

Lepinteur, Anthony et al.

Working Paper

Gender, Loneliness and Happiness during COVID-19

IZA Discussion Papers, No. 15653

Provided in Cooperation with:

IZA – Institute of Labor Economics

Suggested Citation: Lepinteur, Anthony et al. (2022) : Gender, Loneliness and Happiness during COVID-19, IZA Discussion Papers, No. 15653, Institute of Labor Economics (IZA), Bonn

This Version is available at:

<https://hdl.handle.net/10419/267390>

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ISSN: 2365-9793

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ABSTRACT

Gender, Loneliness and Happiness during COVID-19*

We analyse a measure of loneliness from a representative sample of German individuals interviewed in both 2017 and at the beginning of the COVID-19 pandemic in 2020. Both men and women felt lonelier during the COVID-19 pandemic than they did in 2017. The pandemic more than doubled the gender loneliness gap: women were lonelier than men in 2017, and the 2017-2020 rise in loneliness was far larger for women. This rise is mirrored in life-satisfaction scores. Men's life satisfaction changed only little between 2017 and 2020; yet that of women fell dramatically, and sufficiently so to produce a female penalty in life satisfaction. We estimate that almost all of this female penalty is explained by the disproportionate rise in loneliness for women during the COVID-19 pandemic.

JEL Classification: I10, I14, I18, I30

Keywords: loneliness, life satisfaction, gender, COVID-19, SOEP

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* We are very grateful to two anonymous referees, whose comments greatly improved the paper. We also thank Thomas Rieger for his help with the data analysis. The data that support the findings of this study are available from DIW Berlin but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. The code used in the analysis will be made available.

1. Introduction

The COVID-19 pandemic has spurred an enormous amount of work on the ways in which individual's lives have changed. Many contributions have underlined that women have been harder hit than men by the pandemic, in both the home and work environments, even though fatality rates have been higher for men (Global Health 5050, 2020, Dang and Nguyen, 2021, Dunatchik *et al.* 2021, and Yavorsky *et al.* 2021). Between March and April 2020, labour-force participation and working time were significantly reduced by stringency measures in the UK, the US and Germany, with the effects in each country being larger for women (Adams-Prassl *et al.*, 2020); in addition, the risk of poverty rose more for women in 2020 in France, Germany, Italy, Spain and Sweden (Menta, 2021). The closure of schools and daycare centres, combined with the disproportionate effect of social distancing on the sectors with pronounced female employment, exacerbated the existing gender gap in housework in many EU countries (Alon *et al.*, 2021, and Farré *et al.*, 2022). Using the same data as Menta (2021), Clark and Lepinteur (2022) document that COVID-19 policy stringency produced a larger drop in women's life satisfaction, and women were found to report higher levels of general psychiatric disorders and loneliness in the UK during 2020 (Li and Wang, 2020), and greater stress, lack of energy, and loneliness in Germany (Czymara *et al.* 2021, and Hiekel and Kühn, 2022). The 'loneliness epidemic' is of course not new, and was already a subject of discussion pre-COVID-19 (Bu *et al.*, 2020; King 2018). However, social distancing, lockdown measures and disrupted labour markets produced dramatic increases in loneliness during the pandemic (Ausín *et al.*, 2020, Bu *et al.*, 2020, Dahlberg, 2021, Elran-Barak and Mozeikov, 2020, and Entringer and Gosling, 2022).

We here track the consequences of COVID-19 for individual loneliness and subjective well-being in representative German panel data. Loneliness is measured by the three-item version of the UCLA Loneliness Scale, and we show that the pandemic aggravated the existing gender loneliness gap. We then link loneliness to life satisfaction. While men's life satisfaction remained broadly stable after the outbreak of COVID-19, that of women dropped dramatically. These movements were sufficient to produce a significant female well-being penalty in 2020. This female penalty is unusual, as the literature usually finds either no subjective well-being differences between men and women (Batz-Barbarich *et al.*, 2018) or a male penalty (Clark *et al.*, 2018). The emergence of this penalty for women is almost entirely explained by the widening gender gap in loneliness.

Our approach is somewhat related to that in Zoch *et al.* (2022), Siflinger *et al.* (2021) and Etheridge and Spantig (2022). The empirical analysis of the former is based on two specific German samples (the first of individuals born between 1944 and 1986, and the second of those with high education and who are active on the labour market) and focuses on the effect of working conditions. Zoch *et al.* (2022) provide suggestive evidence regarding the role of loneliness in explaining the drop in the life satisfaction of women in the working population. Siflinger *et al.* (2021) looks at a similar population in the Netherlands, and also suggest that loneliness may have partly driven the trends in mental health throughout 2020. Using UK data, Etheridge and Spantig (2022) aim to explain why the GHQ well-being score of women fell more than that of men after the outbreak of COVID-19, and conclude that a relative rise in loneliness may have played a role. We here contribute to this literature in multiple ways. To the best of our knowledge, we are the first to use a validated measure of loneliness, namely the shortened version of the 20-item UCLA Loneliness Scale (Hughes *et al.*, 2004), and provide the first analysis of the relationship between loneliness and life satisfaction in a nationally-representative sample in Germany. We are also the first to show that loneliness is the key driver of the COVID-19 female penalty in life satisfaction. As our results differ from those in UK (Etheridge and Spantig, 2022) and the Netherlands (Siflinger *et al.*, 2021) data, we underline that the same phenomenon (*i.e.* a female penalty in well-being) can be observed in different countries but may not have the same roots.

The remainder of the paper is organised as follows. Section 2 presents the data, the estimation sample and the empirical strategy. The main results and the robustness checks are then discussed at length in Section 3. Last, Section 4 concludes.

2. Methods

a. Data

Our empirical analysis is based on the German Socio-Economic Panel (SOEP) and its complementary COVID-19 survey (SOEP-CoV: see www.soep-cov.de). The SOEP is a large, long-running representative panel survey, recognised for its high standards of data quality and research ethics. The SOEP contains information on a broad set of individual- and household-level characteristics, such as household composition, health and education, income and wealth.

