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# BIMODAL CONTACT REDUCTIONS AND SOCIAL HOMOPHILY DURING COVID-19

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## Abstract

**Background:** The COVID-19 pandemic disrupted social life and forced people to reconsider how, where, and with whom to spend time. These decisions are deeply personal and their intricacies are still poorly understood.

**Methods:** To understand how people make such decisions, we conducted an online survey in summer 2023, collecting self-reported absolute contact numbers for four time points: 2019, 03/2020, summer 2021, and 01/2023. We analyzed the resulting contact data, focusing on the quantification of heterogeneities in reductions.

**Results:** Analysis of the survey data revealed that the COVID-19 pandemic triggered substantial reductions in both the work and the leisure context. Mean reductions gradually decreased as time progressed, but by 01/2023 contact numbers remained below pre-pandemic levels. We found contact behavior to demonstrate heterogeneity in three different aspects. First, the distribution of contact reductions followed a bimodal pattern, with a distinct peak at either extreme: A large fraction of the survey participants initially strongly reduced their contacts, a smaller group maintained nearly normal contact levels, and the remainder of participants reduced their contacts intermediately. Consistent with the decrease of mean contact reductions, the relative sizes of these behavioral groups shifted over time, with par-

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participants relaxing their reductions incrementally. Second, we found risk perception to be an indicator for the strength of contact reductions: Risk-averse participants reduced their leisure contacts significantly more than risk-tolerant participants, resulting in a trend of both fewer and later COVID-19 infections. Neither age, gender, nor having a COVID-19-relevant comorbidity significantly influenced self-reported contact reductions. Third, the survey results provide evidence that social homophily persisted during the COVID-19 pandemic, revealing a correlation between participants' and their closest contacts' number of contacts during the COVID-19 pandemic. Risk-averse participants hereby especially preferred to maintain contact with equally careful individuals.

**Conclusions:** Our study emphasizes the time-dependency and heterogeneity of contact reductions. On the one hand, our findings can easily be integrated into epidemiological models, improving their accuracy and predictive power. On the other hand, the results may guide the design of effective public health interventions, and help to predict and understand their effectiveness.

### 1 **Keywords**

2 COVID-19, Contact Patterns, Contact Reductions, Social Homophily, Heterogeneity of Contacts

### 3 **Introduction**

4 Contact behavior substantially influences infectious disease spread. Whenever humans meet in person, converse, or touch, they create opportunities for pathogens to spread from one human to another. The frequency, duration, and proximity of these interactions directly affect the transmission rates [Smi09, DCZMM14]. While changes in contact behavior serve as critical determinants of disease spread, contact reductions can introduce complexity to the infection dynamics, as people continuously adjust their behaviors in response to the evolving outbreak [Fer07, WAW<sup>+</sup>15, SBM10, PSCVMV15, DWC<sup>+</sup>22, WBC<sup>+</sup>23]. For effective disease mitigation, it is vital to understand the complex interplay between infectious disease spread and contact behavior.

12 Contact behavior can be modified both through governmental nonpharmaceutical interventions (NPIs) and voluntary behavior adaptations. Studies examining contact behavior during the COVID-19 pandemic demonstrated that the combination of mandatory NPIs and voluntary contact behavior adaptations strongly reduced the number of contacts in various contexts, including work and leisure [VHV<sup>+</sup>21, CWG<sup>+</sup>20, WGC<sup>+</sup>23, JCB<sup>+</sup>24, PBN24, DWC<sup>+</sup>22, DZS<sup>+</sup>20, BMS<sup>+</sup>21]. Consequently, when designing NPIs, public health officials should consider the heterogeneity of the underlying social contact network. When taking heterogeneities in social network structure and personal preferences into account, public health officials can design contact reductions that remove essential connections between people, decrease the network's connectivity, and effectively slow down disease spread [Val12].

21 Contact behavior, both before and during an infectious disease outbreak, demonstrates heterogeneity in three distinct aspects. First, people's number of contacts is not uniformly distributed across the population, but displays heterogeneous patterns. Across age groups, school-aged children have the most contacts, mainly with one another, followed by contact with their parents, while the elderly have the fewest contacts [MHJ<sup>+</sup>08,

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25 MWW<sup>+21</sup>, TRB<sup>+21</sup>]. This heterogeneity in contact numbers influences disease spread, as people with more  
26 contacts are the central nodes in the social contact network and may serve as transmission catalysts [WLX18].  
27 Strategically focusing contact reductions on high-contact individuals can make interventions more effective.

28 Second, personal attributes — including age, gender, health conditions, personal preferences, trust in  
29 institutions, and perceived risk — influence the adoption of self-protective behaviors like contact reductions.  
30 Higher *risk perception* encourages contact reductions; for example, through the avoidance of crowded public  
31 events or of people who have traveled to countries with a high incidence [BM10, BAO<sup>+04</sup>]. Being *female*  
32 is associated with greater engagement in self-protective behaviors as well as compliance with protective  
33 measures [Lau03, BM10, JS09, GPP<sup>+20</sup>]. Older *age* encourages the adoption of self-protective behaviors  
34 such as vaccination and hand washing [Lau03, HC06, JS09], as does being diagnosed with a *multimorbidity*  
35 [DMFdPCV22]. Targeting individuals receptive to contact reductions may limit the cost of NPIs without  
36 compromising the effectiveness of mitigation.

37 Third, people have a tendency to prefer connections with others who share similar characteristics, beliefs,  
38 and backgrounds. This “birds of a feather flock together” phenomenon, known as social homophily, shapes  
39 the contact network in the context of friendships, leisure contacts, romantic partnerships, and partly also  
40 professional relationships [MSLC01, HM17, FAA12]. Social homophily may slow down disease spread, as  
41 spread over bridging ties between clusters is less likely [WS98, BS10]. In adaptive networks, social homophily  
42 may even be decisive in stopping an outbreak early, as it requires only minor disruptions in the network  
43 structure to isolate clusters, which then act as a barrier for the disease to reach further parts of the net-  
44 work [NBTK22]. Yet, recent experimental work suggests that such protective behavior may come at a social  
45 cost. When people prioritize infection avoidance, they may break otherwise beneficial social ties, leading  
46 to a loss of cohesion and network fragmentation [NBC<sup>+23</sup>]. These findings underscore the need to better  
47 understand how the structure and dynamics of social contacts influence not only the course of an outbreak  
48 but also its broader impact on social life.

49 Research conducted during the early stages of the COVID-19 pandemic has conclusively demonstrated  
50 significant contact reductions during the first pandemic year [DZS<sup>+20</sup>, LBK<sup>+21</sup>, MBC<sup>+21</sup>]. Still, a knowl-  
51 edge gap persists regarding which contacts are cut and which are maintained, the heterogeneity in reduction  
52 strength, and the decision-making processes that governed these reductions. Gaining a more profound un-  
53 derstanding of the intricacies of contact behavior during the COVID-19 pandemic is essential, as it supports  
54 epidemiological modelers in representing human behavior realistically and public health officials in designing  
55 more nuanced and thus more cost-efficient NPIs for future outbreaks.

56 In this study, we examine three of these intricacies, reflecting the aforementioned three aspects of het-  
57 erogeneity: First, we demonstrate that the aforementioned pre-pandemic heterogeneity in the number of  
58 contacts translates to heterogeneous contact reductions during the COVID-19 pandemic. While many sur-  
59 vey participants reduced their contacts strongly, some displayed little change, and the remainder spread out  
60 between the two extremes, resulting in a bimodal distribution of reduction. This bimodal distribution of  
61 contact reductions can be observed for both work and leisure contacts. For both contexts, the group size  
62 of participants who strongly reduced decreased over the course of the pandemic, while the group sizes of  
63 intermediate reduction and little change incrementally increased. Second, we show that stronger risk per-

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64 ception correlates with stronger initial contact reductions as well as stronger upkeep of these reductions over  
65 time. Third, we provide evidence for the persistence of social homophily and the importance of second-order  
66 contacts during the COVID-19 pandemic.

### 67 **Methods**

#### 68 **Data Collection**

69 All data was collected via an online survey in the summer of 2023. To recruit survey participants, we part-  
70 nered with five German-speaking academics, whose Twitter (now X) followers ranged from 750 to 65,000 at  
71 the time of the study. The five recruiters shared the online survey on Twitter on July 19, 2023, with one  
72 recruiter additionally sharing the survey on Mastodon. To post polls on behalf of each of the five recruiters  
73 and to ensure simultaneous posting, we developed a Twitter poll bot. This bot was set up to share the polls  
74 and the survey link in a thread (multiple linked posts), allowing participants to easily access the survey. The  
75 poll bot was only used by three of the five Twitter recruiters; the remaining two recruiters posted indepen-  
76 dently. The single Mastodon recruiter shared the survey without a bot. The survey data collection ran from  
77 July 18, 2023, to August 30, 2023. We collected data in the following order: basic sociodemographic data  
78 (age, gender), number and timing of COVID-19 infections, contacts of participants, contacts of household  
79 members, contacts of closest contacts, risk perception, vaccination(s), and additional sociodemographic data  
80 (including current occupation, education). Out of 867 started surveys, 398 were completed, and participants  
81 spent on average 13 minutes filling out the survey. The survey in the original German and the anonymized  
82 survey data are available on OSF ([FNM<sup>+</sup>23] and [CVFN<sup>+</sup>25]). We discussed the representativeness of  
83 the study population in a previous publication: The majority of survey participants was between 40 and  
84 59-years-old, individuals who have received higher education were oversampled, while one-person households  
85 were undersampled (Supplementary Figure 1). Infection numbers and 7-Day-Incidence/100,000 of the survey  
86 participants are comparable to high-effort panel studies and official reporting numbers [MNP<sup>+</sup>25]. Data col-  
87 lection was conducted in accordance with the Declaration of Helsinki and approved by the ethics committee  
88 of the University of Lübeck.

#### 89 **Data Processing**

90 All responses were anonymized during data processing: We removed personally identifiable information,  
91 such as IP addresses and free text fields. Speeders – participants who answered the survey in less than  
92 a third of the median time – were removed. Preprocessing code is publicly available on GitHub (<https://github.com/hciuse/twitter-study>).  
93

#### 94 **Contact Data**

95 We defined a “contact” as any situation in which one person comes closer than two meters to another  
96 person for at least 15 minutes. This definition ignores the presence or absence of self-protective measures  
97 (mask-wearing is provided as an example in the survey). Absolute weekly contact numbers were collected  
98 differentiated by context, namely for leisure, school, and work. Contacts were collected retrospectively,  
99 with participants being asked to report their weekly number of distinct contacts for four time points: 2019,  
100 03/2020, summer 2021, and 01/2023. For each time point, the survey provided auxiliary information on the

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101 then-current state of the COVID-19 pandemic, including the stringency of NPIs, the then-current virus strain  
102 and the availability of the vaccine (Supplementary Table 2). Weeks were chosen as the time scale because the  
103 infectious period of SARS-CoV-2 is up to one week [BMC<sup>+</sup>20, HZJ<sup>+</sup>22]. Furthermore, contact patterns vary  
104 throughout the week and our retrospective data collection method did not allow us to distinguish between  
105 weekdays and weekends [TC12, ZPSD<sup>+</sup>23].

106 Participants were asked to report their own contacts, their household members' number of contacts, and  
107 their (non-household) closest contact's (CC) number of contacts (see Supplementary Section Accuracy of  
108 Participants' Reported Contact Numbers for qualitative assessment of participants' accuracy). The collected  
109 contact data does not allow us to determine if there exists an overlap between the participant's and the CC's  
110 contacts: This overlap would mean that some contacts are both contacts of the CC *and* direct contacts of  
111 the participant. In the following, for reasons of simplicity, we refer to the participants' own reported contacts  
112 as first-order contacts and the CCs' contacts as second-order contacts.

