loneliness and social isolation” subgroups, based on a median split of loneliness [21]. However, in those analyses, loneliness was measured using scores on a five-item version of the UCLA loneliness scale [37], yielding scores between 0 and 10, which meant that a median was more meaningful than it would have been in the current analysis, where the only comparable measure of loneliness across the two studies was one item with scores ranging between 0 and 3, and as such because the range was low (4), a median score was less informative. As such the decision was made to retain one concordant group, including those at high and low levels of loneliness, and to control for loneliness as a separate covariate to try to approximate our previous analyses.

### Cognitive impairment

The clinically relevant outcome of interest was the Mini Mental State Examination (MMSE), obtained at baseline [38]. The MMSE is a widely used clinical screening instrument for dementia yielding scores of 0–30, whereby in an Irish context scores below 24 indicate the likely presence of dementia [39]. In this study, MMSE was used as a continuous variable.

### Socio-demographics

Age, sex, and education level were included as covariates in the subsequent inferential analyses. In both studies, age was coded as an integer value. In both studies, sex was coded as a nominal variable (with categories “male” and “female”), and education level was coded as a nominal variable with three categories (“no qualifications”, “second-level qualifications”, “third-level qualifications”). In both studies, data were collected using a combination of self-completion and interview by trained interviewers and medical personnel.

### Data analysis

To first evaluate potential differences in the proportion of individuals falling into each Social Asymmetry category in each country, Chi squared statistics for contingency tables were derived (both variables—Social Asymmetry and country—were considered to be nominal in this analysis). These

analyses are appropriate when the aim is to evaluate whether statistically significant proportions of frequencies in a categorical variable exist across levels of a second categorical variable. Standardised residuals were first calculated for each cell (with rows as Social Asymmetry and columns as country) and compared to the criterion value of 1.96 (with alpha at 0.05). If the residuals were shown to be greater than 1.96, then it can be inferred that there is a greater than expected frequency of individuals in that level of Social Asymmetry in that country.

Next, a series of multilevel linear models were derived. Multilevel linear modelling (MLM; also referred to as hierarchical modelling) is useful if a researcher wishes to evaluate whether an effect exists and varies as a function of a higher-level variable. In this case, the higher-level variable is country, since all other data can be said to be nested within levels of country (Ireland or Sweden). In tandem with these country-level effects, MLM can also compute individual level effects and interactions between these two levels of effects (i.e. country- and individual-level effects).

First, we derived an intercept-only model to ascertain whether a multilevel model was appropriate. This model included MMSE as the outcome, and the intercept as the predictor (using maximum likelihood estimation). Next, we fit the same model, but allowed the intercept to vary across countries (i.e. make it a “random” intercept). If this second model proved to be a better fit to the data than the initial model, then one could conclude that adding random intercept (and therefore a multilevel approach) improves model fit, because there is evidence of a country-level effect on MMSE.

Next, Social Asymmetry was added as a fixed effect, and then as a random slope (i.e. to see if its impact on MMSE varies across countries). Next, covariates age, sex, and education level were added to the model. Finally, loneliness was added as a final covariate, to see if it had an effect beyond that of Social Asymmetry. All analyses were conducted using R Studio software, and the multilevel modelling was conducted using the nlme package (Pinheiro, Bates, DebRoy, Sarkar, R Core Team, 2018). For the purposes of all analyses, data pertaining to the SNAC-K and the TILDA studies were merged using R Studio (R version 3.5.0).

## Results

Samples are described in terms of their baseline data in Table 1. The SNAC-K sample was significantly older than the TILDA sample, with significantly fewer males, and clear differences in the frequencies of individuals attaining third-level education (more than a third of the sample in SNAC-K relative to one-eighth in TILDA). Individuals in the SNAC-K sample reported significantly higher levels of loneliness,

lower levels of social connectedness, and higher scores of global cognitive functioning relative to those in TILDA. The differences in overall social connectedness across the two countries were on closer inspection attributable to differences in the proportions of individuals with at least two close friends or relatives (98% in TILDA; 80% in SNAC-K), in the proportions of those married/cohabiting relative to otherwise (70% in TILDA versus 45% in SNAC-K), in the proportions of those engaged in regular religious activities (65% in TILDA versus 51% in SNAC-K), and in those engaged in other social groups (48% in TILDA versus 62% in SNAC-K).

The difference in loneliness levels across countries ( $\beta = -0.25, p < .001$ ) persisted even after controlling for age ( $\beta = 0.08, p < .001$ ), sex ( $\beta = 0.13, p < .001$ ), and education ( $\beta = -0.05, p < .001$ ).

