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OPEN

# Satisfaction of scientists during the COVID-19 pandemic lockdown

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The discussion of the social, political and economic consequences of the lockdown during the COVID-19 pandemic mainly revolves around negative effects. This study exploits a unique opportunity and analyses data from a survey ( $N = 13,316$ ) that happened to be in the field in the months of the development and eventual manifestation of the COVID-19 pandemic. It documents slightly higher levels of average general life satisfaction as well as of satisfaction with various specific aspects of life (health, work, work-life balance and leisure) during the lockdown among scientists in Austria, Germany and Switzerland. It is argued that the lockdown can be regarded as a large-scale social experiment of a very sudden and abrupt change of work and social life, which is unique in history. Daily survey data elicited before and after the lockdown allows the construction of a quasi-experimental design for analysing how this abrupt change of social reality has affected satisfaction. For scientists, the lockdown mainly entailed the transition to work from home, leading to a reduced speed of life and allowing for more flexibility in incorporating family and leisure into the work day. It is discussed how some of these mechanisms might apply to the general population.

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## Introduction

On March 11 2020, The World Health Organisation (WHO) declared the spread of the disease COVID-19 to be a pandemic. The countries of the world reacted to this with a variety of different measures, aiming to counteract the dispersal of the deadly virus. These measures included social distancing, the directive to work predominantly from home, the shut-down of educational facilities and non-essential businesses, border closure and travel restrictions.

While this is an unprecedented challenge to humanity, it offers unique insights for researchers. The sudden and far-reaching implementations of measures to reduce the spread of the disease are perhaps one of the most severe restrictions of public life imaginable, rendering it one of the largest-scaled social experiments in history. Consequences of the lockdown are feared to be not only economic, but to also entail potentially devastating consequences for individuals in other ways: higher levels of depression and other mental health issues, domestic violence, increased care burdens, as well as compromised educational careers, especially of already disadvantaged individuals (Abel and McQueen, 2020, Lewnard and Lo, 2020). Overall, the public debate is mostly concerned with negative short-term and long-term effects. While there is a lot to do and to worry about for policy-makers, entrepreneurs and citizens to mitigate these effects, we present empirical findings suggesting the existence of some emerging positive side-effects of the COVID-19 pandemic lockdown.

Taking advantage of a unique opportunity, we analyse data stemming from a large-scale survey of scientists in Austria, Germany and Switzerland (Rauhut et al., 2020a, b) which happened to be in the field during the time. The advantage of this web survey is that the invitations to participate in the study were sent out in daily batches over a period of more than two months so that the development of satisfaction with different aspects of life can be observed over time. Being able to compare the satisfaction of those who were contacted and who responded before the implementation of the lockdown with those that were contacted afterwards, we find that levels of individual satisfaction did not decrease during the lockdown; in some regards, we even observe a slight increase. While our sample is limited to scientists (PhD students, postdoctoral researchers and professors) working at higher education institutions, we draw on rich survey data to control for systematic differences in the sample and conclude that our findings are robust. Our study thus provides first insights to this phenomenon, paving the way for further research to follow up on this surprising pattern.

The fact that we only surveyed scientists in higher education institutions has an impact on the generalisability of our results. Simultaneously, it also has three unique methodological advantages, rendering it highly plausible that our findings are in fact due to the new social and working reality during the lockdown. First, from a professional perspective, scientists are a homogeneous part of the general population. Although day-to-day research activities of scientists can be very different, their general working conditions are similar. They share an almost identical educational career and have similar obligations and duties as well as career goals and milestones. This renders their work-life and thus the effect of the pandemic lockdown on their work highly comparable. Second, during a pandemic crisis, scientists are less threatened by immediate job loss than those in other professions. Since they are part of the public sector, jobs are comparatively safe during an economic shut-down, and funding for research projects is often provided in advance. Third, while many people worked with reduced working hours and also workload, scientists' workload remained relatively stable, due to the long-term nature of research projects and the possibility of teaching online.

Overall, we suggest that the results from this specific population of scientists can provide useful insights for the general public concerning the question of how working from home affects life satisfaction, at least for specific groups of the general public who work in certain professional fields.