### 113 **Classification into Subgroups**

114 For subgroup analyses, we classified participants according to the following four characteristics:

115 1. *Risk Perception.* The survey included nine items on attitudes related to COVID-19 at the end of  
116 March 2020, asking participants to compare themselves to an “average person” (Table 3). Answers  
117 were collected on a scale ranging from “a lot less” to “a lot more” (see Table 4 for original German  
118 options). In the analysis, we excluded the answer options “does not apply” and “not specified”,  
119 yielding a 7-point Likert scale. We mapped the answers “a lot less”, “less”, and “slightly less” to  $-1$ ,  
120 “just as much” to 0, and “slightly more”, “more”, “a lot more” to  $+1$ . The scale was reversed for  
121 questions about meeting close contacts despite restrictions and feeling restricted by measures. We  
122 summed up these values to calculate a risk perception score. The risk perception score may take  
123 on integer values between  $-9$  and  $9$ , but we only obtained values between  $-6$  and  $9$  for our sample.  
124 We binned participants into two groups: risk-tolerant (risk perception score  $\leq 3$ ) and risk-averse  
125 (risk perception score  $\geq 4$ ). We introduced the asymmetrical split of the scale to increase the size  
126 of the risk-tolerant group and maximize differences in contact behavior and number and timing of  
127 infections between groups. Some participants did not or only partially answered the risk perception  
128 survey items. Consequently, for these participants, no risk perception score could be computed and  
129 they are classified as “No Risk Perception Score Available”.

130 2. *Age.* Participants were asked to report their age in years. We binned participants into three age  
131 groups: 18-39, 40-59, 60+. Underage individuals were not allowed to participate in this survey due  
132 to data protection reasons.

133 3. *Gender.* Data on gender was collected via a multiple-choice item. Choices were “male”, “female”,  
134 “diverse”, and “I don't want to answer”. Subanalysis by gender only included participants who  
135 reported their gender as “female” or “male” as only seven participants reported their gender as  
136 “diverse” ( $< 1\%$ ), making the sample too small to give statistically meaningful insights.

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137 4. *Comorbidities.* Participants were asked if they had been diagnosed with hypertension, diabetes, car-  
138 diovascular disease, immunodeficiency, cancer, or post-COVID-19 condition. We binned participants  
139 according to whether they reported any of these comorbidities.

### 140 Statistical Methods

141 *Distribution of Change of Contacts:* Participants reported absolute contact numbers for 2019, 03/2020,  
142 summer 2021, and 01/2023. For each participant, we computed the percentage change of number of contacts  
143 in 03/2020, summer 2021, and 01/2023, relative to 2019. As a percentage change from zero cannot be  
144 computed, we excluded participants who reported zero work or leisure contacts for 2019.

145 *Determination of Shape of Distribution:* We used Bayesian modeling to quantify the shape of the distri-  
146 bution of change of the number of work or leisure contacts at each time point. We used Gaussian mixture  
147 models to determine if the change in the number of work and leisure contacts followed a uni-, bi-, tri-, or  
148 quatro-modal distribution. We fitted one to four (half)-normal distributions to the data using Markov chain  
149 Monte Carlo methods. We assumed the means of the normal-distributions and the shift of the half-normal  
150 distribution to be fixed, and estimated the variances and the weights of the distributions. When fitting  
151 one distribution to the data, we used a half-normal distribution shifted to  $-100\%$  such that it only allows  
152 values  $\geq -100\%$ . We added a normal distribution with a mean of  $0\%$  when fitting two distributions to the  
153 data. When considering three distributions, we added an additional normal distribution centered around  
154  $-50\%$ , and when considering four distributions, we added another normal distribution centered around  
155  $+50\%$ . Model comparison was performed using leave-one-out cross validation. Model comparison selected  
156 the model using three distributions, consisting of a narrow half-normal distribution with a lower bound of  
157  $-100\%$ , an equally narrow normal distribution with a mean of  $0\%$ , and a wide and flat normal distribution  
158 covering all contact reductions in between the two extremes. Due to the pointed, narrow distributions at  
159 the two extremes, we will still refer to shape of the contact reductions as “bimodal” (see Supplementary  
160 Section Bayesian Fits for details).

161 *Group Assignment:* We used the posterior mean estimates of the selected model to estimate group mem-  
162 bership probabilities for the three corresponding groups. Using these probabilities, we assigned participants  
163 to the groups of “strong reduction”, “intermediate reduction”, and “little change” for every time point. Few  
164 participants increased their work or leisure contacts. These participants could not be mapped to any of the  
165 aforementioned groups and were instead mapped to the group “none”.

166 *Kolmogorov-Smirnov tests:* To test for significant differences in the distributions of changes in work and  
167 leisure contacts across the multiple time points, we applied two-sided Kolmogorov-Smirnov tests. Analo-  
168 gously, to test for significant differences in distributions of changes in work and leisure contacts for each  
169 time point but between subgroups, we used two-sided Kolmogorov-Smirnov tests. Finally, to test if the  
170 distributions of the number of infections as well as the ECDF of the timing of the first infection differ signif-  
171 icantly between subgroups, we used two-sided Kolmogorov-Smirnov tests. In each instance we, reported the  
172 appropriate significance level (0.01, 0.05, 0.1).

173 *Confidence Intervals:* We analyzed the discrete distribution of the number of reported COVID-19 infec-  
174 tions (0, 1, 2, 3+) using a bar chart. For each bar, we computed 95% confidence intervals. We assumed that  
175 the proportion of participants who reported  $N$  infections approximates the true proportion of participants

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176 who have been infected  $N$  times. Similarly, for the empirical cumulative distribution function (ECDF) of  
177 the timing of participants' first infection, we computed 95% confidence intervals. Again, we assumed that  
178 the proportion of participants who having been infected by a certain date, approximate the true participant  
179 proportion of having been infected by a certain date. In either case, we assumed the true population pro-  
180 portion to be the mean of a binomial distribution, and as the binomial distribution is approximately normal  
181 for large enough samples, we used z-scores when computing the 95% confidence intervals.

182 *Missing data:* We obtained 398 completed and 867 partially filled out surveys. We also used incomplete  
183 surveys for the analysis.

184 *Processing of POLYMOD data:* We compared the survey participants' characteristics and their reported  
185 number of 2019 work or leisure contacts to the results obtained in the POLYMOD study for Germany  
186 [MHJ<sup>+</sup>08]. POLYMOD data was accessed via Zenodo [MNJ<sup>+</sup>20].

### 187 Data Analysis and Availability

188 All analysis code is publicly available on Zenodo [Pal25]. For most data analysis we used R 4.4.1, namely  
189 packages from the tidyverse, whereas to fit two to four (half)-normal distributions to the change of number  
190 of contacts, we used Python 3.11.5, more specifically PyMC 5.10.4 [WAB<sup>+</sup>19, APAC<sup>+</sup>23].

## 191 Results

### 192 Contact Reductions

193 During the COVID-19 pandemic, self-reported work and leisure contacts decreased significantly compared  
194 to the pre-pandemic contact levels of 2019. On average, work contacts were reduced by 75% in 03/2020, by  
195 64% in summer 2021, and by 42% in 01/2023 (Fig. 1A). The Bayesian reduction model maps participants'  
196 reductions to the three groups "strong reduction", "intermediate reduction", and "little change" (see Sup-  
197plementary Section Bayesian Fits for model comparison). The sizes of these groups differed from one to the  
198 subsequent time point, confirming the temporal development of contact reductions ( $p < 0.01$ , see Supplemen-  
199tary Section Kolmogorov-Smirnov tests for details). In 03/2020, more than half of the participants "strongly"  
200 reduced their work contacts (55%, Table 1). This share incrementally decreased, to 42% (summer 2021), and  
201 finally to 24% (01/2023). Complementarily, the share of participants who displayed "little change" in their  
202 work contacts increased from 16% (03/2020) to 17% (summer 2021) to 31% (01/2023). Participants typi-  
203 cally relaxed their work contact reductions incrementally, moving from "strong reduction" to "intermediate  
204 reduction" and from "intermediate reduction" to "little change" (Fig 2A). In sum, work contact reductions  
205 were relaxed over time such that by 01/2023 only 24% of participants maintained "strong" work contact  
206 reductions, 39% "intermediate reductions", and 32% had returned to pre-pandemic levels.

207 Very similar to work contacts, leisure contacts were also decreased in 03/2020, summer 2021, and 01/2023  
208 compared to 2019. On average, participants reduced their leisure contacts by 72% in 03/2020, by 51% in  
209 summer 2021, and by 28% in 01/2023 (Fig. 1B). Analogously to work contacts, leisure contacts had not  
210 returned to pre-pandemic levels by 01/2023. The Bayesian reduction model quantifies the bimodal shape of  
211 the distribution for the three time points. The shape of the distribution changes significantly from one time  
212 point to the subsequent one ( $p < 0.01$ ). According to the Bayesian reduction model, 47% of the participants  
213 "strongly" reduced their leisure contacts in 03/2020. The share of this group decreased over time, to 16%

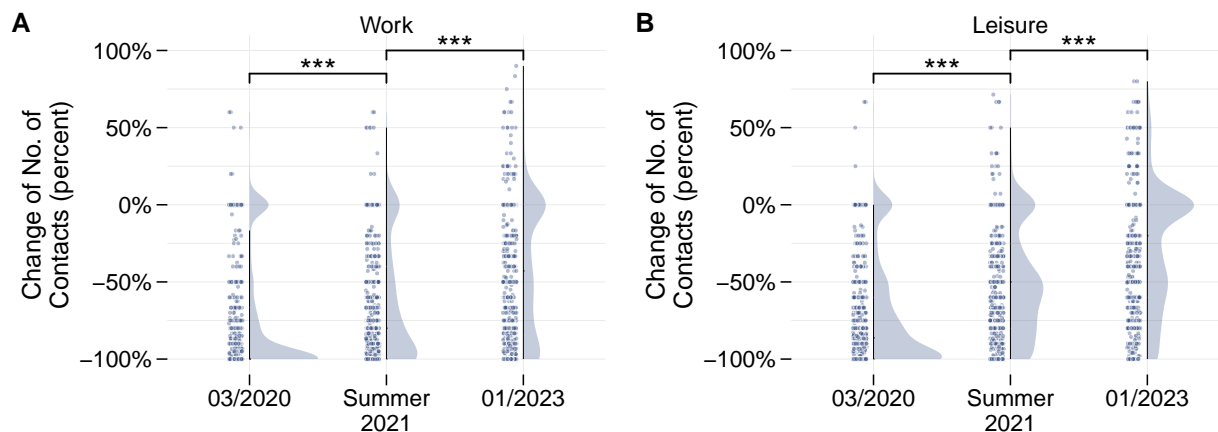


Figure 1: Change of number of contacts (in percent, relative to 2019). Stars indicate that the distributions differ at significance levels of  $***p < 0.01$ . **A. Relative number of work contacts.** On average, participants reduced their work contacts in 03/2020, summer 2021, and 01/2023. A bimodal distribution of reductions is visible for all three time points, with the group of “strong reduction” decreasing and the group of “little change” increasing as time progressed. **B. Relative number of leisure contacts.** On average, participants reduced their work contacts in 03/2020, summer 2021, and 01/2023. For all three time points, the distribution is bimodal. The share of participants who displayed little change in their leisure contacts increased over time, such that by 01/2023, around 40% of participants had returned to pre-pandemic leisure levels.

	Work		Leisure	
	N	%	N	%
<b>03/2020</b>				
Strong Reduction	401	55.1	372	46.5
Intermediate Reduction	203	27.9	328	40.9
Little Change	118	16.2	97	12.1
None	6	0.8	4	0.5
<b>Summer 2021</b>				
Strong Reduction	301	42.0	126	16.1
Intermediate Reduction	281	39.2	489	62.6
Little Change	124	17.3	146	18.7
None	10	0.1	20	2.6
<b>01/2023</b>				
Strong Reduction	168	23.6	60	8.0
Intermediate Reduction	278	39.0	340	45.1
Little Change	229	32.2	295	39.1
None	37	5.2	59	7.8

Table 1: Group assignment based on the change of number of contacts (for details, see Subsection Statistical Methods). For both contexts, the share of individuals in the “strong reduction” group decreases over time.

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214 (summer 2021) and finally to 8% (01/2023). Again, participants incrementally relaxed their leisure contact  
215 reductions (Fig. 2B). In sum, only 8% maintained “strong” reductions, 45% intermediate reductions, and  
216 nearly 40% of participants had returned to their pre-pandemic contact patterns, highlighting a heterogeneity  
217 in contact behavior and the importance of examining contact distributions rather than just mean values.