The SOEP-CoV survey covers a sub-sample of about 6700 regular SOEP respondents, and was fielded to understand the effects of the pandemic on households in Germany. Respondents were asked to provide information on the following topics: *a)* Within-household COVID-19

prevalence, health behaviour, and health inequality; *b*) Labour-market activity and gainful employment; *c*) Social life, networks, and mobility; *d*) Mental health and well-being; and *e*) Attitudes towards social cohesion. In contrast to the regular SOEP survey waves, only one individual per household was interviewed instead of the whole household. As many of the SOEP-CoV questions were asked in previous waves of SOEP, the data from SOEP-CoV can easily be harmonised with previous waves. Although there are some differences in 2019 between the respondents who participated in SOEP-CoV and those who did not (see Table A1 for more details), we apply the cross-sectional weights provided by the data producer to guarantee the national representativeness of the SOEP-CoV sample. The weights were constructed to control for potential nonresponse bias and to compensate for potential undercoverage bias. The 2020 SOEP-CoV field phase started in March 2020 and finished in July of the same year. The 2021 SOEP-CoV was fielded in January and February 2021 and is used to demonstrate the robustness of our results.

b. Sample Selection

In most of our empirical analysis, we take pre-COVID-19 information from the 2017 SOEP wave, and information during the pandemic from the 2020 SOEP-COV wave. Adding the 2018, 2019 and 2021 waves to the analysis sample makes little difference to our main results. To be sure that our analysis is not affected by changing sample composition over time, we analyse the balanced sample of respondents who participated in both the 2017 and 2020 SOEP survey waves. This produces 10892 observations (two observations each on 5446 individuals). The descriptive statistics for this balanced sample appear in Table 1.

Table 1: Descriptive Statistics – Estimation Sample

	Mean	SD	Min	Max
Loneliness (3-15)	6.93	2.61	3	15
Life Satisfaction (0-10)	7.43	1.60	0	10
Female	0.52		0	1
Age Category: [18-29]	0.12		0	1
Age Category: [30-39]	0.15		0	1
Age Category: [40-49]	0.15		0	1
Age Category: [50-59]	0.20		0	1
Age Category: [60-69]	0.16		0	1
Age Category: 70+	0.22		0	1
Net Monthly HH Income (log)	7.87	0.58	4.61	11.28
Born in Germany	0.84		0	1
Post-Secondary Education	0.22		0	1
Employed	0.62		0	1
Partnered	0.51		0	1
Total Number of Health Conditions – pre-COVID	1.29	1.34	0	7
Number of Household Members	2.26	1.22	1	10
At Least One Child in HH	0.23		0	1
Accommodation Sq. Metres per Head	52.2	29.3	7.9	350

Notes: This sample consists of 10892 observations on the 5446 SOEP respondents who appeared in both the 2017 and 2020 survey waves. Cross-sectional weights are used for representativeness.

c. Measurement of the Main Variables of Interest

We analyse two key variables. The first is loneliness. There is an extensive literature on the measurement of loneliness in survey data. Loneliness information in the SOEP questionnaire is collected using the validated German translation of the following three questions coming from Hughes *et al.* (2004): “How often do you feel...”, followed by “that you lack companionship?”, “left out?” and “isolated from others?”. The answers to these questions are on a five-point Likert scale: 1 “Very often”, 2 “Often”, 3 “Sometimes”, 4 “Seldom” and 5 “Never”. These three questions form part of the larger 20-item UCLA Loneliness Scale, and on their own (as in the SOEP questionnaire) are considered to suffice for the construction of a reliable loneliness score (see Hughes *et al.*, 2004, for the evaluation of the measurement invariance across population of this loneliness measure and for the correlations with health, marital status, and social activity that establish its validity). We follow the existing literature (Hughes *et al.*, 2004; Luhmann and Schupp, 2015) and construct the scores as the sum of the reverse-coded responses to produce a loneliness score ranging from 3 to 15, where larger numbers correspond to greater loneliness. Luhmann and Schupp (2015) provide a series of tests supporting the internal validity and construct validity of the SOEP loneliness score based on these five-point Likert scale items. The three questions forming the SOEP loneliness score did

not appear in 2018 and 2019, and our main analysis of loneliness relies on 2017 and 2020 observations only.

The second key variable is life satisfaction. In the SOEP this comes from the question: “*How satisfied are you with your life in the current situation, all things considered?*”, with replies on a Likert-scale ranging from 0 to 10. Subjective well-being as an explicit guideline to policy is discussed in Frijters *et al.* (2020), and has been put forward by a number of national and international institutions: for example, the analysis of cost-effectiveness in the UK Government’s Treasury Green Book guidelines for policy evaluation and the OECD (OECD, 2013). Life satisfaction is one of the most-common measures of cognitive well-being (see Clark, 2016, and Clark, 2018, for respectively a detailed discussion of the measures of subjective well-being and for a literature review of the findings in the Economics of Happiness).

d. Empirical Strategy

We first wish to track the evolution of the gender gap in loneliness before and after COVID-19. To do so, we compare the average gender loneliness gaps in 2017 and 2020, in the spirit of a difference-in-differences analysis. Although informative, this naïve comparison may capture the influence of other factors that are correlated with both loneliness and gender. As such, we partial out the effects of potential confounders by estimating the following loneliness regression via Ordinary Least Squares:

$$Loneliness_{it} = \alpha_t Female_i + \gamma_t X_{it} + \epsilon_{it} \quad (1)$$

Here $Loneliness_{it}$ is the loneliness score of respondent i in year t (respectively 2017 and 2020 in our analysis). We standardise the dependent variable to have a mean of zero and a standard deviation of one in order to simplify the comparisons of the estimated coefficients across regressions. $Female_i$ is a dummy for the respondent being a woman. Gender is considered to be time-invariant, in line with the SOEP data where all 2017 respondents report the same gender in 2020. X_{it} is a vector of time-varying covariates that commonly appear in life-satisfaction regressions: age categories (in 10-year intervals), monthly household net income (equivalised using the square root of the family size and logged), dummies for having at least a post-Secondary education, a job, a partner and at least one child in the household, family size, the total number of health conditions pre-COVID, the size of the house in square metres divided by family size, and a dummy for living in East Germany. The gender differences in life satisfaction before and just after the outbreak of COVID-19, holding the X_i variables constant, are then captured by the estimated values of α_{17} and α_{20} .