### Social Asymmetry across countries

Frequencies across the three categories of Social Asymmetry were compared in the two countries using a Chi square contingency table analysis and a post hoc multiple regression [40], with Bonferroni corrections applied for multiple comparisons. The overall Chi square contingency analysis indicated that the null hypothesis (that country and Social Asymmetry were independent) was rejected ( $\chi^2_2 = 171.3, p < .001$ ; Cramer’s  $V = 0.165$ ), meaning that there was country-level differences in the proportions of individuals belonging to each Social Asymmetry category.

On closer inspection of the standardised residuals, in SNACK, there were more number of participants than expected (based on the Chi square analysis) falling into the concordant category (standardised residual = 2.8, compared to 1.96 at  $p < .05$ ), fewer than expected participants falling into the discordant robust category (standardised residual = -8.9), and more than expected participants falling into the discordant susceptible category (standardised residual = 4.2). In TILDA, meanwhile, there were fewer than expected participants falling into the concordant category (standardised residual = -2.2), more than expected participants falling into the discordant robust category (standardised residual = 7.1), and fewer than expected participants falling into the discordant susceptible category (standardised residual = -3.3).

### Multilevel modelling in SNACK and TILDA

Next, we explored the impact of Social Asymmetry on MMSE within a multilevel context (scores of Social Asymmetry and MMSE were nested within country as the higher-level variable). As described above, six alternative, nested models were implemented and compared using their “-2 log-likelihood” values, or -2LL (a useful statistic for comparing nested models), and using comparative Chi squared statistics with lower levels indicating better model fit (see Table 2). AIC and BIC, two penalised likelihood criteria which can be used to compare models such that lower values indicate better fit, were also calculated.

**Table 1** Baseline characteristics for the two study samples (TILDA and SNAC-K)

	TILDA (mean and standard deviation or frequency) <i>n</i> = 4565	SNAC-K (mean and standard deviation or frequency) <i>n</i> = 3042	Difference ( $\chi^2$ or <i>t</i> )
Age	69.58 (6.55)	73.27 (10.48)	$t = 24.86, p < .001$
Sex	Male 46.38% ( <i>n</i> = 2117) Female 53.62% ( <i>n</i> = 2448)	Male 37.1% ( <i>n</i> = 1128) Female 62.9% ( <i>n</i> = 1914)	$\chi^2 = 70.08, p < .001$
Education Level	None 39.84% ( <i>n</i> = 1817) Secondary 47.91% ( <i>n</i> = 2185) Tertiary 12.26% ( <i>n</i> = 559)	None 15.3% ( <i>n</i> = 464) Secondary 49.87% ( <i>n</i> = 1512) Tertiary 34.83% ( <i>n</i> = 1056)	$\chi^2 = 683.68, p < .001$
Loneliness	0.29 (0.67)	0.74 (0.98)	$t = 22.15, p < .001$
Social connectedness*	2.91 (0.87)	2.46 (1.01)	$t = 19.97, p < .001$
MMSE	27.95 (2.33)	28.8 (1.48)	$t = 13.18, p < .001$

MMSE Mini-Mental State Examination Global Cognitive Function score (McHugh, McHugh and Folstein 1973)

\*While scores on the BSNI scale (representing social isolation) were reversed for inferential statistical analysis, here they are represented in their usual format with higher scores indicating greater levels of social connectedness

First, the random-intercept model was compared to the intercept-only model to confirm that multilevel modelling was appropriate for the data, and the resulting improvement in model fit suggested that it was. Additionally, the intraclass correlation (ICC) was calculated for this model to quantify the variance accounted for by the higher-level variable (i.e. country). ICC was calculated as the square of the standard deviation in the model, which here yielded an ICC of 0.0441. This can be interpreted to mean that 4.4% of the variance in the data is accounted for by the higher-level variable (i.e. country). To check whether multicollinearity between loneliness and Social Asymmetry was likely to affect the models, variance inflation factors were separately calculated for regression models including these two variables, alongside the other listed covariates, and no values above 1.6 were reported, suggesting that multicollinearity was not an issue in the subsequent models.

The model with the best fit was that with country as a random effect, Social Asymmetry as a fixed effect, and covariates age, sex, and education in the model (see Table 3). Results indicate that Social Asymmetry was associated with MMSE scores across both countries, controlling for age, sex, and education, and that the effect does not differ significantly across countries. As can be seen in Table 3, the highest scores of global cognitive functioning were yielded by those in the discordant robust group,  $\beta = 0.61$ ,  $p < .001$ . Country had no effect on the relationship between Social Asymmetry and MMSE scores.