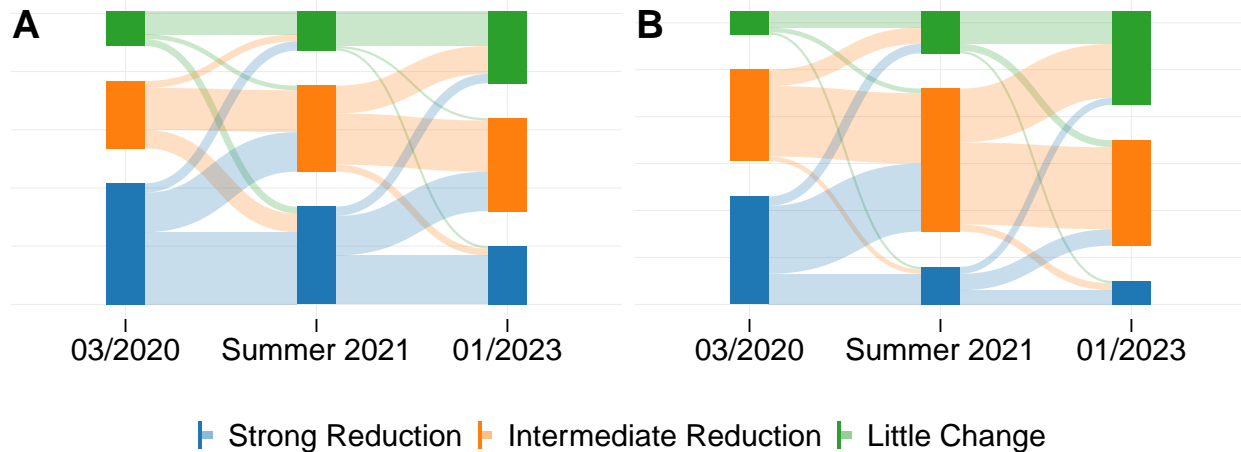


Figure 2: Sankey diagrams depicting the flow between reduction groups. Participants decreased their reductions over time. **Sankey diagram change of work contacts.** Participants gradually decreased their reductions (moving from “strong reduction” to “intermediate reduction” to “little change”). **Sankey diagram change of leisure contacts.** Participants gradually decrease their reductions (moving from “strong reduction” to “intermediate reduction” to “little change”). Hardly anyone moved to a more restrictive group.

### 218 Subanalysis by Risk Perception Score

219 Risk-averse and risk-tolerant participants showed no difference in their 2019 pre-pandemic contact levels.  
220 The two groups are comparable in their general sociability, as neither the reported work nor the reported  
221 leisure contact numbers differed significantly ( $p > 0.1$ , Supplementary Section Pre-Pandemic Contact Data  
222 Differentiated by Risk-Perception Score).

223 Risk-averse participants, however, reported stronger work contact reductions than the risk-tolerant par-  
224 ticipants (Fig. 3). In 03/2020, risk-averse participants reduced their work contacts on average by 78%, while  
225 risk-tolerant participants reduced theirs by 64% (difference statistically significant,  $p < 0.05$ , see Supplemen-  
226 tary Section Kolmogorov-Smirnov tests for details). Both groups relaxed their work contact reductions over  
227 time. In summer 2021, the mean work contact reduction was 65% for risk-averse and 58% for risk-tolerant  
228 participants, respectively ( $p > 0.1$ ). In 01/2023, mean work contact reductions were 46% (risk-averse partic-  
229 ipants) and 36% (risk-tolerant participants) ( $p > 0.1$ ). Overall, risk-averse participants reduced their work  
230 contacts significantly more in 03/2020, and there exists a trend of them maintaining lower levels of work  
231 contacts compared to risk-tolerant participants.

232 In the leisure context, risk-averse participants reduced their contacts more strongly and maintained these  
233 reductions for longer than risk-tolerant participants. Compared to 2019, risk-averse participants reduced  
234 their leisure contacts on average by 77% in 03/2020, while risk-tolerant participants reduced theirs by 53%.  
235 Both groups relaxed their leisure contact reductions as time progressed, leading to average reductions of 54%  
236 (risk-averse) and 31% (risk-tolerant) in summer 2021, and average reductions of 33% (risk-averse) and 6%

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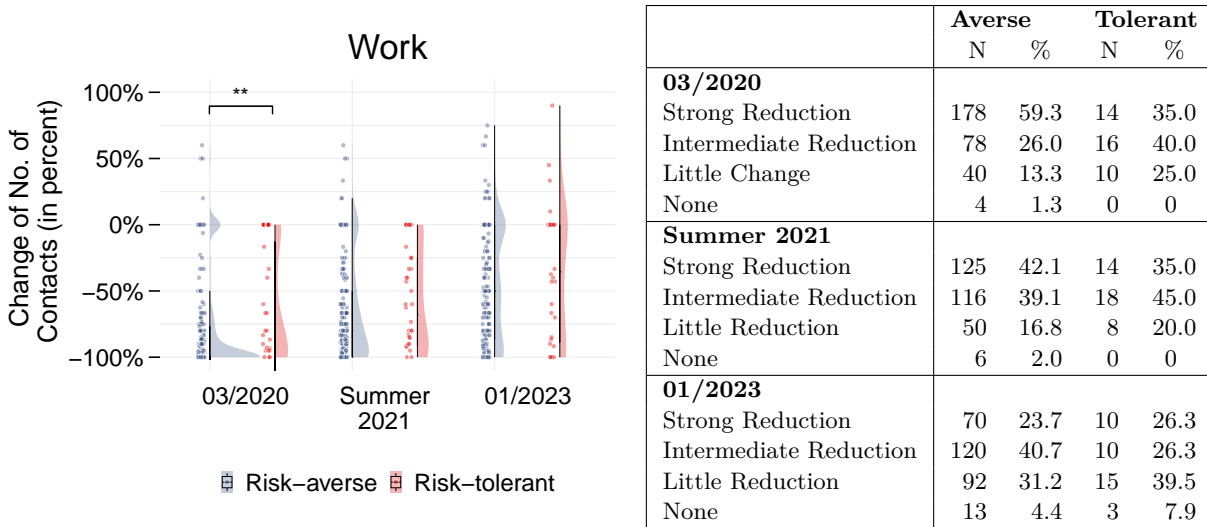


Figure 3: **Left:** Change of number of contacts (in percent, relative to 2019). Stars indicate that the distributions differ at significance levels of  $**p < 0.05$ . On average, both risk perception groups reduced their work contacts for all three time points. In 03/2020, risk-averse participants reduced their work contacts significantly more than risk-tolerant participants. **Right:** Group assignment based on the change of number of contacts (for details, see Subsection Statistical Methods). For all three time points, risk-averse tolerant participants tend to reduce more strongly than risk-tolerant participants.

237 (risk-tolerant) in 01/2023 (Fig. 4). The differences between risk perception groups are statistically significant  
 238 for all three time points ( $p < 0.01$ ). Overall, risk perception consistently influenced leisure contacts, with  
 239 risk-averse participants reducing more strongly and maintaining the reductions for longer than risk-tolerant  
 240 participants.

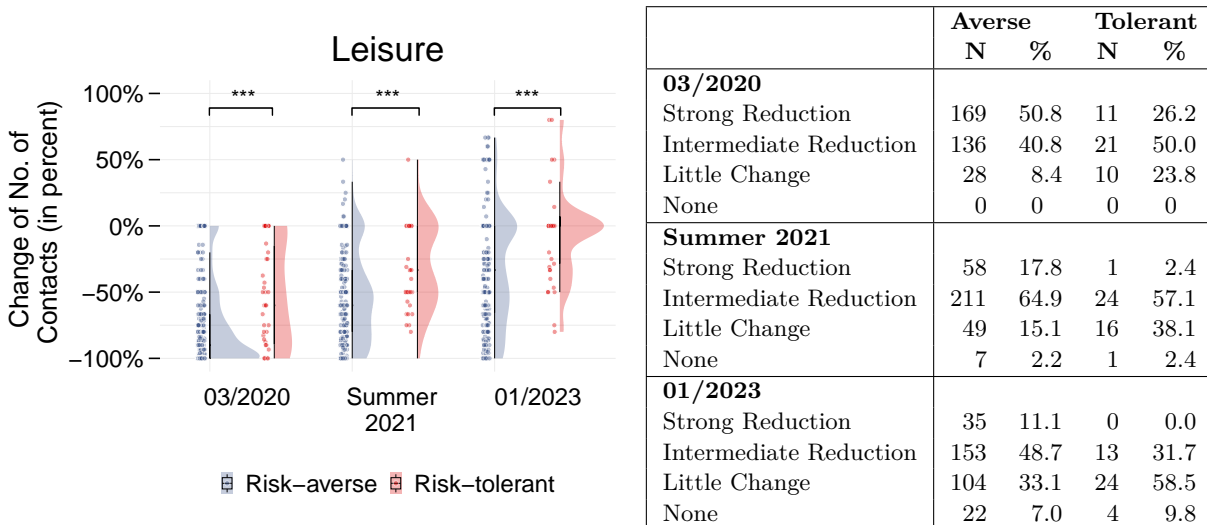


Figure 4: **Left:** Change of number of contacts (in percent, relative to 2019). Stars indicate that the distributions differ at significance levels of  $***p < 0.01$ . In 03/2020, more risk-averse than risk-tolerant participants reduced their leisure contacts “strongly”. The share of risk-tolerant participants who “strongly” reduced their leisure contacts was negligible in summer 2021. The majority of risk-tolerant participants had returned to pre-pandemic contact levels in 01/2023. **Right:** Group assignment based on the change of number of contacts (for details, see Subsection Statistical Methods). The difference between risk perception groups already arises in 03/2020 and persists for the two later points in time. Risk-averse participants were more than twice as likely to strongly reduce contacts and half as likely to maintain leisure contacts compared to risk-tolerant participants.

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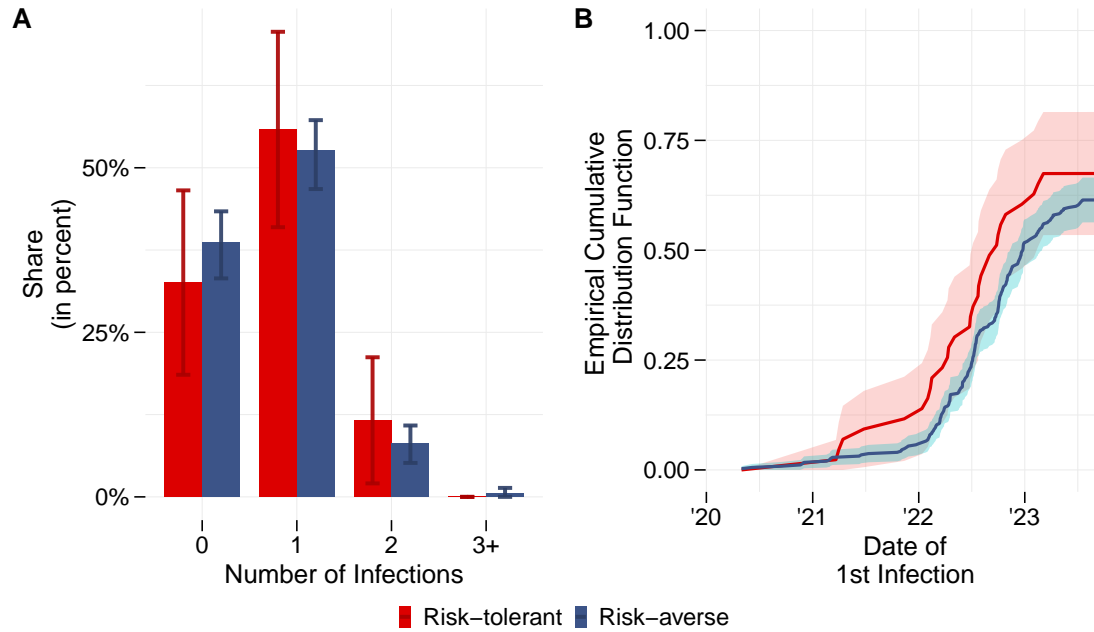


Figure 5: **A.** Share of respondents who reported 0/1/2/3+ infections, differentiated by risk perception score. Error bars represent 95% confidence intervals (see Subsection Statistical Methods for computation and motivation). There exists a trend of risk-tolerant participants reporting more infections than risk-averse participants. **B.** Timing of participants' (first) infection(s); differentiated by risk perception score. Ribbons represent 95% confidence intervals (see Subsection Statistical Methods for computation and motivation). Risk-averse participants reported fewer infections, and, starting from the spring of 2021, the ECDF of the risk-averse group is constantly below the ECDF of the risk-tolerant group.