## Data and methods

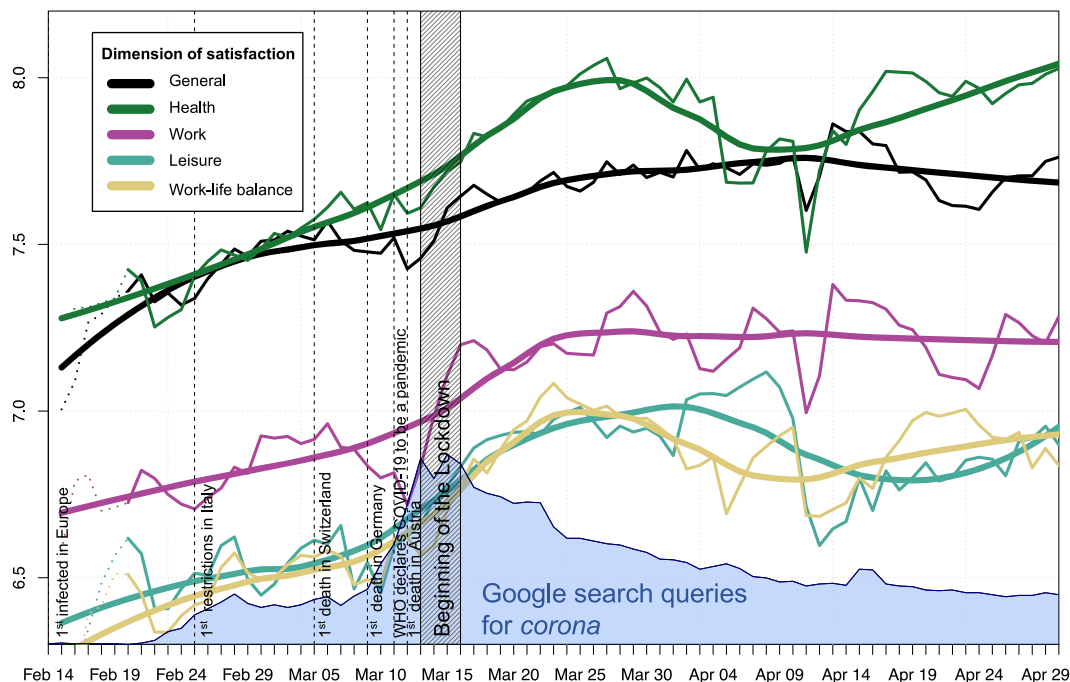
**Sample.** Our data stems from a representative online survey of scientists in Austria, Germany and Switzerland (Rauhut et al., 2020a, b). The survey has been approved by the University of Zurich Ethics Commission (Approval number: 18.8.7) and was carried out from February to April 2020.

The contact data were collected manually in cooperation with the German Centre for Higher Education Research and Science Studies by means of online research on the institution's web pages. Invitations were sent via email to all scientists working at Swiss and Austrian institutions of higher education. In Germany, a 50 per cent random sample of all scientist working at such institutions was drawn; all prospective respondents in the sample were invited via email. The scientists were contacted directly and not through their respective institutions; i.e., the institutions at which the scientists were working were not informed in advance that the survey will take place, and they were also not asked to encourage their employees to participate. Thus, the scientists contacted did not have to fear any disadvantages if they did not want to participate (Rauhut et al., 2020b).

To avoid that the invitation emails were treated as spam, they were sent out on a day-by-day basis, as opposed to all at once (Rauhut et al., 2020b). This standard procedure in online surveys, to guarantee a smooth contact and response rate without spam-blocker problems, opened the unique opportunity to conduct precise before-after comparisons around the critical event of the lockdown. Up to 12,000 researchers were contacted per day; that includes PhD students, postdoctoral researchers and professors. In total, around 141,500 researchers were invited to take part in the survey. For researchers who did not participate after the initial invitation, up to two reminders were sent. 15,972 researchers took part in the survey (response rate = 11.3 per cent) (Rauhut et al., 2020b). Hence, an average of around 207 responses per day was obtained during the 77-day field period (for an overview over the number of invitations and responses per day among the respondents, see Fig. 1 in the Appendix).

A comparison with official statistics shows that professors as well as scientists from the humanities, social sciences and natural sciences are overrepresented in our sample; junior and senior academics without professorships as well as scientists from the field of medicine are underrepresented (Rauhut et al., 2020b). We take this into account by controlling for discipline and status in our models (among other factors, see below). Some types of higher education institutions (such as colleges of education or universities of applied sciences) differ significantly between Austria, Germany and Switzerland in terms of objectives and staffing. Thus, for reasons of better comparability, we limit our analyses to researchers working at regular, full universities or at technical universities.