The second part of our analysis evaluates the contribution of loneliness to the 2020 gender gap in life satisfaction. To do so, we estimate the following regressions

$$LS_{it} = \beta_t Female_i + \gamma_t X_{it} + v_{it}. \quad (2)$$

$$LS_{it} = \beta'_t Female_i + \gamma'_t X_{it} + \delta_{it} Loneliness_{it} + \mu_{it}. \quad (3)$$

Our hypothesis is that the values taken on by $Loneliness_{i20}$ (which are in particular higher for women than for men) will at least partly explain the gender gap in life satisfaction in 2020. If this is the case, we then expect to find $|\beta_{20}| > |\beta'_{20}|$. If $\beta_{20} \neq 0$ and $\beta'_{20} = 0$, we can say that loneliness entirely explains the gender gap in life satisfaction. If $\beta'_{20} \neq 0$, the ratio $\frac{\beta_{20} - \beta'_{20}}{\beta_{20}}$ indicates the partial contribution of loneliness to explaining the gender life-satisfaction gap.

3. Results

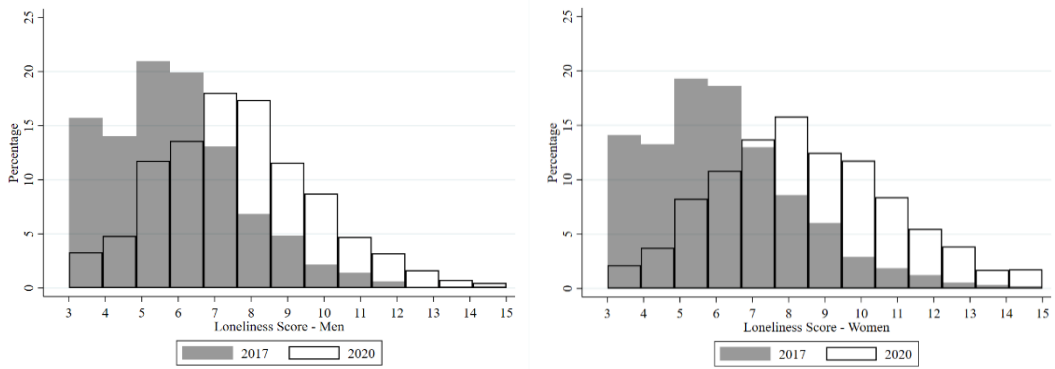
We document below the change in the gender loneliness gap from the pre- to post-COVID-19 periods (*i.e.* from 2017 to 2020), and then evaluate the extent to which these lie behind the 2017-2020 movements in life satisfaction by gender.

a. The gender difference in loneliness before and after COVID-19

The right-shift in loneliness is immediately apparent in Figure 1; the average sample loneliness score jumped by 40% between 2017 and 2020 (from 5.83 to 8.08). This increase is significant at the 0.1% level. There are gender differences in the 2017-2020 shift in Figure 1: on the left, men's average loneliness score increased by roughly 2 points (5.64 *vs.* 7.65), while that of women on the right rose by almost 2.5 points (5.95 *vs.* 8.43).

We can use these figures to estimate the change in the gender loneliness gap via a difference-in-differences analysis. The 2017 gender gap was 0.31 (5.95 minus 5.64) and statistically different from zero at the 1% level. The analogous 2020 gap, also statistically significant, rose to 0.78 (8.43 minus 7.65). The 2017-2020 change in the gender loneliness gap was then 0.78 minus 0.31 = 0.47 (s.e. = 0.09): this rise is statistically significant.

Figure 1: The Distribution of Loneliness in 2017 and 2020 for Men and Women

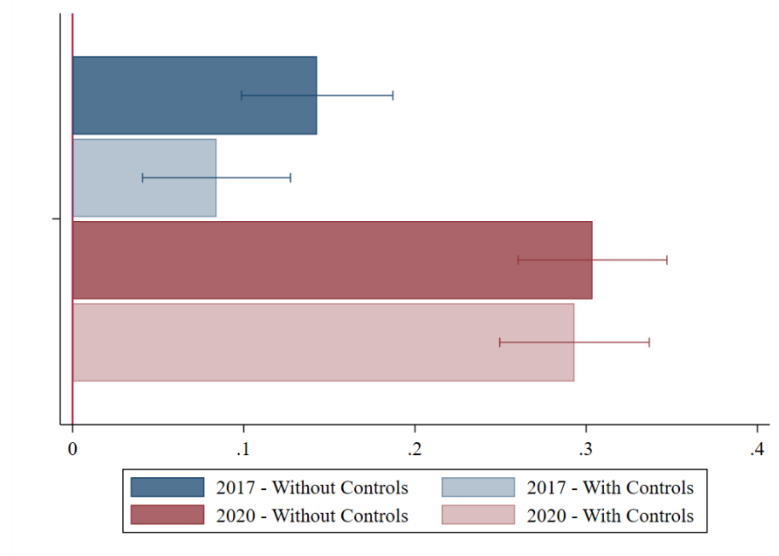


Notes: This sample consists of 5446 SOEP respondents who appeared in both the 2017 and 2020 survey waves. Cross-sectional weights are used for representativeness.

The figure given above is the average gender loneliness gap for all SOEP respondents. However, certain groups may have had different experiences in this respect. We therefore split respondents in turn by age, education, household income, partnership, parenthood, and employment status. Respondents are divided into ‘young’ and ‘old’ using the threshold of the median age, and into ‘poor’ and ‘rich’ via median household income. The results in Table A2 reveal significant gender gaps in loneliness in both 2017 (except for the most-educated respondents) and 2020. This is consistent with the findings of Bu *et al.* (2020) and the references therein. Those without a partner or a job are also lonelier, and parents report higher average loneliness scores (meta analyses of the risk factors associated with loneliness appear in Pinquart and Sörensen, 2001 and 2003). In the last column, the difference-in-differences calculation shows that the gender loneliness gap rose for all of these separate groups at the 5% level at least, with this rise being larger for respondents with a partner, with lower income, and without a job.