### 241 Correlation of Contact Reductions and Reported COVID-19 Infections

242 Risk-averse participants reported fewer COVID-19 infections than risk-tolerant participants. Of the risk-  
 243 averse participants, 39% (95% CI: [33%, 43%]) reported zero infections compared to 32% (95% CI: [19%,  
 244 46%]) of risk-tolerant participants. The shares of risk-averse and risk-tolerant participants who reported  
 245 one COVID-19 infection are comparable (risk-averse: 53%, 95% CI: [47%, 57%], risk-tolerant: 56%, 95% CI:  
 246 [41,71]). More risk-tolerant than risk-averse participants reported two infections (12% (95% CI: [2%, 21%])  
 247 vs 8% (95% CI: [5%, 11%])). The difference in distribution of the number of COVID-19 infections between  
 248 risk perception groups, however, was not statistically significant ( $p > 0.1$ ) – potentially an artifact of the  
 249 small number of risk-tolerant participants (Table 2).

Risk Group	N	Percent
Risk-tolerant	39	11.8
Risk-averse	292	88.2
No Risk Perception Score Available	372	-

Table 2: Number of participants per risk perception group.

250 Risk-averse participants reported later dates of first infection than risk-tolerant participants, although  
 251 this difference was not statistically significant. The empirical cumulative distribution functions (ECDF)  
 252 of the timing of the first infection of risk-averse and risk-tolerant participants are indistinguishable until  
 253 spring 2021. From spring 2021 onwards, the ECDF for the risk-averse group remained consistently below

## Bimodal Contact Reductions and Social Homophily during COVID-19

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254 that of the risk-tolerant group (Fig. 5B). This indicates a trend of risk-averse participants being more  
255 successful at avoiding infection than risk-tolerant participants ( $p > 0.1$ ). Overall, the results indicate a  
256 correlation between stronger contact reductions and fewer and later COVID-19 infections, but did not reach  
257 statistical significance due to the small number of risk-tolerant participants.

### 258 **Sub-analyses by Age, Gender, and Comorbidities**

259 18-39 year olds and 40-59 year olds reduced their work contacts more strongly than 60+ year olds ( $p < 0.05$ ,  
260 see Supplementary Section Subgroup Analysis by Age Group), but age did not significantly influence leisure  
261 contact reductions. Neither gender nor having a COVID-19 relevant comorbidity significantly influenced self-  
262 reported contact reductions ( $p > 0.1$ , Section Subgroup Analysis by Gender, and Section Subgroup Analysis  
263 by Comorbidities).

### 264 **Contact of Household Members and Closest Contacts**

265 Household members and the closest contacts of participants significantly decreased their work and leisure  
266 contacts during the COVID-19 pandemic. Work contact reductions were stronger than leisure contact re-  
267 ductions for both household members and CCs. Similarly to the participants, household members and CCs  
268 relaxed their reductions over time. Participants reported the strongest work and leisure contact reductions  
269 for themselves, followed by their household members, and finally by their CCs. In the work context, the  
270 differences between participants and household members and between participants and CCs are significant  
271 for all three time points ( $p < 0.01$ , see Supplementary Section Contact Reductions of Participant, House-  
272 hold member, Closest contact for details). In the leisure context, the difference between participants and  
273 household members and between participants and CCs is statistically significant for all three time points  
274 ( $p < 0.01$ ), except for 03/2020: Here, the difference between participants and their household members is  
275 not statistically significant ( $p > 0.1$ ). In sum, participants reported stronger reductions for themselves than  
276 for their household members and CCs, but the bimodal shape and time-dependency of contact reductions  
277 are visible across groups.

### 278 **Social Homophily During the COVID-19 Pandemic**

279 Social homophily persisted during the COVID-19 pandemic: The Pearson correlation coefficient of the  
280 participants' and their CCs' number of contacts is consistently different from zero ( $p < 0.01$ ). The correlation  
281 coefficient is positive in both the work and leisure context and ranges between 0.19 and 0.24 (Table 3). For  
282 the risk-averse subgroup, the correlation is larger in magnitude than for the whole sample, ranging between  
283 0.34 and 0.36 in the work context and between 0.29 and 0.35 in the leisure context (Fig. 6). For risk-tolerant  
284 participants, on the other hand, the correlation coefficient is not significantly different from zero in the  
285 leisure context ( $p > 0.1$ ). As risk-tolerant participants perceived the COVID-19 pandemic as less of a threat,  
286 this could indicate that they were not concerned about infection risk due to their second-order contacts.  
287 In the work context, risk-tolerant participants' correlation coefficients are similar to those of risk-averse  
288 participants and the overall sample, but are only significantly different from zero at the 10% significance  
289 level. In conclusion, the correlation coefficients indicate that the participants preferred to maintain contact  
290 with others who reduced their contacts similarly to themselves, providing evidence for the persistence of  
291 social homophily during the COVID-19 pandemic.

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Time point	All Participants	Risk-Averse Participants	Risk-Tolerant Participants
<b>Work</b>			
2019	0.21***	0.36***	0.30*
03/2020	0.21***	0.35***	0.26*
Summer 2021	0.23***	0.34***	0.27*
01/2023	0.24***	0.35***	0.28*
<b>Leisure</b>			
2019	0.19***	0.34***	-0.07
03/2020	0.21***	0.32***	-0.07
Summer 2021	0.22***	0.29***	0.03
01/2023	0.24***	0.35***	0.06

Table 3: Correlation coefficient of participants’ number of contacts and their closest contacts’ number of contacts. Stars indicate that the correlation coefficient is significantly different from zero, with significance levels of \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

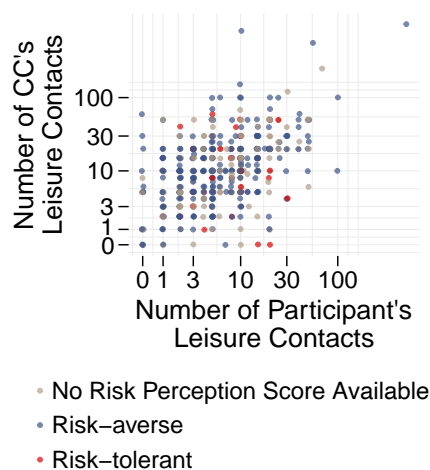


Figure 6: Correlation plot of leisure contacts in 01/2023. Colors depict the different risk perception groups. The number of contacts is depicted on a pseudolog/pseudolog scale to allow the display of 0 contacts.

## 292 Discussion

293 Our study showed that contact reductions during the COVID-19 pandemic were heterogeneous in three differ-  
 294 ent aspects. First, we quantified that the reductions of work and leisure contacts were both time-dependent  
 295 and bimodal – with some participants “strongly” reducing, some displaying “little change” in their number  
 296 of contacts, and the remainder of participants spreading out between the two extremes. Second, we demon-  
 297 strated that higher risk perception encourages stronger reduction of contacts and, in turn, leads to fewer and  
 298 later infections. Third, we found evidence that social homophily persisted during the COVID-19 pandemic,  
 299 especially for risk-averse participants. Considering these heterogeneities may support epidemiological mod-  
 300 elers in representing human behavior realistically as well as public health officials and decision makers when  
 301 implementing measures that aim to reduce contacts.

302 First, consistent with previous contact studies, we found that both work and leisure contacts were sub-  
 303 stantially reduced during the pandemic [VHV<sup>+</sup>21, CWG<sup>+</sup>20, WGC<sup>+</sup>23, JCB<sup>+</sup>24]. Notably, we found these  
 304 reductions to be time-dependent: Contact reductions were relaxed over time, with leisure contacts recover-

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305 ing faster than work contacts. Still, by 01/2023, the contacts reported for either context remained below  
306 pre-pandemic levels. One potential explanation for the lasting reduction in the work context could be the  
307 permanent alteration of office culture: Since the COVID-19 pandemic, more office workers have been able  
308 to at least partially work from home and not come into the office every day [MCMW23, Sta21]. This, in  
309 turn, reduces their work contacts. In sum, analysis of the mean contact reduction reveals that contacts were  
310 most substantially reduced at the beginning of the pandemic, but still remained below pre-pandemic levels  
311 by 01/2023.

312 Examining not only the mean contact reduction but also the full distribution of reductions reveals an  
313 important heterogeneity: The distribution of reductions is bimodal, with a peak at either extreme. Some  
314 participants reduced their contacts “strongly“, while others showed “little change” in their number of contacts.  
315 The shape of this bimodal distribution evolves over time: Typically, participants incrementally relaxed their  
316 contact reductions. Still, there exists a noticeable share of participants who moved from the “intermediate”  
317 to the “strong” reduction group from 03/2020 to summer 2021. One possible explanation is Germany’s  
318 implementation of home office mandates in January 2021. This implementation yielded a reduction of work  
319 attendance of the participants, but potentially also of their coworkers. The reduction in attendance then  
320 decreased the number of work contacts of the participants. Overall, analysis of the full distribution of contact  
321 reductions reveals a bimodal pattern that evolved over time, reflecting heterogeneous behavioral responses.

322 Second, consistent with evidence from other communicable diseases and the health belief model, risk-  
323 averse participants who perceived COVID-19 as more dangerous reported stronger contact reductions than  
324 risk-tolerant participants [Ros90, Fer07, BM10, LA09, dGCDD22]. This difference in reduction became es-  
325 pecially apparent in the leisure context, with risk-averse participants reducing more strongly and upholding  
326 these reductions longer. This difference between the two contexts could, on the one hand, indicate a perma-  
327 nent change in office culture. Since the COVID-19 pandemic, remote work has become more common, and  
328 online meetings are the norm in many companies [MCMW23, Sta21]. Here, both risk perception groups ben-  
329 efit from the possibility to work from home, and contact reductions are not necessarily a result of the disease  
330 spread. On the other hand, the difference may be an indicator of participants’ greater freedom over their  
331 leisure contacts. In the leisure context, risk perception can be more easily expressed and acted upon, whereas  
332 workplace contacts remain largely dictated by organizational requirements, limiting individuals’ freedom to  
333 (not) reduce their work contacts. Differences in contact reductions propagated to differences in infections:  
334 Risk-averse participants reported fewer infections, as well as a later date for their first infection. Subanaly-  
335 ses that examined age, gender, and comorbidities did not demonstrate any significant differences in contact  
336 reductions. In sum, the findings demonstrate that risk perception was the main driver of contact reductions,  
337 with risk-averse participants’ stronger and more sustained reductions translating into fewer infections.

338 Third, our analysis provides evidence for social homophily during the COVID-19 pandemic. In the work  
339 context, the correlation between the participants’ and their closest contacts’ remained constant from 2019  
340 until 01/2023. Differentiated by risk perception score, the correlation coefficient for risk-averse participants  
341 was higher than for the risk-tolerant participants. In contrast, in the leisure context, only risk-averse par-  
342 ticipants displayed a correlation between their own contacts and their closest contact’s number of contacts  
343 significantly different from zero. Again, this may be traced back to participants’ freedom over their leisure

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344 contacts and lack thereof over their work contacts. These findings demonstrate that social homophily influ-  
345 enced contact patterns during the pandemic, with participants – particularly those who were risk-averse –  
346 preferring to maintain relationships with others who reduced their contacts similarly to themselves.

347 Both our second and our third main results show that risk perception – not demographics – is the main  
348 driver of behavior. Recognizing the difference in risk perception may support public health communication  
349 and the design of intervention strategies. Tailored messaging that aligns with individual risk perceptions  
350 may be more effective than uniform approaches.