## Discussion

Results indicate that loneliness relative to social isolation was lower in Ireland (where there were more participants in the discordant robust category) than in Sweden, contrary to expectation. Social Asymmetry was also associated with

**Table 3** Fixed effects multilevel model with MMSE as outcome and Social Asymmetry and covariates age, sex, and education as fixed effects, with country as a random effect

	Beta	SE	Df	T	p
Intercept	30.21	0.38	5244	79.89	<0.001
Concordant	0.28	0.07	5244	4.25	<0.001
Discordant robust	0.61	0.08	5244	7.64	<0.001
Education	0.71	0.04	5244	19.31	<0.001
Age	-0.05	0.003	5244	-18.35	<0.001
Sex	0.25	0.05	5244	5.27	<0.001

For Social Asymmetry, the referent group was discordant susceptible. For sex, the referent group was female

cognitive functioning in both countries, beyond the effects of loneliness alone.

This finding corroborates previous findings suggesting that Social Asymmetry is a clinically meaningful phenomenon in separate countries [21]. Finding a similar pattern of results across both countries corroborates previous findings indicating that Social Asymmetry has clinical relevance in older populations. We also corroborate previous studies demonstrating cross-cultural differences in loneliness [15–20], since we found that both loneliness and social isolation were lower in Ireland than Sweden.

These results have implications for theoretical considerations of loneliness. In keeping with the loneliness threshold theory of cultural differences in loneliness [3], we found cross-cultural differences in levels of loneliness notwithstanding differences in social isolation. Contrary to our initial hypothesis, in Ireland, there were more individuals whose levels of loneliness were either lower or the same as expected relative to social isolation. This may be interpreted to mean that older Irish individuals are relatively robust to experiencing loneliness in response to social isolation. We previously found, using a qualitative approach, that loneliness connotes boredom, inactivity, and vulnerability for

**Table 2** Results of six nested models and their comparisons using -2LL formula and Chi squared statistical tables

Model	AIC	BIC	-2LL	Df	Df change	Chi squared change	Significance of change
Model 1: intercept only	25,840	25,854	25,836	2	1	264	$p < .01$
Model 2: random intercept	25,578	25,598	25,572	3			
Model 3: Social Asymmetry Fixed	21,426	21,458	21,416	5	2	4156	$p < .01$
Model 4: Social Asymmetry Random	21,427	21,492	21,407	10	5	9	$p > .05$
Model 5: Social Asymmetry Fixed plus covariates (age, sex, education)	20,580	20,633	20,564	8	3	852	$p < .01$
Model 6: Social Asymmetry Fixed plus covariates, plus loneliness	20,582	20,641	20,564	9	1	0	$p > .05$

Model 4, “Social Asymmetry Random”, did not improve model fit and as such Social Asymmetry as a fixed effect was retained throughout the models with covariates added (i.e. models 5 and 6). Therefore the most appropriate comparator was model 3 (“Social Asymmetry Fixed”)

older Irish adults who are socially isolated [41]. A separate qualitative study with Swedish participants previously found that loneliness connoted a state that departs from the norm of social connectedness, occurring because of the absence of, or rejection by, important others [42]. It is possible that loneliness has a different meaning in Ireland compared to Sweden, which would help to explain the differing relationship between social isolation and loneliness in these two countries.

A methodological strength of this study is the use of two independent samples from two different countries. Both studies had large sample sizes recruited using random sampling, making results representative of both Irish and Swedish older populations. Another strength of the current study is the use of multilevel modelling to analyse potential between-country differences. This analytic approach allows us to explore the possibility that Social Asymmetry had a different relationship with cognitive outcomes in the separate countries analysed.

However, the studies used in the current analysis were not designed to be harmonised and as such may not be ideal for such purposes. Some measures, for instance, were derived in slightly different ways (as described above). Additionally, the study used a cross-sectional analysis only, limiting the extent to which conclusions can be drawn about the predictive power of Social Asymmetry. Results pertain to an older population and replication in a younger cohort may demonstrate different effects, since it is possible that younger adults may have different standards or anchors of adequate social connectedness. Another study limitation is that while the Irish cohort was national and as such included both urban and rural dwellers, the Swedish cohort was urban only, which may mean that there are systematic differences across the cohorts that might affect their perspectives on social isolation. We previously found that rural older Irish adults, for instance, define loneliness in a manner different from that previously found in the literature (McHugh Power, Hannigan, Carney and Lawlor [41]), citing low geographical density and relative isolation as positive aspects of rural living, while loneliness was seen as more of a reaction to the possible security consequences of living in an isolated place. This association between rural dwelling and loneliness has been reported cross-sectionally in Ireland previously [43], while rurality was also shown to predict increasing social isolation over time in an English ageing population [44]. However, other findings indicate that loneliness is higher among urban-dwelling older adults [45], or that there is no effect of geographical location on loneliness in later life [46], making it difficult to predict the effect that having had more rural dwellers in the Swedish cohort would have had on cohort differences in loneliness.