These figures are raw numbers, and may confound gender with the effect of other variables that are correlated with gender. We thus now turn to multivariate loneliness regressions, run separately in 2017 and 2020, to estimate the gender gap net of these confounders. The socio-demographic controls are those presented in Section 2. The loneliness scores are standardised, so that the coefficients are to be read in terms of proportions of a standard deviation. All regressions include dummies for the month of interview to account for seasonality.

Figure 2: The Gender Gap in Loneliness in 2017 and 2020 – Regression Results



Notes: This sample consists of 5446 SOEP respondents who appeared in both the 2017 and 2020 survey waves. The bars show the estimated coefficient on the ‘female’ dummy variable and the 95% confidence intervals in OLS loneliness regressions with controls (for the lighter-shaded bars) as listed in the text, and only month-of-interview dummies for the darker-shaded bars. The loneliness score is standardised. Cross-sectional weights are used for representativeness.

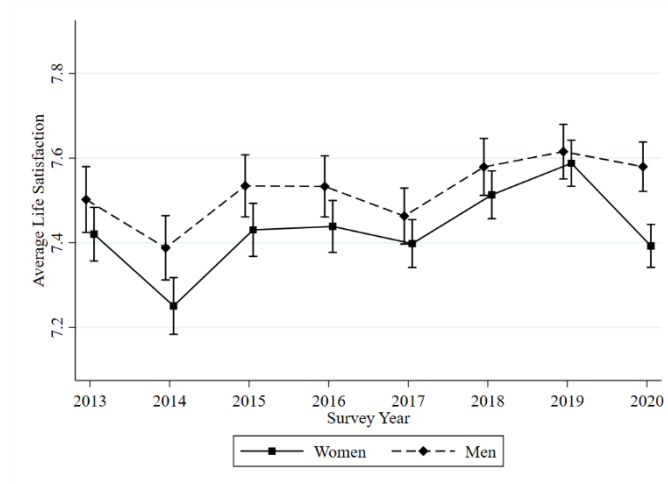
Figure 2 depicts the estimated gender coefficients from the estimation of Equations (1) and (2). The blue bars at the top correspond to 2017 and the red bars below to 2020. The darker-shaded bars come from regressions that control only for seasonality, and the lighter-shaded bars are those from the regression analyses with control variables. Women were lonelier than men in 2017, both with and without controls. This continues to be the case in 2020, but now however with a female penalty that is twice as large.

b. Loneliness and the gender life-satisfaction gap during COVID-19

We now turn to an overall measure of subjective well-being: life satisfaction. Figure 3 shows the 2013-2020 trends in life satisfaction by gender for those individuals who appear in our estimation sample: the trend in life satisfaction was the same for both men and women up to the start of the pandemic, when it sharply diverged. There is no significant difference in life satisfaction between men and women in most pre-pandemic years.¹

¹ Appendix Figure A1 depicts the evolution of life satisfaction by gender over the same period for the whole sample. The time trend is fairly similar, and the average life satisfaction of men and women differs only little in most years.

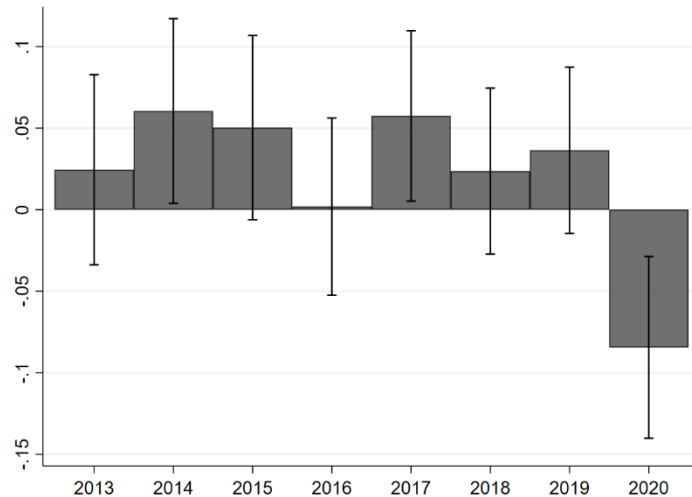
Figure 3: The Evolution of Life Satisfaction over Time by Gender



Notes: The sample is of SOEP respondents who appear in both the 2017 and 2020 waves. The points indicate average life satisfaction (0-10) by gender by survey wave. Cross-sectional weights guaranteeing national representativeness provided by the data producers have been applied.

We now depict the estimated gender life-satisfaction gaps corresponding to each separate year in multivariate regressions including all of the control variables discussed above, where life satisfaction has been standardised. As in Montgomery (2021), the conditional gender life-satisfaction gap is positive in favour of women (although not always statistically different from zero) in all pre-2020 years, with no obvious time trend. There is then a sharp break in the pattern in 2020. While average male life satisfaction barely changed from 2019 to 2020 (7.602 vs. 7.597), that of women fell substantially and significantly (from 7.59 to 7.37).

Figure 4: The Gender Gap in Life Satisfaction from 2013 to 2020 – Regression Results



Notes: This sample consists of 5446 SOEP respondents who appeared in all of the 2017 and 2020 surveys. The bars show the estimated coefficient on the ‘female’ dummy variable and the 95% confidence intervals in OLS life-satisfaction regressions with controls as listed in the text. The life-satisfaction score is standardised. Cross-sectional weights are used for representativeness.