351 While this study has several methodological limitations, our findings are consistent with previous con-  
352 tact studies and contribute valuable insights into pandemic contact behavior. Participants were asked to  
353 report their contacts from 2019, 03/2020, summer 2021, and 01/2023 in July and August 2023, potentially  
354 introducing recall bias. Especially when reporting contacts from the beginning of the pandemic and when  
355 answering the risk perception questions, participants might have been tempted to underestimate their con-  
356 tacts and overestimate their self-protective behaviors to adhere to societal expectations, leading to social  
357 desirability bias. Participants were recruited via Twitter: As Twitter users have traditionally been younger,  
358 more male, and better educated than the general population, this recruitment method may lead to a biased  
359 sample [MLA<sup>+</sup>21]. In our sample, even the most risk-tolerant participants reported reducing their contacts  
360 in 03/2020. Our recruitment strategy consequently underrepresented participants who did not consider  
361 COVID-19 to be a threat and who, as a result, maintained their pre-pandemic level of contacts, even during  
362 peak pandemic periods. Thus, one subpopulation that is of special interest for understanding the state of  
363 an outbreak and designing effective public health interventions could not be reached with this recruitment  
364 method. Despite these limitations, the distribution of COVID-19 infections and incidence rates observed  
365 in our survey are consistent with large-scale studies and official reporting statistics [MNP<sup>+</sup>25]. Our pre-  
366 pandemic contact data is comparable to the POLYMOD study for Germany, while our pandemic contact  
367 data aligns with previous studies examining contact patterns and activity reductions during this period  
368 [TRB<sup>+</sup>21, MPR<sup>+</sup>24, PBN24, PBJ<sup>+</sup>25] (see Supplementary Section Comparison to POLYMOD for details).  
369 While these limitations should be considered, they do not diminish the study’s contribution to understanding  
370 the intricacies of contact behavior during the COVID-19 pandemic.

371 Most importantly, our study contributes novel insights by uncovering bimodal patterns of contact reduc-  
372 tions and persistent social homophily during the COVID-19 pandemic. These insights reveal substantial  
373 heterogeneities in pandemic behavioral response that have been overlooked in previous research. Our results  
374 can support epidemiological modelers in representing human behavior more realistically, improving both  
375 model accuracy and predictive power [Fer07, FSJ10]. Our findings also have critical implications for public  
376 health strategies, as they emphasize the need for non-pharmaceutical interventions that address and exploit  
377 these heterogeneities. By tailoring communication strategies and policy measures to these three distinct  
378 behavioral groups, public health officials may increase intervention effectiveness while minimizing societal  
379 burden. Our findings yield a shift toward targeted public health strategies that account for behavioral het-  
380 erogeneities, ultimately supporting more effective and sustainable pandemic preparedness for future health  
381 crises.

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### 382 **Availability of Data and Materials**

383 The survey in the original German is available on OSF [FNM<sup>+</sup>23]. The anonymized dataset analysed in this  
384 study is available on OSF [CVFN<sup>+</sup>25]. Analysis code is available on Zenodo [Pal25].

### 385 **Competing interests**

386 The authors declare that they have no competing interests.

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409 Supervision: VP, MEK, ACV, KN  
410 Validation: all  
411 Visualization: SP  
412 Writing - Original Draft: SP, LS, VP  
413 Writing - Review & Editing: all

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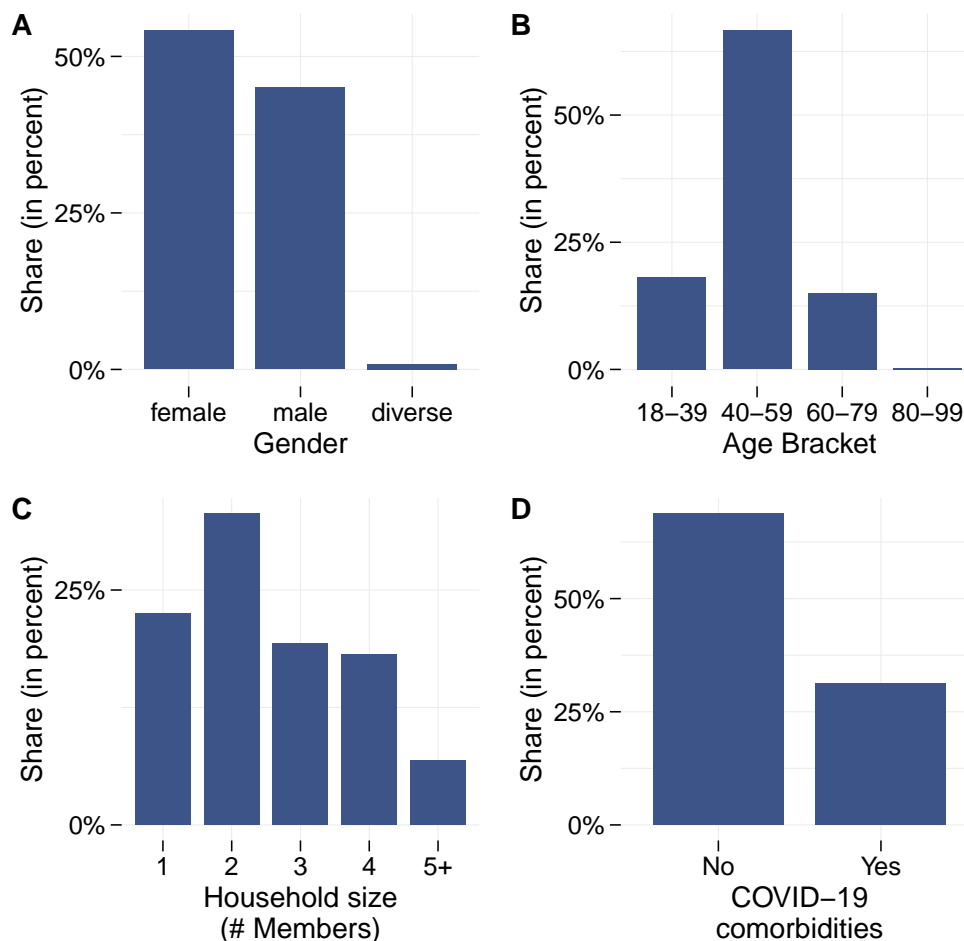
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### 623 **Supplementary material**

#### 624 **Participant Characteristics**

625 The online survey was started by 867 and completed by 398 participants. The majority of survey participants  
626 was between 40 and 59 years old, less than one percent were over the age of 80 (Supplementary Figure 1).  
627 Around 54% of the participants reported their gender as female, 45% as male, and < 1% as diverse. The  
628 mean household size in the survey was 2.7. A detailed analysis of the demographic composition of the sample  
629 can be found in our previous publication [MNP<sup>+</sup>25].



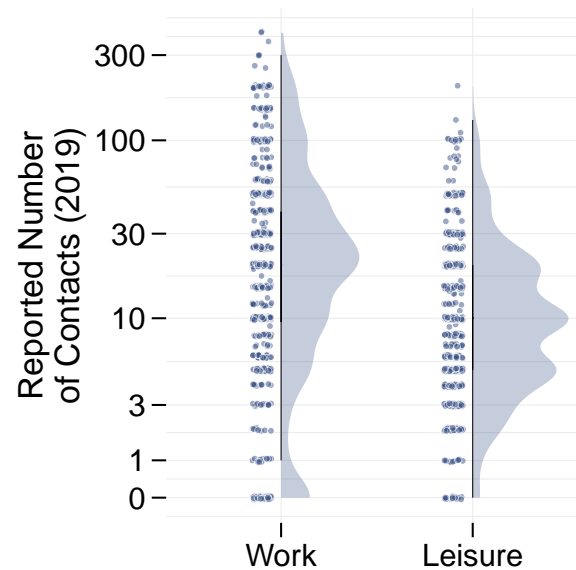
Supplementary Figure 1: Participants' demographic characteristics. **A.** Gender distribution. 54% of participants reported their gender as female. **B.** Age distribution. Around 66% of participants were between 40 and 50 years old. **C.** Household size distribution. 1-Person-Households are undersampled. **D.** Comorbidities distribution. Around 31% reported a COVID-19 relevant comorbidity.

#### 630 **Pre-pandemic Contact Data**

631 For 2019, participants reported more work than leisure contacts. On average, participants reported 37.4  
632 weekly work contacts (median: 20, IQR: 10-40) and 14.4 leisure contacts (median: 10, IQR: 5-20). The  
633 distribution of participants' work contacts is heavy-tailed and unimodal, while the distribution of leisure  
634 contacts is also heavy-tailed, but displays three bumps around 5, 10, and 20 (Supplementary Figure 2).

## Bimodal Contact Reductions and Social Homophily during COVID-19

635 Overall, work contacts dominated participants' pre-pandemic contact behavior, with around 2.5 times more  
636 contacts reported in the work context than in leisure settings.



Supplementary Figure 2: Distribution of survey participants' number of weekly work (left) and leisure (right) contacts in 2019. Participants reported more work than leisure contacts.

### 637 Comparison to POLYMOD

638 In contrast to our survey, the POLYMOD study recruited underage participants, but the remaining partici-  
639 pant characteristics are comparable. The POLYMOD study surveyed 1,341 German participants, about 1.5  
640 times more than our survey (Supplementary Table 1). Just like our survey, the POLYMOD study failed to  
641 recruit the elderly. They did, however, survey underage participants. The gender distribution and household  
642 sizes in the POLYMOD sample are comparable to our survey sample.

643 The comparability of pre-pandemic contact numbers according to our survey and the POLYMOD study  
644 is limited due to the different study designs. First, the definition of “contact” differed slightly in the two  
645 studies: In the POLYMOD study, a contact was characterized as either a physical contact involving skin-  
646 to-skin contact (e.g. handshake or kiss), or a nonphysical contact consisting of a two-way conversation  
647 of at least three words in the physical presence of another person but without skin-to-skin contact. In  
648 our survey, we defined a “contact” as any situation in which one person comes closer than two meters to  
649 another person for at least 15 minutes. Second, we asked for the weekly number of contacts, whereas the  
650 POLYMOD study surveyed the number of contacts on a single day. Third, our online survey was conducted  
651 in July and August 2023 and retrospectively collected the number of contacts, while POLYMOD asked  
652 participants to report their contacts for the previous day. Consequently, in POLYMOD, the mean number  
653 of work contacts is 2.5 (median: 0, IQR: 0-4), and the mean number of leisure contacts is 2.3 (median:  
654 2, IQR: 0-3) (Supplementary Figure 3). Again, comparability is limited and the difference in definition of  
655 contact cannot be overcome, but to naively transform the weekly number of the survey to daily number  
656 of contacts, we divided them by seven and rounded down. Consequently, we obtain a mean number of

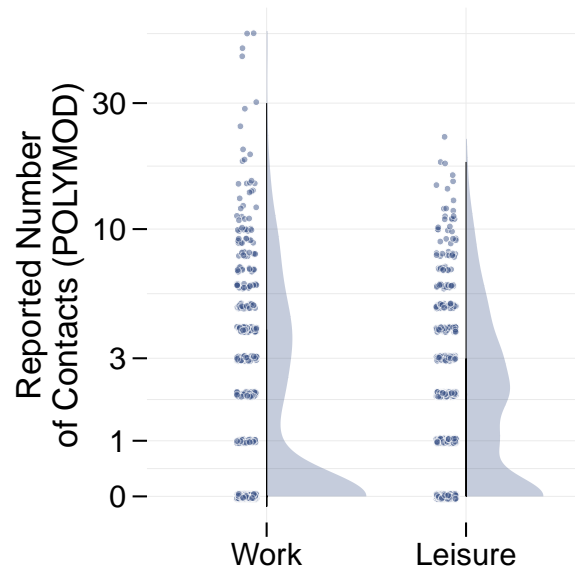
Bimodal Contact Reductions and Social Homophily during COVID-19

	<b>SURVEY</b>		<b>POLYMOD</b>	
	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>
<b>Age category</b>				
0-17	0	0.0	361	27.9
18-39	155	18.1	369	28.5
40-59	569	66.7	347	26.8
60-79	128	15.0	205	15.8
80+	2	0.2	13	1.0
Missing	13	—	46	—
<b>Sex of participants</b>				
Female	464	54.2	722	55.4
Male	386	45.0	581	44.6
Diverse	7	0.8	NA*	NA
Missing	19	—	38	—
<b>Household size</b>				
1	194	22.6	250	18.6
2	285	33.1	411	30.6
3	166	19.3	339	25.3
4+	215	25.0	341	25.4
Missing	7	—	0	—

Supplementary Table 1: Participant characteristics in our survey compared to the POLYMOD study. Our survey did not include underage participants and oversampled 40-59-year-olds. The gender and household distributions are comparable in both studies. \*The POLYMOD study only allowed participants to report their gender as either female or male.