In all three countries, lockdown measures were implemented almost at the same time between Friday, March 13, 2020 and Monday, March 16, 2020. For our analysis of the effects of the lockdown, we exclude all responses made during the period of this weekend, and classify those answers recorded before the 13th as pre-lockdown, and those after the 16th as post-lockdown. Accordingly, the number of cases included in our analysis is 13,316 (Germany  $N=7476$ , Austria  $N=2151$  and Switzerland  $N=3689$ ). The basic characteristics of our respondents are as



**Fig. 1 Scientists' satisfaction over time.** Thin lines show the previous 7-days moving weighted average of reported satisfaction coloured by the respective dimensions. Thick lines describe the trend of the 7-days moving average by showing the 7-days moving average local regression curve. The dotted line beginnings indicate observation points at which there are less than seven days of previous observations. The blue area shows the public awareness on the pandemic by displaying the relative distribution of Google search queries (Google Trends) on 'corona' in Austria, Germany and Switzerland during the observed period. (The Google Trend data represent the relative google search volume for the term 'corona' normalised and rescaled to the query's time and location: data were obtained for each country separately and represent the queries' search volume divided by the total searches of the geography and time. The resulting numbers for that period are scaled for each country separately on a range of 0-100 (highest relevance during that period and location). For each day, the data points shown in Fig. 1 represent the countries averages rescaled to 0-100 over the entire period. For illustration purposes, this distribution was rescaled to cover only a fraction of the figure. Shaded areas and vertical lines show key events during the COVID-19 pandemic.

follows: 43% female; 39% PhD Students, 39% Post-Docs, 18.6% Professors and 3.4% other positions.

**Measurements and analytical strategy.** We define the responses captured after the lockdown as *treated* and those collected before as *untreated* measures. As expected, the analysis of the pre-lockdown and post-lockdown response rate shows that some subject characteristics are associated with the treatment (see Table 1 in the Appendix), which is a common observation in a quasi-natural experiment (Dunning, 2012). We address this by including these additional variables into the multivariate regression models, when analysing the effect of the pandemic lockdown on life satisfaction.

One key variable of interest is general life satisfaction. Respondents were asked: "All in all, how satisfied or unsatisfied are you currently with your life?". In addition, we also include more specific measures of satisfaction, such as how satisfied or unsatisfied respondents are with the following areas of life: work; work-life balance; leisure; health. All scales range from -5 (totally unsatisfied) to +5 (totally satisfied) and were recoded to a range from 0 to 10. Descriptive statistics of the outcome variables are presented in Table 2 in the Appendix.

The survey also included questions on demographics, work conditions and publication behaviour, and captured the exact time of respondents' participation in the study. This unique setup allows us to explore how the lockdown and especially the change to socially distanced working affects scientists' life-satisfaction.

To get an impression of the changes in life satisfaction among scientists, we first investigate life satisfaction during the pandemic on a daily basis, considering the moving averages for each day

based on the responses from the past seven days (Fig. 1). We statistically supplement the visual impressions of changing average satisfaction by comparing pre-lockdown and post-lockdown responses with simple t-tests. We also provide standardised mean differences (Cohen's *d*) by researcher's status and parenthood to a child (aged 0-17) along with its statistical significance to test whether the lockdown effect differed in strength for researchers with and without children (Table 1). Finally, we present a comprehensive multivariate analysis (Table 2). Besides demographic characteristics (gender, age) as well as academic status and parenthood, the multivariate analyses further accounts for cohabitation (i.e., whether respondents live with the partner), work contract type (permanent or non-permanent), working hours, survey country and scientific field.

We further analyse whether different groups of respondents react differently to the lockdown, i.e., whether particular groups show stronger increases in average satisfaction than others. This is achieved by including interaction terms between the treatment variable (post-lockdown) and each of the respondent characteristics used in the baseline regression, employing a multivariate linear regression model. The interaction effects are displayed at the bottom of Table 2. Note that we focus on the relevant interaction effects in the main text; full results are reported in Table 5 in the Appendix. Statistically significant, positive interaction coefficients indicate that a particular sub-group reacted more positively to the lockdown than its reference group, i.e., its effect on satisfaction is stronger. By contrast, statistically significant, negative interaction coefficients indicate that a particular sub-group reacted more negatively to the lockdown compared to its reference group, i.e., the effect on satisfaction is weaker.