Is the changing gender distribution of loneliness responsible for this striking 2020 female life-satisfaction penalty? We investigate by controlling for loneliness in the life-satisfaction regressions (we do so only in 2017 and 2020, as loneliness was not measured in the other years in Figure 4): the results appear in Figure 5. The blue bars refer to 2017, where holding the individual’s loneliness score constant (in the lighter-shaded bar) leads to a small and insignificant rise in the gender life-satisfaction gap. The red bars refer to 2020. Here, controlling for loneliness sharply reduces the female penalty in life satisfaction from -0.084 to (an insignificant) -0.009. As such, the relative rise in women’s loneliness during COVID-19 entirely explains the switch in the sign of the male-female life satisfaction gap over the same period.²

Figure 5: Gender Gaps in Life Satisfaction in 2017 and 2020 – Regression Results



Notes: This sample consists of 5446 SOEP respondents who appeared in both the 2017 and 2020 survey waves. The bars show the estimated coefficient on the ‘female’ dummy variable and the 95% confidence intervals in OLS life-satisfaction regressions with other controls as listed in the text. The life-satisfaction score is standardised. Cross-sectional weights are used for representativeness.

The numbers in Figures 2 and 5 result from separate estimations of loneliness and life satisfaction respectively in 2017 and 2020. We can also pool these two years, and run a difference-in-differences analysis. This (more-restrictive) approach imposes that the estimated

² Loneliness and life satisfaction are both also measured in 2013 and 2021. We can replicate the analysis displayed in Figure 4 using these 2013 and 2021 observations. The results, in Appendix Figure A2, are qualitatively similar: the female penalty in life satisfaction only appears in post-COVID-19 years, and holding loneliness constant renders this penalty insignificant.

coefficients on all of the control variables be identical in the two years under consideration. The results appear in Appendix Table A3. The estimates in column (1) reconfirm that women were lonelier than men in 2017, and that this gap more than doubled in 2020. The rise in the gap in the regression is comparable in magnitude to the raw 2017-2020 change in the gender loneliness gap documented above (0.48 vs. 0.47): this suggests that the change in the gender loneliness gap is not explained by the controls included in our multivariate regressions. Column (2) refers to life satisfaction with the same non-loneliness controls as listed in Section 2. There is no significant life-satisfaction difference between men and women in 2017,³ and the estimated '2020' coefficient indicates lower life satisfaction for both sexes during the first stage of the pandemic. The estimated coefficient on the Female*2020 interaction term shows that this fall in life satisfaction was larger for women (as in Figures 3 and 5). Column (3) then carries out the same difference-in-differences life-satisfaction analysis, but now controlling for loneliness: the results are consistent with the coefficients in Figure 5, as the Female*2020 interaction term is now smaller and insignificant. As such, the 2020 female penalty in life satisfaction disappears once loneliness is held constant.

c. Ruling out competing hypotheses

We have suggested above that the female life-satisfaction penalty in 2020 reflects the disproportionate rise in women's loneliness. While the statistical results above support this hypothesis, loneliness cannot be argued to be random nor the sole driver of the female life-satisfaction penalty. It is therefore useful to assess the plausibility of a number of alternative hypotheses. In this subsection, we first demonstrate that the pandemic and the ensuing lockdown-style policies do not confound our results. We then show that changes in time use and exposure to the economic and health shocks due to COVID-19 play only a minor role in explaining the female life-satisfaction penalty. Last, our robustness tests suggest that the common method variance problem is not of major importance.

The spread of the pandemic and the subsequent containment policies may well have simultaneously affected both loneliness and other unobserved variables, in a way that differs between men and women. These omitted variables will bias our estimates of the (gendered) effect of loneliness on life satisfaction. As we cannot, by definition, control for

³ The gender life-satisfaction gap of 0.041 in Table A3 is slightly smaller than the corresponding dark-blue figure in Figure 5, likely due to somewhat different estimated coefficients on the control variables in 2017 and 2020.

these unobserved factors, we instead hold the spread of COVID-19 and pandemic policies constant.

The first row of Appendix Table A4 reproduces the -0.084 'Female' coefficient corresponding to the dark-red bar in Figure 5. The following rows show how this figure changes when we control for the monthly flow of cases and deaths, and pandemic-policy stringency. These turn out to have no effect on the estimated gender coefficient: the role of loneliness in inverting the gender life satisfaction gap does not reflect the parallel evolution of the pandemic.

Using UK data, Etheridge and Spantig (2022) argue the female penalty in well-being (as measured by GHQ scores) observed after the outbreak of the pandemic is partly explained by the disproportionate rise in loneliness, but also by changes in time use and economic and health shocks. To see whether the same pattern applies for life satisfaction in Germany, we carry out a Gelbach decomposition that allows the female penalty in life satisfaction to be driven by these four factors. We consider the following six time-use variables: weekly hours of work, inside housework, outside housework, caring activities, education (and in-job training), and leisure. For the economic and health shocks, the SOEP-CoV questionnaire asks whether the following events have taken place due to COVID-19: job loss, financial difficulties, taking out a loan, liquidating assets and having had a life-threatening illness. The Gelbach-decomposition results appear in Table A5. In line with our main results, going from the baseline (in column (1)) to the full model (in column (2), which includes loneliness and all of the time-use and shock variables) renders the female life-satisfaction penalty statistically insignificant. Column (3) of Table A5 lists the contribution of the different factors. The first row corresponds to the contribution of all four together. The remaining four rows reveal the importance of each of the individual four factors. It is clear that loneliness is the only covariate out of the four that produces a significant fall in the estimated female coefficient. As such, the female penalty in life satisfaction in Germany during COVID-19 is not explained by the other factors emphasised by Etheridge and Spantig (2022) in the UK.

Common-method variance is a last potential issue, as both the dependent and independent variables are subjective. It can then be argued that replacing the loneliness score in Figure 4 with any other subjective variable would produce similar conclusions. We check this proposition in Table A6 in the Appendix, where we in turn consider the roles of variables capturing general concerns, opinions about trust, and concerns about COVID-19 in mediating the relationship between gender and life satisfaction. The 2020 gender gap in life satisfaction remains statistically different from zero when any of these subjective variables are included,

with most changes in the estimated gender gap being only very marginal. As none of these come close to the almost-total mediation effect of loneliness in 2020 (as can be seen in the red bars in Figure 5), we assume that common-method variance may only be a second-order problem.