657 daily work contacts of 5 (median: 2, IQR: 1-5) and a mean number of daily leisure contacts of 2 (median:  
658 1, IQR: 0-2). Following this transformation, the daily number of work contacts in our study and in the  
659 POLYMOD study are of the same magnitude. Still, in comparison to the POLYMOD study, the number of  
660 survey participants who reported zero daily work contacts is significantly smaller. Daily leisure contacts are  
661 comparable. Overall, when transformed to daily contacts, our data shows comparable contact patterns to  
662 those found in POLYMOD despite the different study designs.

## Bimodal Contact Reductions and Social Homophily during COVID-19



Supplementary Figure 3: Distribution of Germany POLYMOD participants' number of daily work and leisure contacts. Work raincloud plot only includes participants who reported that they were working at the time of the study. The median (IQR) number of work contacts is 0 (0-4) and the median (IQR) number of leisure contacts is 2 (0-3).

### 663 Auxiliary Information on Time Points of Interest

664 The survey was conducted in July and August 2023. Consequently, absolute contact numbers for 2019,  
 665 03/2020, summer 2021, and 01/2023 were collected retrospectively. To help participants recall their contact  
 666 behavior at these time points, auxiliary information was provided on the then-current state of the COVID-19  
 667 pandemic (Supplementary Table 2).

Time point description (original German)	Time point description (English translation)
<i>Im Jahr 2019</i> , vor der Pandemie: Hier geht es um einen Zeitpunkt vor der Pandemie, z.B. eine typische Arbeitswoche im Jahr 2019.	<i>2019</i> : A point in time before the pandemic, for example, a typical working week in 2019.
<i>Ende März 2020</i> : Die erste Coronawelle breitet sich aus, die Schulen werden geschlossen, der erste Lockdown wirdverordnet, die Pandemie beginnt. Die Bilder aus Bergamo und New York gehen um die Welt.	<i>End of March 2020</i> : The first coronavirus wave spreads, schools are closed, the first lockdown is imposed and the pandemic begins. The images from Bergamo and New York go around the world.
<i>Sommer 2021</i> : Die Impfkampagne läuft an. Die Delta-Variante tritt auf. Die Maßnahmen sind abhängig von der lokalen Inzidenz (Grenzwerte 35 und 50) sowie vom persönlichen Impfstatus. Die Inzidenzen bleiben eher niedrig. Die Fussball-EM findet in vielen Großstädten-verteilt in ganz Europa statt.	<i>Summer 2021</i> : The vaccination campaign starts. The Delta variant occurs. The measures depend on the local incidence (threshold values of 35 and 50) and the personal vaccination status. Incidence rates remain rather low. The European Football Championship takes place in many major cities across Europe.
<i>Januar 2023</i> : Viele Maßnahmen wurden eingestellt. Es gibt einen bivalenten Impfstoff. In ÖPNV und der Bahn gilt vielerorts noch die Maskenpflicht.	<i>January 2023</i> : Many measures have been discontinued. A bivalent vaccine is available. Masks are still compulsory on public transport and trains at many locations.

Supplementary Table 2: Additional contextual information provided to the online survey participants when they were surveyed about their contacts at the four specific time points.

## Bimodal Contact Reductions and Social Homophily during COVID-19

### 668 Survey Items on Attitudes Related to Covid-19

669 Nine of the survey items surveyed participants regarding their attitudes related to COVID-19 at the end of  
 670 March 2020. Participants were asked to report their attitude compared to an “average person” (Supplemen-  
 671 tary Table 3 for survey items). Possible answers ranged from “a lot less” to “a lot more”, but also included  
 672 the options “does not apply” and “not specified” (Supplementary Table 4). For the analysis, the options  
 673 “does not apply” and “not specified” were excluded, yielding a 7-point Likert scale.

Survey item (original German)	Survey item (English translation)
Im Vergleich zu einer durchschnittlichen Person habe ich das Ansteckungsrisiko als gering eingeschätzt.	Compared to an average person, I considered the risk of acquiring an infection to be low.
Im Vergleich zu einer durchschnittlichen Person habe ich den Verlauf einer Infektion als risikoreich eingeschätzt.	Compared to an average person, I have assessed the course of an infection as high-risk.
Im Vergleich zu einer durchschnittlichen Person hatte ich eine hohe Risikowahrnehmung.	Compared to an average person, I had a high perception of risk.
Im Vergleich zu einer durchschnittlichen Person habe ich häufig risikoreiche Situationen vermieden.	Compared to an average person, I often avoided risky situations.
Im Vergleich zu einer durchschnittlichen Person war ich mir der Effektivität von Abstandsregeln bewusst.	Compared to an average person, I was aware of the effectiveness of social distancing rules.
Im Vergleich zu einer durchschnittlichen Person war mir klar, dass korrektes Masketragen das Infektionsrisiko senkt.	Compared to an average person, it was clear to me that wearing a mask correctly reduces the risk of infection.
Im Vergleich zu einer durchschnittlichen Person konnte ich den empfohlenen Maßnahmen Folge leisten.	Compared to an average person, I was able to follow the recommended measures.
Im Vergleich zu einer durchschnittlichen Person habe ich mich durch die vorgeschriebenen Maßnahmen eingeschränkt gefühlt.	Compared to an average person, I felt restricted by the prescribed measures.
Im Vergleich zu einer durchschnittlichen Person habe ich FFP2/3 Maske anstatt medizinischer Maske getragen.	Compared to an average person, I wore FFP2/3 masks instead of medical masks.

Supplementary Table 3: Survey items on attitudes related to COVID-19. The beginning of the corresponding survey section states that these items refer to the end of March 2020 and asked participants to report their own attitudes in comparison to an average person.

Survey item (original German)	Survey item (English translation)
viel weniger	a lot less
weniger	less
etwas weniger	slightly less
genauso	just as much
etwas mehr	slightly more
mehr	more
viel mehr	a lot more
trifft nicht zu	does not apply
keine Angabe	not specified

Supplementary Table 4: Answer options for items on attitudes related to COVID-19. “Does not apply” and “not specified” were excluded from the analysis, yielding a 7-point Likert scale.

### 674 Bayesian Fits

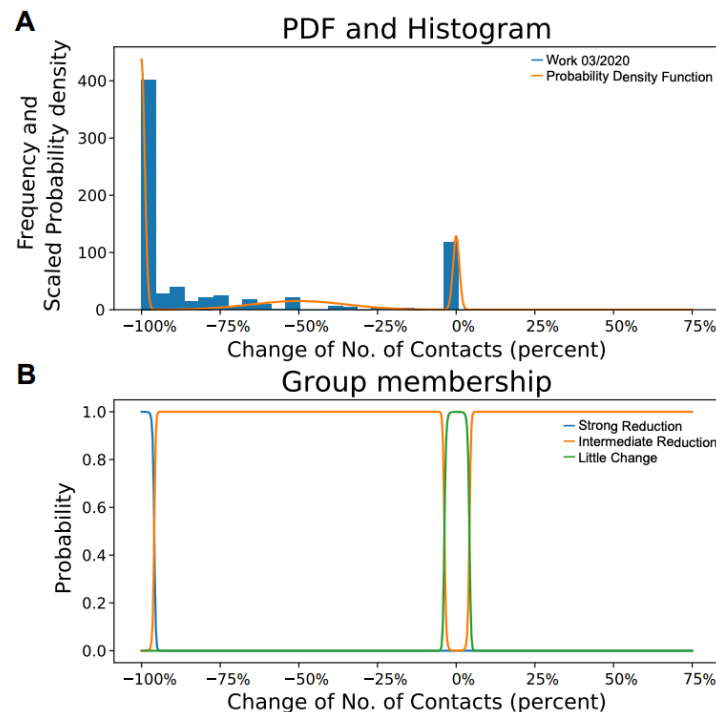
675 We used Bayesian modeling to quantify the shape of the distribution of change of number of work or  
 676 leisure contacts at each time point. Gaussian mixture models were used, fitting one to four (half-)normal

## Bimodal Contact Reductions and Social Homophily during COVID-19

677 distributions to the data using Markov chain Monte Carlo. Means of the distribution were assumed to be  
678 fixed, variances and weights of the distributions were estimated. The following four models were fitted to  
679 the data:

- 680 • **One distribution:** Half-normal distribution shifted to  $-100\%$ , variance estimated.
- 681 • **Two distributions:** Half-normal distribution shifted to  $-100\%$ , normal distribution with a mean  
682 of  $0\%$ . Variance and weight of distributions estimated.
- 683 • **Three distributions:** Half-normal distribution shifted to  $-100\%$ , normal distribution with a mean  
684 of  $0\%$ , normal distribution with a mean of  $-50\%$ . Variance and weight of distributions estimated.
- 685 • **Four distributions:** Half-normal distribution shifted to  $-100\%$ , normal distribution with a mean  
686 of  $0\%$ , normal distribution with a mean of  $-50\%$ , normal distribution with a mean of  $50\%$ . Variance  
687 and weight of distributions estimated.

688 For each context and each point in time, we used leave-one-out cross validation to compare the differ-  
689 ent fits. With the exception of the leisure context in 01/2023, the cross validation always favored three  
690 distributions (see Supplementary Table 5). For each context and each time point, we used the posterior  
691 mean estimates to estimate group – “strong reduction”, “intermediate reduction”, and “little change” –  
692 membership probabilities. Based on these probabilities, participants were assigned to the three groups (see  
693 Supplementary Figure 4 for exemplary model results for work 03/2020).



Supplementary Figure 4: Exemplary depiction of Bayesian model results for the work context in 03/2020. **A.** Histogram depicting the distribution of the change of number of contacts (blue). Bayesian models were fit to this data and the scaled probability density function of the three distributions model is depicted in yellow **B.** Probability of assignment to groups “strong reduction” (blue), “intermediate reduction” (yellow), and “little change” (green).

## Bimodal Contact Reductions and Social Homophily during COVID-19

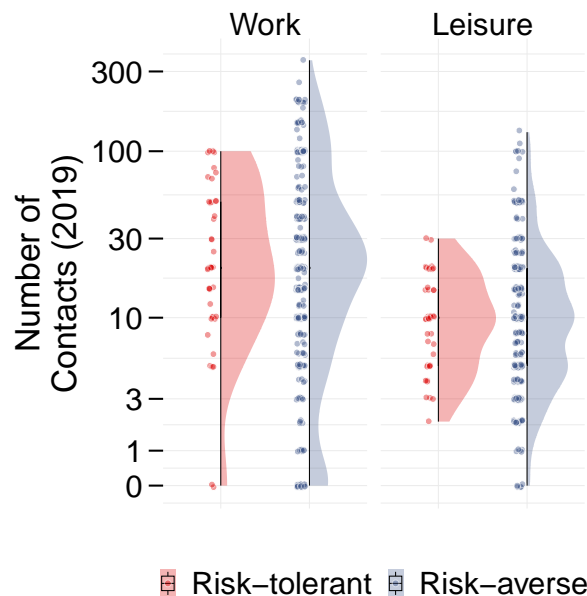
	Model	Rank	ELPD LOO	ELPD Difference	Weight	
<b>Work</b>	03/2020	One Distribution	3	-10012.13	7776.51	0.09
		Two Distributions	4	-10230.77	7995.14	0.00
		Three Distributions	2	-2274.76	39.12	0.73
		Four Distributions	1	-2235.63	0.00	0.18
	Summer 2021	One Distribution	3	-8409.55	5373.87	0.00
		Two Distributions	4	-20164.70	17129.02	0.09
		Three Distributions	2	-3097.85	62.17	0.79
		Four Distributions	1	-3035.68	0.00	0.12
	01/2023	One Distribution	3	-9246.89	6217.54	0.00
		Two Distributions	4	-24627.46	21598.12	0.05
		Three Distributions	2	-3454.83	425.48	0.67
		Four Distributions	1	-3029.35	0	0.28
<b>Leisure</b>	03/2020	One Distribution	3	-9339.88	6134.47	0.00
		Two Distributions	4	-21209.59	18004.17	0.08
		Three Distributions	1	-3205.42	0.00	0.85
		Four Distributions	2	-3209.80	4.38	0.07
	Summer 2021	One Distribution	3	-7395.95	3831.27	0.00
		Two Distributions	4	-40435.55	36870.87	0.03
		Three Distributions	2	-3730.85	166.17	0.74
		Four Distributions	1	-3564.68	0.00	0.23
	01/2023	One Distribution	3	-10075.85	6983.84	0.00
		Two Distributions	4	-32817.07	29725.06	0.00
		Three Distributions	2	-4014.20	922.19	0.33
		Four Distributions	1	-3092.01	0.00	0.67

Supplementary Table 5: Model comparison results. Leave-one-out cross-validation, an estimate of the out-of-sample predictive fit, was used for model comparison. The weights provided in column six may loosely be interpreted as the probability of each model being true. With the exception of the leisure context in 01/2023, the largest weight is always placed on the model fitting three distributions.