**Table 1 Effect sizes of the lockdown on researchers' average satisfaction levels depending on their academic status and parenthood of a child (aged 0 to 17).**

	All	With kid	Without kid	P
General life satisfaction				
PhD	0.12***	0.10	0.12***	0.770
Student				
Post-Doc	0.08**	0.10*	0.07	0.635
Professor	0.19***	0.19**	0.17**	0.787
Other	0.14*	0.00	0.18*	0.285
All	0.09***	0.08*	0.10***	0.671
Satisfaction with health				
PhD	0.21***	0.24**	0.21***	0.800
Student				
Post-Doc	0.19***	0.23***	0.16***	0.277
Professor	0.21***	0.18**	0.21***	0.666
Other	0.21**	-0.02	0.29***	0.067
All	0.20***	0.20***	0.20***	0.965
Satisfaction with work				
PhD	0.16***	0.21**	0.16***	0.492
Student				
Post-Doc	0.11***	0.06	0.13**	0.282
Professor	0.22***	0.25***	0.18**	0.367
Other	0.22**	0.11	0.26**	0.371
All	0.12***	0.09**	0.14***	0.225
Satisfaction with work-life balance				
PhD	0.17***	0.03	0.19***	0.068
Student				
Post-Doc	0.10***	0.03	0.15***	0.056
Professor	0.20***	0.12	0.26***	0.107
Other	0.21**	-0.02	0.28***	0.068
All	0.15***	0.04	0.19***	<0.001
Satisfaction with leisure				
PhD	0.11***	0.11	0.11***	0.949
Student				
Post-Doc	0.12***	0.13**	0.12**	0.866
Professor	0.16***	0.10	0.17**	0.453
Other	0.14	-0.08	0.20*	0.098
All	0.12***	0.10**	0.13***	0.473

Numeric values show Cohen's *d* effect size, which is the difference between the two groups means proportional to the pooled standard deviation. Stars indicate the statistical significance of the associated inferential *t*-test comparing the two means. *P* values indicate the statistical significance of the effects sizes' difference between researchers with and without kids using approximate permutation tests. The permutation test involved 10,000 repetitions in estimating each distribution of the effect size differences between researchers with and without kids. \**p* < 0.05; \*\**p* < 0.01; \*\*\**p* < 0.001.

**Results**

Figure 1 shows the averages of 5 measures of life satisfaction on a daily basis. It also marks several key events and public awareness, operationalised by the relative share of Google search queries for the word *corona* in Austria, Germany and Switzerland during the relevant period. For each day and measure, the thin line indicates the last seven days weighted moving average of respondents' satisfaction. In contrast, thick lines represent symmetric trend filters of these moving averages looking forwards or backwards, respectively. We observe a slight increase in satisfaction measures across all dimensions during the initial lockdown period; especially in work-related satisfaction. When comparing the trend lines, work-related satisfaction settles at a higher level compared to pre-lockdown period. Naïve *t*-tests neglecting differences in respondent characteristics indicate that scientists' average satisfaction is generally higher during the lockdown: General life satisfaction (Pre-lockdown: 7.48 vs. Lockdown: 7.67, *t*(12786) = 5.23, *p* < 0.001), health (Pre-lockdown: 7.53 vs. Lockdown 7.98, *t*(12514) = 11.08, *p* < 0.001), work (Pre-lockdown: 6.84 vs. Lockdown 7.15, *t*(12711) = 6.91, *p* < 0.001), work-life

balance (Pre-lockdown: 6.56 vs. Lockdown 6.96, *t*(12665) = 8.16, *p* < 0.001), and leisure time (Pre-lockdown: 6.63 vs. Lockdown 6.94, *t*(12565) = 6.77, *p* < 0.001).

Next, we present a detailed summary of the differences between the average satisfaction scores of scientists participating before and during the lockdown. Table 1 shows the differences in responses collected before and during the lockdown in terms of the effect size together with the degree of statistical significance of an associated *t*-test. Doctoral students, Post-Docs and Professors who participated after the lockdown reported, on average, not lower but even slightly higher satisfaction levels (Cohen's *d* between 0.1 and 0.22, all *p* < 0.001). This also applies to the other academic staff (*d* between 0.14 and 0.22, all *p* < 0.05), except for their satisfaction with leisure activities, for which we did not find a significant effect (*d* = 0.14, *t*(856) = -1.94, *p* = 0.053). More interestingly, among the respondents with children of child-care age (aged 0-17), satisfaction with work-life balance did not change among those who participated after the onset of the lockdown (*d* = 0.04, *t*(3667) = 1.18, *p* = 0.24), whereas we observed a slight increase in average work-life satisfaction among researchers without children (*d* = 0.19, *t*(8810) = 5.78, *p* < 0.001). This observation is consistent for all academic positions (with kid: *d* between -0.02 and 0.12, all *p* > 0.05, without kid: *d* between 0.15 and 0.28, all *p* < 0.001), and the effect size of average work-life satisfaction for subjects with children (*d* = 0.04) is significantly smaller than the effect for (*d* = 0.19) those without children (permutation test with 10,000 repetitions, *p* < 0.001).