4. Discussion

In German panel data, women were lonelier than men before the outbreak of COVID-19: this holds in both the raw data and controlling for a number of demographic and economic variables. This gender loneliness gap has already been noted in the literature (see, among others, Pinquart and Sörensen, 2001, for a meta-analysis).

The female loneliness penalty doubled in 2020, almost entirely due to a sharp rise in loneliness for women. It is worth emphasising that these patterns come from balanced panel data, and so do not reflect changes in the composition of survey respondents pre- and post-COVID-19.

Why have women become lonelier? Containment measures were one of the most-frequent pandemic policy responses. Although these were designed to limit the spread of infection and save lives, they also had negative consequences. Many of these latter were economic (Adams-Prassl *et al.*, 2020, Beland *et al.*, 2022, Bontan *et al.*, 2020, Guven *et al.*, 2020, Brewer and Gardiner, 2020, and Menta, 2021), but lockdowns and ‘stay-at-home’ orders also restricted face-to-face social interactions and produced more sedentary lifestyles (Hu *et al.*, 2020, Kumari *et al.*, 2020, Medrano *et al.*, 2020 and Giuntella *et al.*, 2021). We find that observable economic characteristics such as household income or employment status actually explain only little of the higher 2020 gender loneliness gap, so that the latter may instead reflect reduced social interactions and changing lifestyles during the pandemic.

In line with other work (Oreffice and Quitana-Domeque, 2021, Siflinger *et al.*, 2021), we also show that women’s well-being fell more than did that of men during the pandemic. Putting our two results together, we suggest that the deterioration in women’s life satisfaction relative to men’s came about almost entirely due to the relative rise in female loneliness.

These results have potentially important implications. Lonelier individuals suffer from worse mental and physical health (see Cacioppo *et al.*, 2009 and the references therein). The health consequences of increased loneliness, which is behind the sharp drop in female life satisfaction, may then not fade away quickly post-pandemic. There is evidence that wars cause long-term physical and psychological harm, with an increase in the incidence and prevalence

of mental disorders especially among women (see Murthy and Lakshminarayana, 2006, for a review). Along the same lines, disasters, generally defined as a disruption of the functioning of a community or a society that can be either natural or man-made, have been shown to have long-run psychological effects that are more pronounced among women (see Makwana, 2019, for a narrative review). It is possible that these same enduring effects will be found following COVID-19.

Subjective well-being in general has been shown to affect individual behaviours and outcomes such as productivity (Oswald *et al.*, 2015), job search (O'Connor, 2020), fertility (Cetre *et al.*, 2016), health (Danner *et al.*, 2001) and voting intentions and outcomes (Liberini *et al.*, 2017; Ward, 2020). The larger effect of the pandemic on women's loneliness and life satisfaction may then also feed through to future gender gaps in other dimensions of life.

Our analysis has a number of limitations. We cannot explicitly prove that these movements resulted from the pandemic, as we do not have a plausible counterfactual group: almost everyone was affected, directly or indirectly. Although the adoption of more sedentary lifestyles and fewer face-to-face social interactions are plausible suspects, the exact identification of the roles that illness, lifestyles, insecurity about the future played in the evolution of individual sentiments is both a promising and essential avenue for future research.