### 694 Pre-Pandemic Contact Data Differentiated by Risk-Perception Score

695 The two risk perception groups reported comparable work and leisure contacts for 2019. For risk-tolerant  
696 participants, the mean of weekly work contacts was 33 (median: 20, IQR: 10-50), while for risk-averse  
697 participants the mean was 37 (median: 20, IQR: 8-40). Similarly, the mean number of leisure contacts was  
698 11 for the risk-tolerant participants (mean: 10, IQR: 5-15) and 14 for the risk-averse participants (IQR: 5-20)  
699 (Supplementary Figure 5A). The difference in distribution was neither statistically significant for the work  
700 nor for the leisure context ( $p > 0.1$ , see Supplementary Section Kolmogorov-Smirnov tests). The two risk  
701 perception groups display no apparent difference in their pre-pandemic sociability.

## Bimodal Contact Reductions and Social Homophily during COVID-19



Supplementary Figure 5: **A.** Distribution of participants number of work (left) and leisure (right) contacts in 2019 differentiated by risk perception group. For both groups and both contexts, the distribution of the number of contacts is unimodal. There exists no significant difference in the distribution of the number of contacts between the two groups.

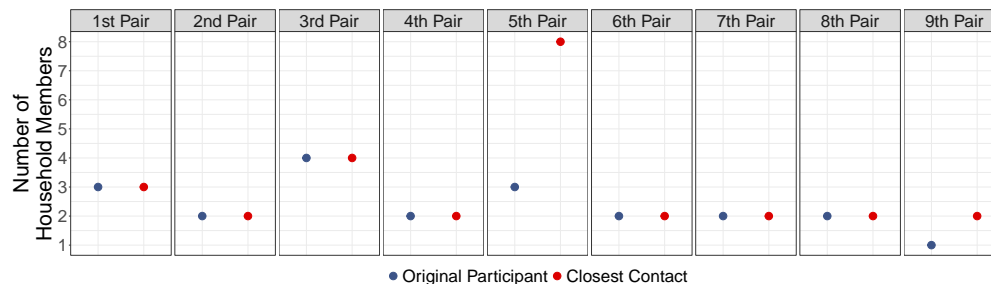
### 702 Accuracy of Participants' Reported Contact Numbers

703 Our validation approach to examine participants' accuracy in reporting their CCs' behavior yielded limited  
704 data, with only nine analyzable pairs allowing for qualitative assessment. To examine how accurately par-  
705 ticipants reported their closest contacts' number of contacts, we invited them to forward the survey to the  
706 CCs they had been reporting on throughout the survey. Only 22 participants followed this invitation and  
707 forwarded the survey to their CC. This yielded 22 pairs of "original" and "referred" participants. Of these  
708 22 pairs, we only analyzed the pairs for which a) the original participant forwarded the survey to exactly one  
709 contact and b) both the "original" and the "referred" participant reported that they had not changed their  
710 CC during the COVID-19 pandemic. This promotes that the closest contact described in the survey is the  
711 same person who received the forwarded survey. This filtering process resulted in nine pairs and only allows  
712 qualitative comparison. Overall, only a fraction of participants forwarded the survey to their CC, allowing  
713 only a qualitative assesment of the participants' accuracy.

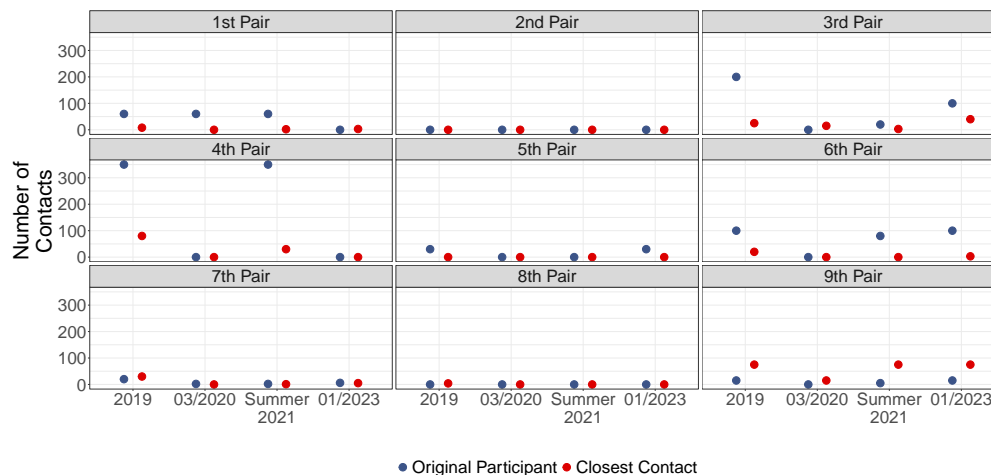
714 Participants reported the CCs' household members and leisure contacts reasonably well, but differed in  
715 their ability to report the CCs' work contacts. The "original" participants, with the exception of a deviation  
716 of five for the 5th pair and a deviation of one for the 9th pair, reported their CC's number of household  
717 members accurately (Supplementary Figure 6). Apart from the 3rd pair, the "original" participants reported  
718 the CCs' number of leisure contacts accurately (Supplementary Figure 8). The "original" participants of the  
719 2nd, 5th, 7th, and eight 8th pair, estimated the number of the CCs' work contacts reasonably well, while  
720 the "original" participants of the remaining pairs (1st, 3rd, 4th, 6th, and 9th) pair misjudged the number  
721 of work contacts of the CCs (Supplementary Figure 7). Interestingly, with the exception of the 9th pair,  
722 all "original" participants overestimated the number of work contacts of their CC. Overall, we note that

## Bimodal Contact Reductions and Social Homophily during COVID-19

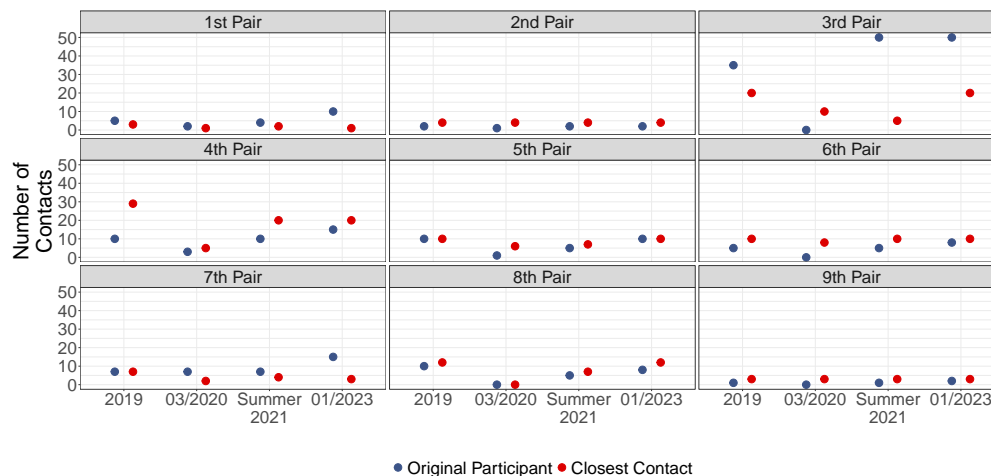
723 participants accurately reported the CCs' leisure contacts, but not all participants succeeded at reporting  
 724 the CCs' work contacts.



Supplementary Figure 6: Number of household members the original participants reported for their CC (blue) vs number of household members the CC themselves reported (red).



Supplementary Figure 7: Number of work contacts the original participants reported for their CC (blue) vs number of work contacts the CC themselves reported (red).



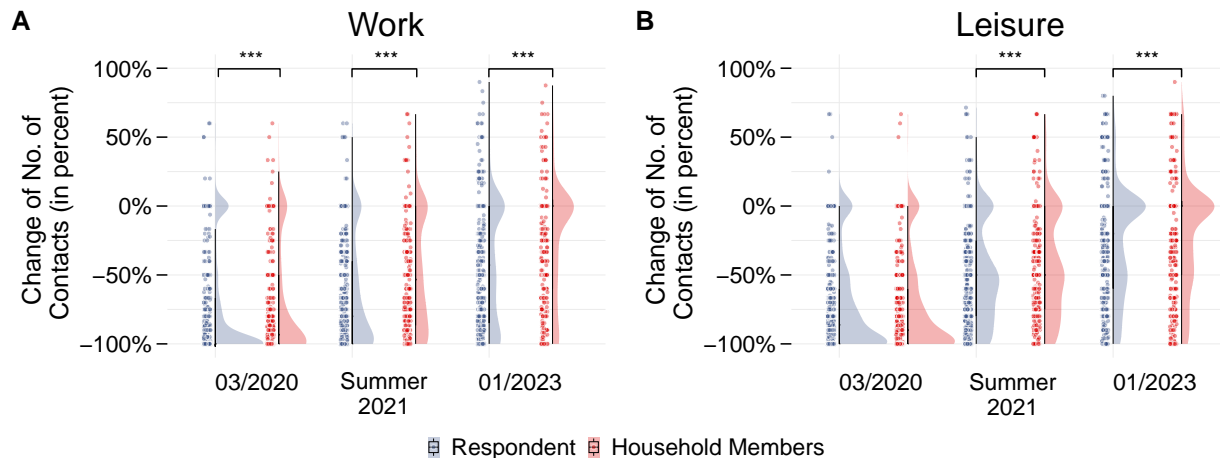
Supplementary Figure 8: Number of leisure contacts the original participants reported for their CC (blue) vs number of leisure contacts the CC themselves reported (red).

## Bimodal Contact Reductions and Social Homophily during COVID-19

### 725 Contact Reductions of Participant, Household member, Closest contact

726 The survey asked participants to report

- 727 (a) their own contacts,
- 728 (b) their household members' contacts (only if the participant did not live in a one-person-household),
- 729 (c) their closest non-household contact's contacts,
- 730 (d) if they reported having changed their closest contact during the COVID-19 pandemic, their novel
- 731 closest contact's contacts.



Supplementary Figure 9: Change of number of contacts (in percent, relative to 2019) of participants vs of household members. **A. Relative number of work contacts.** Analogously to the participants, household members reduced their work contacts at all three time points. For all three time points, fewer household members than participants “strongly” reduced their work contacts. **B. Relative number of leisure contacts.** Overall, the shape of the distributions are similar for participants and household members.