Estimates from multivariate regression models of pre-lockdown vs. post-lockdown satisfaction measures confirm the identified tendency that average life satisfaction did not decrease, but rather slightly increased on all dimensions after the implementation of the lockdown. The analyses demonstrate the robustness of our graphical and bivariate analyses above. The multivariate models control for different individual-level characteristics and possible sample imbalance. The top of Table 2 shows the main results (The full model is shown in Table 4 in the Appendix). For example, satisfaction with work, on average, increases by 0.38 points (unstandardised regression coefficient  $\beta$  = 0.376; 95% confidence interval (CI) = 0.29 to 0.462; *t*-statistic (d.f.) *t*(12178) = 8.567; *p* < 0.001) and average work-life balance increases by 0.4 points (unstandardised  $\beta$  = 0.401; 95% CI = 0.305 to 0.497; *t*(12148) = 8.215; *p* < 0.001) after the lockdown compared to pre-lockdown. Scientists' average overall life-satisfaction increased by 0.23 (unstandardised  $\beta$  = 0.229; 95% CI = 0.159 to 0.298; *t*(12231) = 6.439; *p* < 0.001).

Next, we investigate whether different groups reacted differently to the lockdown. To that end, we add respective interaction terms to the multivariate regression models. The bottom of Table 2 shows the coefficients of these interaction terms (the full model is shown in Table 5 in the Appendix). None of the interaction terms reaches conventional levels of statistical significance for researchers' general life and health satisfaction. In the other models, almost all interaction terms are statistically insignificant, despite the large sample size and number of coefficients. Moreover, the model fit statistics only increase marginally when including the interactions into the models. Hence, the results reveal that the lockdown enhances satisfaction in most groups to the same extent.

Notable effects of the lockdown on satisfaction are found for the following groups: The effect of the lockdown on work-life satisfaction is considerably weaker among researchers with children compared to their colleagues without children (the unstandardised  $\beta$  of the interaction term is -0.482; 95% CI = -0.733 to -0.232; *t*(12114) = 3.781; *p* < 0.001). The effects of the lockdown on the work-life satisfaction is weaker for those with higher employment levels (unstandardised  $\beta$  of the interaction