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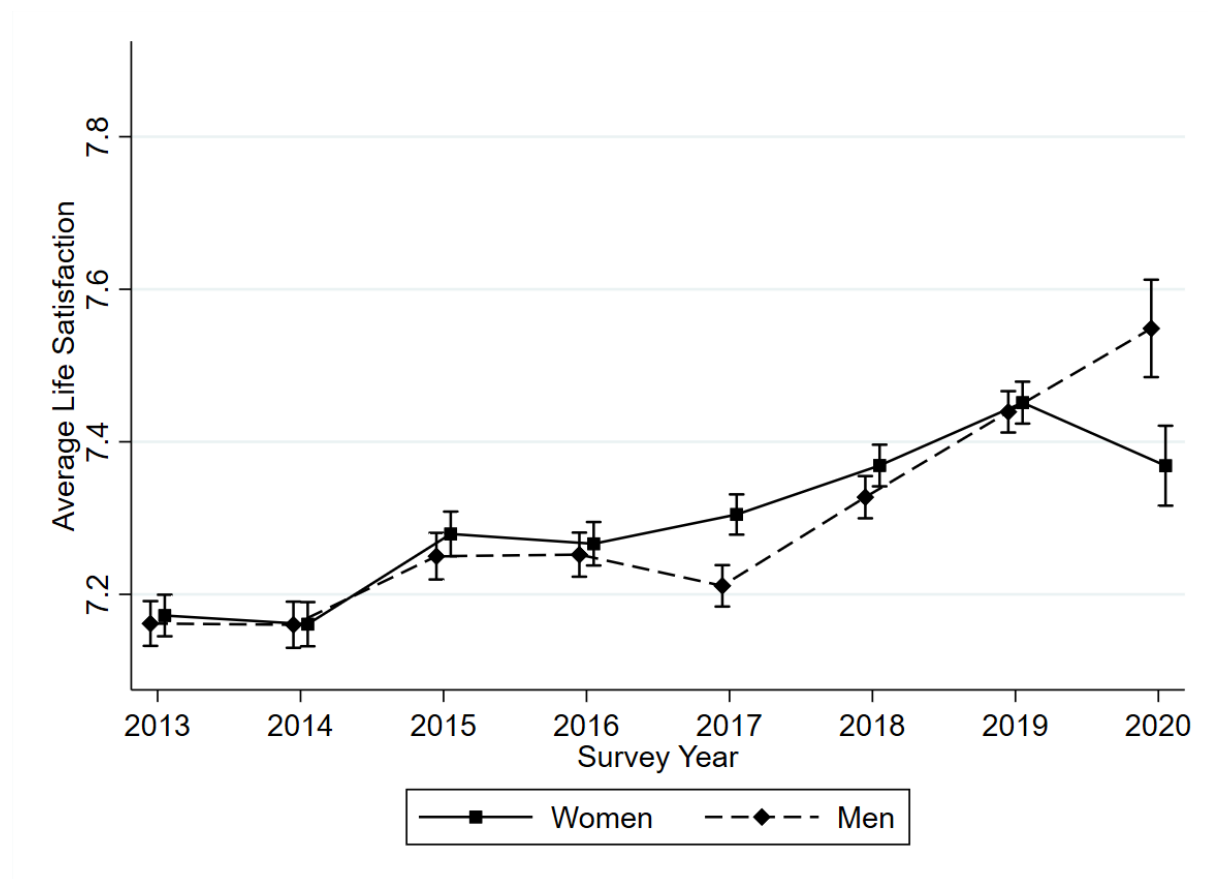
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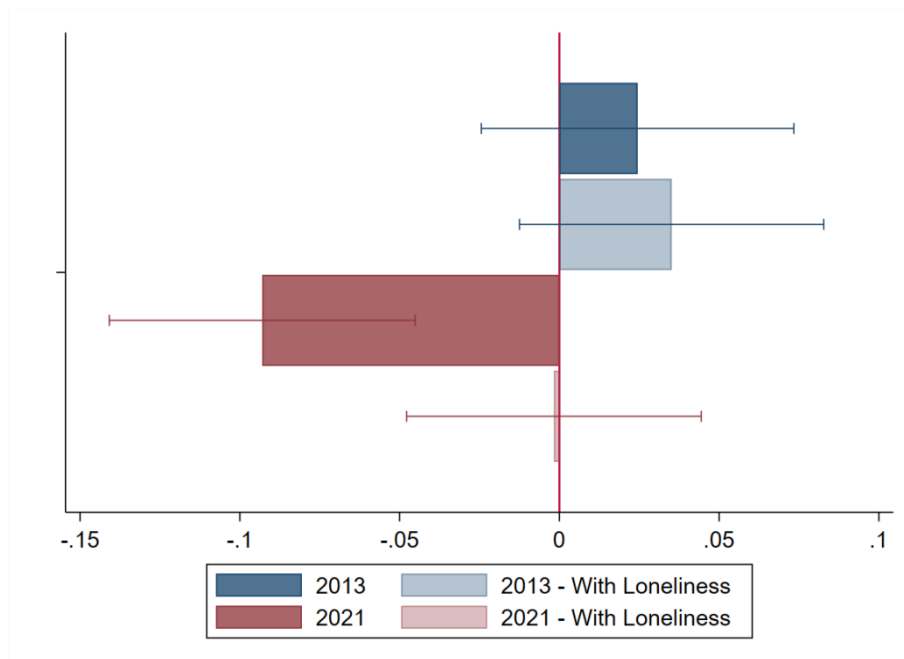
Supplementary Online Appendix

Figure A1: The Evolution of Life Satisfaction over Time by Gender



Notes: The sample is of all SOEP respondents with valid life satisfaction scores. The points indicate average life satisfaction (0-10) by gender by survey wave. Cross-sectional weights guaranteeing national representativeness provided by the data producers have been applied.

Figure A2: Gender Gaps in Life Satisfaction in 2013 and 2021 – Regression Results



Notes: This sample consists of 3920 and 4625 SOEP respondents who respectively appeared in the 2013 and 2021 survey waves and were also observed in the 2017 and 2020 survey waves. The bars show the estimated coefficient on the ‘female’ dummy variable and the 95% confidence intervals in OLS life-satisfaction regressions with other controls as listed in the text. The life-satisfaction score is standardised. Cross-sectional weights are used for representativeness.

Table A1: Differences in 2019 Variable Means between the SOEP 2017 respondents who appeared in the 2020 survey and those who did not

	2017 Respondents		Difference
	Not in 2020	In 2020	
Life Satisfaction	7.399 [1.714]	7.531 [1.644]	0.132*** (0.025)
Female	0.501 [0.500]	0.558 [0.497]	0.057*** (0.007)
Age	50.367 [18.878]	54.753 [17.318]	4.386*** (0.272)
Net Monthly HH Income (log)	7.954 [0.583]	7.850 [0.614]	-0.104*** (0.009)
High Education	0.187 [0.390]	0.252 [0.434]	0.065*** (0.006)
Employed	0.612 [0.487]	0.600 [0.490]	-0.012* (0.007)
Number of HH Members	2.494 [1.268]	2.070 [1.184]	-0.424*** (0.018)
Partnered	0.534 [0.499]	0.443 [0.497]	-0.091*** (0.007)
Total Number of Health Conditions – pre-COVID	1.137 [1.330]	1.281 [1.330]	0.144*** (0.020)
Sq. Metres per head	49.094 [27.717]	57.090 [32.304]	7.996*** (0.429)

Notes: The sample in column (1) consists of SOEP 2019 respondents who also appeared in the 2017 survey (14293 individuals) but not in the 2020 survey, and that in column (2) the SOEP 2019 respondents who appeared in both the 2017 and 2020 surveys (6022 individuals). The figures refer to the mean values of the observable characteristics for the two groups in 2019. Standard errors are in parentheses and standard deviations in square brackets. Cross-sectional weights for 2019 guaranteeing national representativeness provided by the data producers have been applied.