There were more females in the Swedish than in the Irish cohort (just over one-half of the Irish cohort relative to over

3/5 of the Swedish cohort). This difference may partly drive some of the observed differences in key variables in the current analysis (although analyses were adjusted for gender). For instance, loneliness among women is found to be higher following meta-analysis [47], while disagreement across studies is evident in relation to the effect of gender on social isolation [48], with some studies finding higher rates among males and others among females. This means that it is difficult to make predictions about gender breakdown in Social Asymmetry, and the manner in which different proportions of females to males would impact this variable.

Differences were reported across the samples in education level also. While two-fifths of the Irish sample received less than second-level education, only less than one-fifth of the Swedish sample were categorised as such, and while only one-eighth of the Irish sample received third-level education or higher, over one-third of the Swedish sample were in this category. The Swedish cohort were from Stockholm, which is the area with the highest level of education among adults in Sweden [49]. In addition, comparisons of education level rates by EuroStat (gathered in the EU Labour Force Survey) indicate that in the oldest age group recorded (55–74), more Irish than Swedish older adults obtained less than second-level education (41.6% relative to 26.1% in 2017), but rates of third-level education were almost comparable (26.4% in Ireland relative to 29.7% in Sweden) [50]. This suggests that the differences found in the current analysis are likely to be a result of the specific location in Sweden chosen as the comparator, rather than reflecting a broader cross-country difference in education levels. However, the current inferential analyses show that while education level was associated with cognitive functioning in both countries, the nature or extent of this effect did not differ across countries—in both Sweden and Ireland, those with the highest educational attainment level also have the highest scores of cognitive functioning.

We used the Berkman–Syme Social Network Index [36] to measure social isolation in both cohorts. This measure has been used in TILDA and is an abbreviated version of an earlier index [51] designed to be deliverable in a large battery of biopsychosocial tests; thus, it is designed for brevity rather than detail. We acknowledge, however, that the index is not an ideal measure of social isolation and that, given more resources and participant time, a more detailed account of social isolation status could be created in both cohorts. This would potentially provide the context necessary to give a full account of the cross-cultural differences in social isolation in existence, and further collection of contextual variables such as family size and friendship group size (which may vary cross-culturally also) would help to explain cross-cultural variation in isolation such as that found in the current study.

Furthermore, while the MMSE is frequently used as a scale of global cognitive functioning, some have contended that this measure is more useful as a clinical

screening instrument rather than a satisfactory measure of global cognitive functioning [52, 53]. Further research could use more appropriate cognitive measurements to further explore the nature of the association between Social Asymmetry and cognitive functioning in older adults.

The current findings bring forth further questions in relation to the cross-cultural differences in loneliness and in relation to the clinical relevance of Social Asymmetry. Given that Social Asymmetry associated more strongly than loneliness in relation to cognitive functioning, it may be that the former is more informative than the latter, since it provides information about loneliness in the context of social isolation and susceptibility to loneliness. Further research should explore Social Asymmetry in relation to other clinically important outcomes for older adults. For instance, loneliness and social isolation are both associated with depression and anxiety in later life [54–62], and our unpublished analyses using TILDA data indicate that Social Asymmetry is also predictive of these important psychiatric outcomes, which are reported to be the two most common psychiatric complaints of later life [63].

Further research is also required to explain the differences in Social Asymmetry and loneliness in different cultures. If, as we propose, this is due to different meanings of loneliness in different cultures, then this would have important implications for the manner in which interventions are designed to mitigate the effects of loneliness; if in Ireland, for instance, loneliness suggests vulnerability, then attempting to make older socially isolated adults feel more secure in their homes may serve to alleviate it.

In conclusion, we report that Social Asymmetry has a different prevalence in Ireland and Sweden, but that the association between Social Asymmetry and cognitive functioning is consistent across both countries. We provide evidence that runs counter to the ideas previously put forward in relation to a north–south divide in loneliness, such that loneliness and Social Asymmetry are lower and less of an issue in Ireland than in Sweden. We suggest that differences in Social Asymmetry and loneliness across Ireland and Sweden may stem from different interpretations of the concept in these countries.

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### Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** All human studies were approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

**Informed consent** All persons gave their informed consent for inclusion in the study.

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