**Table 2 Comparison of scientists' average satisfaction before and after the lockdown.**

	Aspects of life-satisfaction:				
	General	Health	Work	Work-life balance	Leisure
	(1)	(2)	(3)	(4)	(5)
<b>Main effects from baseline models (without interactions)</b>					
Treatment (post-lockdown)	0.229***	0.442***	0.376***	0.401***	0.291***
Constant	7.078***	7.086***	6.763***	6.259***	6.449***
<b>Interactions terms from interaction models</b>					
Gender (female = 1)	-0.009	0.080	-0.060	-0.041	0.142
Kids (yes/no)	-0.020	-0.123	-0.117	-0.482***	-0.145
Partner in the same household (yes/no)	-0.111	-0.081	-0.049	0.008	0.046
Age (30-39 years as reference)					
below 30	0.094	-0.200	0.230	-0.035	-0.144
40-49	0.041	-0.042	0.219	-0.095	-0.248
50-59	-0.006	-0.151	0.199	0.280	-0.035
60 or above	0.057	0.006	0.326	0.247	0.200
Country (Germany as reference)					
Austria	0.142	0.129	0.204	0.012	0.106
Switzerland	-0.010	0.008	-0.031	-0.033	-0.060
Academic status (PhD students as reference)					
Post-Doc	0.072	0.010	0.064	0.034	0.117
Professor	0.273	0.045	0.193	0.315	0.187
Other	-0.0001	-0.114	0.151	0.058	-0.067
Contract type (permanent contract as reference)					
Fixed-term	0.133	-0.076	0.174	0.066	0.026
Fixed-term with permanent perspective	0.044	-0.234	-0.214	0.100	0.246
Other	0.141	0.220	0.072	0.161	0.374
Full-time equivalent (in per cent)	-0.004	-0.004	-0.004	-0.006*	-0.003
Field (Humanities as reference)					
Agricultural forestry and veterinary medicine	-0.037	0.272	0.091	0.096	-0.138
Biology	-0.006	-0.072	-0.147	-0.017	-0.035
Chemistry	-0.353	-0.012	-0.164	-0.233	-0.374
Construction and architecture	0.276	0.037	0.233	0.375	-0.109
Geology	-0.154	-0.394	-0.646**	-0.491	-0.536*
Economics	-0.190	-0.178	-0.244	-0.519*	-0.262
Educational science and research	-0.141	-0.090	-0.210	-0.019	-0.158
Heat and process engineering	-0.399	0.095	-0.111	-0.137	0.262
IT systems and electrical engineering	-0.160	-0.031	-0.335	-0.053	-0.123
Law Sciences	-0.174	0.434	-0.219	-0.022	0.377
Materials science and engineering	0.089	-0.063	0.526	0.382	0.284
Mathematics	-0.398	0.201	-0.703**	-0.169	0.062
Mechanical engineering and production technology	-0.031	0.381	0.159	0.182	-0.158
Medicine	-0.383*	-0.228	-0.355	-0.155	-0.307
Physics	-0.329	-0.256	-0.241	-0.449	-0.212
Psychology	-0.021	0.192	-0.058	-0.122	-0.330
Social sciences	-0.165	0.100	-0.194	-0.324	-0.378
Other subject	-0.238	-0.180	-0.211	-0.257	-0.356
Constant	7.084***	6.981***	6.800***	6.145***	6.400***
Observations	12,267	12,038	12,214	12,184	12,090

The regression table is showing average changes in scientists' life-satisfaction associated with the implementation of the pandemic lockdown. Two different sets of models are shown. The baseline models include the post-lockdown marker and control variables. Only the treatment effects (after vs. before lockdown) are shown to ease readability (the full model is shown in Table 4 in the Appendix.). The lower part denotes the interaction models, where interaction effects between all the control variables of the main model and the post-lockdown marker are included. Only interaction coefficients are shown, denoting as to whether specific groups have different reactions of the lockdown on satisfaction (Table 5 in the Appendix shows full results). Note that baseline and interaction models are estimated separately.  
 \* $p < 0.1$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$ ; \*\*\*\* $p < 0.001$ .

term = -0.007; 95% CI = -0.012 to -0.001;  $t(12114) = 2.462$ ;  $p < 0.02$ ). Furthermore, four interaction terms associated with the scientists' field of research are significantly different from the effect the lockdown has on researchers in the humanities. Among geologists and mathematicians, the effect of the lockdown on their work satisfaction is significantly lower (the unstandardised  $\beta$ s of the interaction terms are -0.646 and -0.703; 95% CI = -1.126 to -0.167 and -1.197 to -0.21;  $t(12144) = 2.642$  and

2.793; both  $p < 0.01$ ); among economists, the same applies to the effect of the lockdown on their satisfaction with work-life balance (unstandardised  $\beta$  of the interaction term = -0.519; 95% CI = -0.994 to -0.045;  $t(12114) = 2.144$ ;  $p < 0.04$ ). Similarly, geologists' satisfaction with leisure is negatively affected (the unstandardised  $\beta$  of the interaction term is -0.536; 95% CI = -1.049 to -0.023;  $t(12020) = 2.046$ ;  $p < 0.05$ ). With these few exceptions, the interaction terms overall indicate that the lockdown has a

similar effect on scientists' satisfaction with various aspects of their lives.

To gain insight into whether and how scientists' daily work routines differ before and during the lockdown, we add a further piece of analysis to our study, and consider the share of the overall workload that respondents devote to administration, teaching and research. After the onset of the lockdown, we see, on average, a decrease of 6.9% in the workload devoted to administrative tasks (25.25% vs. 23.51%,  $t(12379) = 5.57, p < 0.001$ ), but an increase in research activity by 3.8% (48.87% vs. 50.73%,  $t(12657) = 4.1, p < 0.001$ ). The workload associated with teaching does not change during the lockdown (27.18% vs. 27.43%,  $t(12247) = 0.73, p = 0.463$ ). Since this question does not explicitly refer to the last few days or weeks, it can be assumed that a lockdown-related change in workload could only slowly or partially be observed in the information provided by the scientists. Nevertheless, observing a difference even when employing this conservative empirical approach lends support for the assumption that the lockdown came with fewer administrative tasks for scientists and freed up time for research, supporting our line of argument.