Table A2: Changes in Loneliness over Time by Gender

	2017			2020			Diff-in-Diffs
	Women	Men	Diff.	Women	Men	Diff.	
<i>Respondent groups:</i>							
Below Median Age	6.09 [2.22]	5.73 [2.58]	0.36*** (0.08)	8.55 [2.14]	7.74 [2.34]	0.78*** (0.09)	0.42*** (0.12)
Above Median Age	5.80 [2.20]	5.53 [2.00]	0.27*** (0.10)	8.32 [2.58]	7.52 [2.53]	0.80*** (0.09)	0.53*** (0.14)
Secondary Education at Most	6.06 [2.26]	5.67 [2.09]	0.39*** (0.08)	8.55 [2.60]	7.70 [2.49]	0.85*** (0.08)	0.46*** (0.11)
Post-Secondary Education	5.54 [1.96]	5.56 [2.05]	-0.02 (0.11)	7.93 [2.44]	7.48 [2.27]	0.45*** (0.11)	0.47*** (0.16)
Below Median HH Income	6.21 [2.40]	6.03 [2.28]	0.18* (0.10)	8.52 [2.66]	7.78 [2.64]	0.75*** (0.11)	0.57*** (0.15)
Above Median HH Income	5.60 [1.87]	5.29 [1.82]	0.32*** (0.08)	8.32 [2.49]	7.56 [2.29]	0.76*** (0.08)	0.44*** (0.11)
Partnered	5.70 [2.02]	5.48 [1.93]	0.22*** (0.08)	8.43 [2.48]	7.64 [2.37]	0.79*** (0.08)	0.58*** (0.12)
Not partnered	6.20 [2.37]	5.81 [2.22]	0.39*** (0.10)	8.42 [2.68]	7.65 [2.52]	0.77*** (0.07)	0.38*** (0.09)
Child in HH	6.05 [2.21]	5.60 [2.05]	0.45*** (0.12)	8.73 [2.62]	7.81 [2.37]	0.92*** (0.12)	0.47*** (0.16)
No Child in HH	5.92 [2.21]	5.66 [2.09]	0.27*** (0.08)	8.33 [2.56]	7.60 [2.46]	0.72*** (0.08)	0.46*** (0.11)
Employed	5.86 [2.04]	5.54 [2.93]	0.32*** (0.08)	8.47 [2.54]	7.80 [2.42]	0.67*** (0.08)	0.36*** (0.11)
Not Employed	6.08 [2.42]	5.87 [2.36]	0.22* (0.12)	8.37 [2.64]	7.36 [2.47]	1.01** (0.11)	0.80** (0.16)

Notes: This sample consists of 10892 observations on the 5446 SOEP respondents who appeared in both the 2017 and 2020 surveys. These figures refer to mean loneliness by gender in the sub-group indicated in column 1. Standard errors are in parentheses and standard deviations in square brackets. Cross-sectional weights from the data producers guaranteeing national representativeness have been applied.

Table A3: The Gender Gap in Loneliness and Life Satisfaction in 2017 and 2020 – A difference-in-differences approach

	Loneliness	Life Satisfaction	
	(1)	(2)	(3)
Female	0.218*** (0.063)	0.041 (0.027)	0.072*** (0.026)
2020	2.153*** (0.077)	-0.072** (0.033)	-0.061* (0.032)
Female*2020	0.480*** (0.088)	-0.110*** (0.038)	-0.056 (0.037)
<i>Observations</i>	10892	10892	10892
<i>Holding loneliness constant</i>	.	.	Yes

Notes: This sample consists of the SOEP respondents who appeared in both the 2017 and 2020 survey waves. These are OLS life-satisfaction regressions with controls as listed in the text. The loneliness and life-satisfaction scores are standardised. Cross-sectional weights are used for representativeness. Standard errors in parentheses are clustered at the individual level.

Table A4: The Gender Gap in Life Satisfaction, and Pandemic Spread and Policies in 2020

	Gender Gap in Life Satisfaction in 2020 (1)
Baseline	-0.084*** (0.028)
Holding constant:	
Flow of daily COVID-19 cases/100,000 inhabitants (monthly average)	-0.084*** (0.028)
Flow of daily COVID-19 deaths/100,000 inhabitants (monthly average)	-0.084*** (0.028)
Stringency Index (two-weeks average)	-0.084*** (0.028)
<i>Observations</i>	5446

Notes: This sample consists of the SOEP respondents who appeared in both the 2017 and 2020 survey waves. Each row lists the estimated coefficient on the 'Female' dummy variable in OLS life-satisfaction regressions with the controls as listed in the text. The life-satisfaction score is standardised. Cross-sectional weights are used for representativeness.

Table A5: The Gelbach Decomposition of the 2020 Gender Gap in Life Satisfaction

	Specification		Explained
	Baseline	Full	
	(1)	(2)	(3)
Female	-0.084*** (0.028)	0.004 (0.030)	-0.088*** (0.013)
Covariates:			
Loneliness	No	Yes	-0.075*** (0.008)
Time use	No	Yes	-0.015 (0.010)
Economic shocks	No	Yes	0.000 (0.002)
Health shocks	No	Yes	0.002 (0.002)
<i>Observations</i>	5446		

Notes: This sample consists of the SOEP respondents who appeared in both the 2017 and 2020 survey waves. These are OLS life-satisfaction regressions with the controls as listed in the text. The life-satisfaction score is standardised. Cross-sectional weights are used for representativeness.

Table A6: The 2020 Gender Gap in Life Satisfaction and Common Method Variance

	Gender Gap in Life Satisfaction in 2020 (1)
Baseline	-0.084*** (0.028)
Mediation via:	
Worries about economic development	-0.061** (0.028)
Worries about personal finances	-0.072*** (0.028)
Worries about own health	-0.062** (0.028)
Worries about the environment	-0.088*** (0.029)
Worries about cohesion in society	-0.080*** (0.028)
Affirmation “On the whole, I trust people”	-0.071** (0.028)
Affirmation “Nowadays, I can’t trust anyone”	-0.085*** (0.028)
Affirmation “I am cautious towards foreigners”	-0.081*** (0.028)
Concern about getting necessary medical assistance if infected with COVID-19	-0.073** (0.028)
Concern about supply of important goods during COVID-19	-0.076*** (0.028)
Concern about prices of important goods during COVID-19	-0.073** (0.028)
Concern about stock market during COVID-19	-0.085*** (0.028)
<i>Observations</i>	5446

Notes: This sample consists of the SOEP respondents who appeared in both the 2017 and 2020 survey waves. Each row lists the estimated coefficient on the ‘Female’ dummy variable in OLS life-satisfaction regressions with the controls as listed in the text, and mediation via the variable in the first column. The life-satisfaction score is standardised. Cross-sectional weights are used for representativeness.