## Discussion

Using 13,316 responses from an online survey that—coincidentally—was in the field before and during the lockdown, we present empirical evidence of how scientists' life satisfaction has been affected by the COVID-19 pandemic lockdown in Germany, Austria and Switzerland in the spring of 2020. We find that average life satisfaction did not decrease during the lockdown, and find evidence for a slight increase on all measured dimensions, particularly with regard to health, work and work-life balance. While our design does not allow for within-person comparisons over time, we discuss some possible explanations for this clear trend on the aggregate level.

Our main interpretation of these results is that the stable or even slight increase in scientists pre-term and post-pandemic life satisfaction is due to shifting from office to working from home. While home-office may bring several down-sides, for example, restricted laboratory access for scientists and harder self-organisation, it also results in a flexible work-life organisation, making it easier to fit in time for the family, hobbies, or exercise. Furthermore, it leads to less crowded and dense daily lives for most of the population. Research from social physics, social psychology and sociology (Epstein, 1981, Helbing et al., 2005) suggests that dense crowds, such as in public transport, big lecture halls, or conference venues, create individual unhappiness and discomfort. Scientists are likely to have more experience with home-office and are likely more self-selected on intrinsic work motivation. While these aspects likely render them more adaptive to the new situation, the discussed processes are nevertheless likely to apply to other fields of occupation, too.

Generally, a slower pace of life may also generally increase satisfaction, as our modern life is often considered to involve too many distractions (Rosa, 2013). These insights on the effects of the lockdown during the COVID-19 pandemic on life satisfaction of scientists suggests that a deceleration of work and more lenient policies on home-office are lessons that should be taken on in the future. These insights are likely to apply as well in other professional fields in which home-office is possible and where long-term goals, creative and highly concentrated work is needed, such as in some fields of higher public administration, media, or IT.

Simultaneously, it might even be the case that average levels of satisfaction rise during the lockdown since individuals become aware of their privileges, such as having a stable job that is manageable from home or simply the fact that one is healthy.

Our surprising results are at first glance at odds with several expert opinions and findings from general public surveys, which study more heterogeneous populations that are on average impacted more by the economic consequences of the pandemic.

Our analysis and conclusions, however, focus on the particular population of central European scientists, who are mainly affected by the transition from office work to home office. Hence, we argue that through this specific setup, we are able to gain insights into whether and how this transition affects life satisfaction. It is plausible that this effect will also apply to other fields of occupation in which home-office is a viable option.

Much attention has also been paid to the fact that women, in particular mothers, suffer comparably more from the lockdown measures of the COVID-19 pandemic, since they are more likely to provide care for dependent children or other relatives in comparison to men in general or fathers in particular (Broster, 2020, Lewis, 2020, McCarthy et al., 2020). This is only partly the case in our data. While having children is negatively associated with lower levels of satisfaction with work-life balance, we do not see an additional decrease in female scientists' satisfaction associated with the lockdown. We argue that this is likely due to our particular sample. Research on partnerships and marriages has repeatedly documented the tendency for partners to have a similar degree of education (for a review, see Kalmijn, 1998). Hence, it is likely that women in science have partners with equally high levels of education, who accordingly work in high-paying jobs. Individuals with these jobs were the ones that were mostly moved to home-office during the corona pandemic, as identified by a German study (Mohring et al., 2020). The same study simultaneously identified that in households in which both partners can work from home, there is a more equal distribution of child care responsibilities between partners. We argue that this can explain why we do not see an additional gender effect in our data.

Worrying reports from the United Kingdom that draw on nationally representative panel data document higher levels of depressive symptoms and lower levels of life satisfaction in comparison to the years before (Pennekamp, 2020). We argue that this discrepancy in results is due to the data basis as well as to contextual differences. First, the British data includes all layers of the population, including those who experience severe economic hardship and those who work in different fields of occupation. Drops in life satisfaction and rises in mental health issues have been observed for those who had to stop working due to the crisis (Zhang et al., 2020). Individuals in this situation are included in the British data, but not in our particular sample: The scientists in our sample were currently employed by a higher education institution. Academic jobs at universities are currently still mostly unaffected by the crisis and the looming economic crash. Teaching and research continuous without much break and scientists may have fewer worries about losing their job than people in other sectors. Second, the United Kingdom is in a much more vulnerable economic state in comparison to the three countries in our sample. To date, the United Kingdom continues to suffer comparably more deaths and more severe social repercussions from the pandemic. It is likely that this renders the general contextual circumstances in the United Kingdom to be more threatening, boosting depressive symptoms and suppressing life satisfaction.

The fact that satisfaction in the United Kingdom has decreased in the general population but that it has been stable or even slightly increased in the population of researchers in Austria, Germany and Switzerland, may add to our argument to interpret the lockdown in our sample as a social experiment of how the transition to home-office affects satisfaction. The already mentioned specific characteristics of our sample as well as the fact that in Austria, Germany and Switzerland, the economic and health situation has to date not been as dramatic as in other countries, highlights how our design is similar to an experiment that tests the effects of home-office on life satisfaction: The single, most crucial and unifying change in scientists' lives was the transition to working from home. This implies that the lockdown effect may be

generalisable to those with similar professional circumstances—an assumption that future research should follow up on.

Nevertheless, our findings should be treated with some caution. While our design enables relatively robust before-after comparisons on the aggregate level, resembling a quasi-experimental design, further research is needed to validate short-term and long-term effects. The lockdown has changed many aspects of life at the same time and future research should work on how to isolate the effects of home-office in a more specific way. In addition, while satisfaction is a crucial factor for long-term sustainable working conditions in companies and universities, future studies should also investigate the long-term efficiency of home-office compared to regular office work. While it may be plausible that more satisfied workers generate more output, problems of self-organisation and less coordination may also inhibit performance.

### Data availability

Due to the sensitive nature of our data and related commitments to the ethics board, we are unable to deposit the data on an open server. However, material for replication can be made available directly by the authors.

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### References

- Abel T, McQueen D (2020) The COVID-19 pandemic calls for spatial distancing and social closeness: not for social distancing! *Int J Public Health* 65:231
- Broster A (2020) Coronavirus could have serious consequences for women's health, says the un. *Forbes Magazine*
- Dunning T (2012) *Natural experiments in the social sciences: a design-based approach*. Cambridge University Press
- Epstein YM (1981) Crowding stress and human behavior. *Soc Issues* 37:126–144
- Helbing D, Buzna L, Johansson A, Werner T (2005) Self-organized pedestrian crowd dynamics: experiments, simulations, and design solutions. *Transp Sci* 39:1–24
- Kalmijn M (1998) Inter-marriage and homogamy: causes, patterns, trends. *Ann Rev Sociol* 24:395–421
- Lewis H (2020) The coronavirus is a disaster for feminism. *The Atlantic*
- Lewnard JA, Lo NC (2020) Scientific and ethical basis for social distancing interventions against COVID-19. *Lancet Infect Dis* 20:631
- McCarthy E, Gibson C, Andrews-Dryer H, Joyce A (2020) A working mom's quarantine life. *The Washington Post*
- Mohring K, Naumann E, Reifenscheid M, Blom AG, Wenz A, Rettig T, Lehrer R, Krieger U, Juhl S, Friedel S, Fikel M, Cornesse C (2020) Die Mannheimer Corona-Studie. *Mannheimer Corona Studie*

- Pennekamp J (2020) Wie die Corona-Krise Lebensglück vernichtet. *Frankfurter Allgemeine Zeitung*
- Rauhut H, Johann D, Jerke J, Rathmann J, Velicu A (2020a) Zurich Survey of Academics: data set. University of Zurich, Zurich
- Rauhut H, Johann D, Jerke J, Rathmann J, Velicu A (2020b) Zurich Survey of Academics: methods, design and data. University of Zurich, Zurich
- Rosa H (2013) *Social acceleration: a new theory of modernity*. Columbia University Press
- Zhang SX, Wang Y, Rauch A, Wei F (2020) Unprecedented disruption of lives and work. Health, distress and life satisfaction of working adults in China one month into the COVID-19 outbreak. *Psychiatry Res* 288:112958

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### Author contributions

I.J.R., A.E., D.J. and H.R. designed research; D.J. and H.R. performed research; I.J.R. and A.E. analysed data; I.J.R., A.E., D.J. and H.R. wrote the paper.

### Competing interests

The authors declare no competing interests.

### Additional information

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