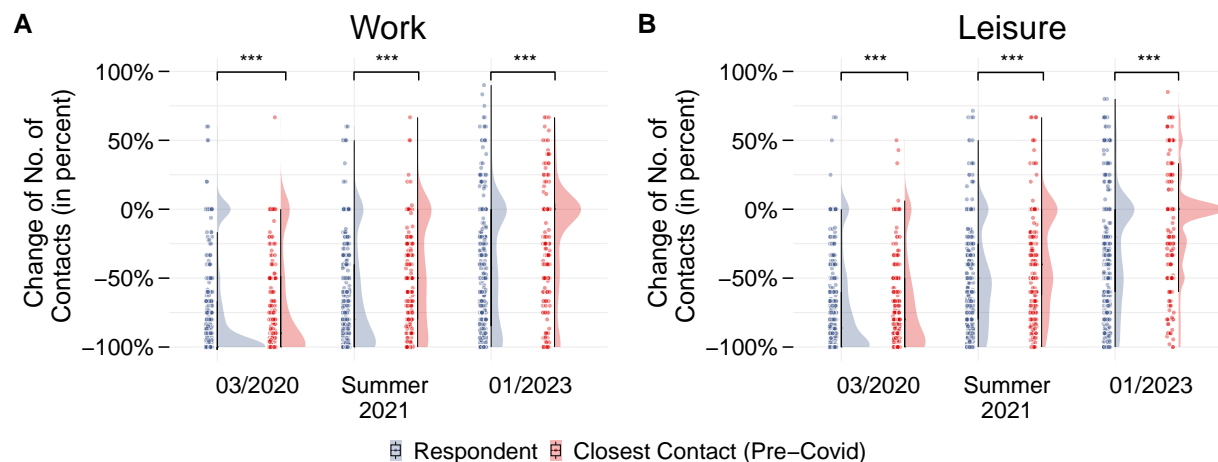
732 For 03/2020, summer 2021, and 01/2023, participants reported the largest average work contact reduction for  
733 themselves, followed by their household members, and finally by their closest contact (CC): In March 03/2020,  
734 participants reported an average reduction of 75% for themselves, of 71% for their household members, and  
735 of 69% for their CC. These reductions were relaxed from 03/2020 to summer 2021, leading to an average  
736 reduction of 64% for the participants, of 49% for the household members, and of 46% for the CCs. Reductions  
737 were further relaxed such that for 01/2023, participants reported an average work contact reduction of 42%  
738 for themselves, of 27% for their household members, and of 21% for their CC (Supplementary Figure 9 A  
739 and Supplementary Figure 10 A). These differences in mean reductions are mirrored by the differences of  
740 the Bayesian reduction model: For all three time points, the share of “strong reduction” is largest for the  
741 participants, second largest for the household members, and smallest for the CCs. Complementary, the  
742 share of “little change” is always largest for the CCs, followed by household members, and finally by the  
743 participants (Supplementary Table 6). Differences in the distribution of change of work contacts between (a)  
744 participants and their household members and (b) participants and their CCs are statistically significant for  
745 all three time points ( $p < 0.001$ , Supplementary Table 8). Overall, participants reported the strongest work  
746 contact reductions for themselves, but the overall work behavior patterns – with a bimodal distribution and  
747 incrementally relaxing reductions – are visible for the household members and CCs, too.

Bimodal Contact Reductions and Social Homophily during COVID-19

	Participant Work		HH members Work		Closest Contact Work	
	N	%	N	%	N	%
<b>03/2020</b>						
Strong Reduction	401	55.1	213	48.3	169	45.6
Intermediate Reduction	203	27.9	148	33.6	130	35.0
Little Change	118	16.2	73	16.6	71	19.1
None	6	0.8	7	1.5	1	0.3
<b>Summer 2021</b>						
Strong Reduction	301	42.0	109	25.4	78	21.1
Intermediate Reduction	281	39.2	199	46.4	177	48.0
Little Change	124	17.3	107	24.9	108	29.3
None	10	0.1	14	3.3	6	1.6
<b>01/2023</b>						
Strong Reduction	168	23.6	53	12.8	46	12.9
Intermediate Reduction	278	39.0	144	34.8	87	24.4
Little Change	229	32.2	188	45.4	194	54.5
None	37	5.2	29	7.0	29	8.2

Supplementary Table 6: Group assignment based on the change of no. of contacts (for details see Subsection Statistical Methods). Across all three points in time, participants reported themselves to reduce their work contacts more than their household members who, in turn, reduced their work contacts more than the participants' CCs.

748 In the leisure context and with the exception of 03/2020, participants again report the largest average  
749 reductions for themselves, followed by their household members and their CCs: In 03/2020, the mean leisure  
750 contact reduction was 72% for the participants, 73% for the household members, and 69% for the CCs.  
751 Participants, household members and CCs relaxed their reduction of leisure contacts from 03/2020 to summer  
752 2021, leading to mean reductions of 51% (participants), 44% (household members), and 36% (CCs). Finally,  
753 for 01/2023, participants reported a mean leisure reduction of 28% for themselves, of 23% for their household  
754 members and of 9% for their CCs (Supplementary Figure 9 B and Supplementary Figure 10 B). The Bayesian  
755 reduction model mostly determines the largest share of “strong reduction” for the participants themselves,  
756 closely followed by their household members, and then finally by the CCs (Supplementary Table 7). The  
757 only exception is 03/2020, when the share of household members who “strongly” reduced leisure contacts is  
758 larger than the share of participants who “strongly” reduced leisure contacts. The distributions of leisure  
759 contact reductions of participants and household members are not statistically different in 03/2020 ( $p > 0.1$ ,  
760 Supplementary Table 7). For the two subsequent time points, however, and for all three time points for the  
761 participants and the CCs, the difference is statistically significant ( $p < 0.01$ ). In sum, the behavior of the  
762 household members and CCs mirrors the behavior of the participants, with strong leisure reductions during  
763 the early phase of the COVID-19 pandemic and incremental relaxations.



Supplementary Figure 10: Change of number of contacts (in percent, relative to 2019) of participants vs of their closest contacts. As a percentage increase from zero cannot be computed, individuals who reported zero work/leisure contacts in 2019, were excluded from the corresponding context. **A.** In comparison to the share of participants who completely cut their work c,

	Participant Leisure		HH Members Leisure		Closest Contact Leisure	
	N	%	N	%	N	%
<b>03/2020</b>						
Strong Reduction	372	46.5	252	49.3	187	40.7
Intermediate Reduction	328	40.9	197	38.6	207	45.0
Little Change	97	12.1	59	11.5	62	13.5
None	4	0.5	3	0.6	4	0.8
<b>Summer 2021</b>						
Strong Reduction	126	16.1	68	14.0	33	7.4
Intermediate Reduction	489	62.6	290	59.5	253	56.9
Little Change	146	18.7	106	21.8	144	32.4
None	20	2.6	23	4.7	15	3.3
<b>01/2023</b>						
Strong Reduction	60	8.0	32	7.0	11	2.6
Intermediate Reduction	340	45.1	194	41.8	125	29.5
Little Change	295	39.1	190	40.9	227	53.5
None	59	7.8	48	10.3	61	14.4

Supplementary Table 7: Group assignment based on the change of no. of contacts (for details see Subsection Statistical Methods). Across the three considered time points, the shares for the participants and the share for the household members are comparable. More participants than closest contacts are assigned to the “completely reduced” group.

## Bimodal Contact Reductions and Social Homophily during COVID-19

	Participant vs HH members		Participant vs CC	
	D	p-value	D	p-value
<b>Work</b>				
03/2020	0.14	$1.16e-05^{***}$	0.43	$< 2.2e-16^{***}$
Summer 2021	0.26	$4.09e-16^{***}$	0.42	$< 2.2e-16^{***}$
01/2023	0.26	$< 2.2e-16^{***}$	0.43	$< 2.2e-16^{***}$
<b>Leisure</b>				
03/2020	0.06	0.24	0.42	$< 2.2e-16^{***}$
Summer 2021	0.12	$4.2e-04^{***}$	0.41	$< 2.2e-16^{***}$
01/2023	0.12	$6.3e-04^{***}$	0.41	$< 2.2e-16^{***}$

Supplementary Table 8: Output of Kolmogorov Smirnov tests comparing the ECDF of change of number of contacts between participants, their household members, and their CC. Statistic D takes the largest absolute difference between the two empirical cumulative distribution functions. Stars indicate that distributions differ at a significance level of  $^{***}p < 0.01$ ,  $^{**}p < 0.05$ ,  $^{*}p < 0.1$ .

### 764 Kolmogorov-Smirnov tests

#### 765 Whole Sample

766 Kolmogorov-Smirnov tests were used to compare contact reductions between time points. The distributions  
767 of work and leisure contact reductions differed significantly between time points ( $p < 0.01$ , Supplementary Ta-  
768 ble 9).

	D	p-value
<b>Work</b>		
03/2020 vs Summer 2021	0.21	$< 2.2e-16^{***}$
03/2020 vs 01/2023	0.35	$< 2.2e-16^{***}$
Summer 2021 vs 01/2023	0.22	$< 2.2e-16^{***}$
<b>Leisure</b>		
03/2020 vs Summer 2021	0.32	$< 2.2e-16^{***}$
03/2020 vs 01/2023	0.48	$< 2.2e-16^{***}$
Summer 2021 vs 01/2023	0.29	$< 2.2e-16^{***}$

Supplementary Table 9: Output of Kolmogorov Smirnov tests comparing the contact reductions between time points. Statistic D takes the largest absolute difference between the two empirical cumulative distribution functions. Stars indicate that distributions differ at a significance level of  $^{***}p < 0.01$ .

### 769 Risk-Averse vs Risk-Tolerant Participants

770 Kolmogorov-Smirnov tests were used to compare pre-pandemic sociability between risk perception groups.  
771 In 2019, the distributions of work contacts and leisure contacts did not differ significantly between risk  
772 perception groups ( $p > 0.1$ , Supplementary Table 10).

773 The difference in distribution of work contact reductions between risk perception groups was only sta-  
774 tistically significant in 03/2020 ( $p < 0.05$ , Supplementary Table 11). In the leisure context, however, the  
775 difference was statistically significant for all three subsequent time points ( $p < 0.01$ ).

## Bimodal Contact Reductions and Social Homophily during COVID-19

	D	p-value
<b>Work</b>		
2019	0.14	0.45
<b>Leisure</b>		
2019	0.08	0.94

Supplementary Table 10: Output of Kolmogorov Smirnov tests comparing the absolute number of contacts between risk-averse and risk-tolerant participants for 2019. Statistic D takes the largest absolute difference between the two empirical cumulative distribution functions. Stars indicate that distributions differ at a significance level of \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

	D	p-value
<b>Work</b>		
03/2020	0.26	0.01**
Summer 2021	0.19	0.12
01/2023	0.17	0.21
<b>Leisure</b>		
03/2020	0.32	$6.9e-04$ ***
Summer 2021	0.30	$9.5e-04$ ***
01/2023	0.30	0.002***

Supplementary Table 11: Output of Kolmogorov Smirnov tests comparing the distribution of change of number of contacts between risk-averse and risk-tolerant participants. Statistic D takes the largest absolute difference between the two empirical cumulative distribution functions. Stars indicate that distributions differ at a significance level of \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

### 776 Subgroup Analysis by Age Group

777 Relative to 2019, all three age groups reduced their work contacts in 03/2020, summer 2021, and 01/2023.  
 778 All three age groups relaxed their mean reductions of work contacts over time: In 03/2020, 18-39 year  
 779 olds reduced their work contacts on average by 83%, 40-59 year olds by 75%, and 60+ year olds by 63%  
 780 (Supplementary Figure 11). In summer 2021, mean work contact reductions were relaxed to 69% (18-39  
 781 year olds), 63% (40-59 year olds), and 61% (60+ year olds). Finally, in 01/2023, they were relaxed to 46%  
 782 (18-39 year olds), 39% (40-59 year olds), and 49% (60+ year olds). For all three time points, the difference  
 783 in distribution between 18-39 year olds and 60+ year olds and between 40-59 year olds and 60+ year olds  
 784 is statistically significant ( $p < 0.05$  for some comparisons,  $p < 0.01$  for others, see Supplementary Table 14).  
 785 Just like for the whole sample, the Bayesian reduction model confirms the temporal development of the  
 786 reductions: The share of participants who “strongly” reduced their work contacts decreased over time for  
 787 all three age groups, while the share of participants who displayed “little change” in their number of work  
 788 contacts increased (Supplementary Table 13). In sum, although all age groups reduced their work contacts  
 789 substantially at the beginning of the COVID-19 pandemic, work contact reductions were incrementally  
 790 relaxed over time, with 18-39 year olds consistently showing the highest reductions and 60+ year olds the  
 791 lowest.

792 Considering the change of number of leisure contacts, we observe that, on average all three age groups  
 793 reduced their leisure contacts in 03/2020, summer 2021, and 01/2023. For 03/2020, 18-39 year olds reported  
 794 an average reduction of 78%, 40-59 year olds of 73%, and 60+ year olds of 62% (Supplementary Figure 12).  
 795 From 03/2020 to summer 2021 these reductions were relaxed to 46% (18-39 year olds), 52% (40-59 year olds),  
 796 and 46% (60+ year olds). In 01/2023 mean reductions had been further relaxed, to 29% (18-30 year olds),

## Bimodal Contact Reductions and Social Homophily during COVID-19

Age category	N	Percent
18-39	155	18.2
40-59	566	66.6
60+	129	15.2
Missing	13	—

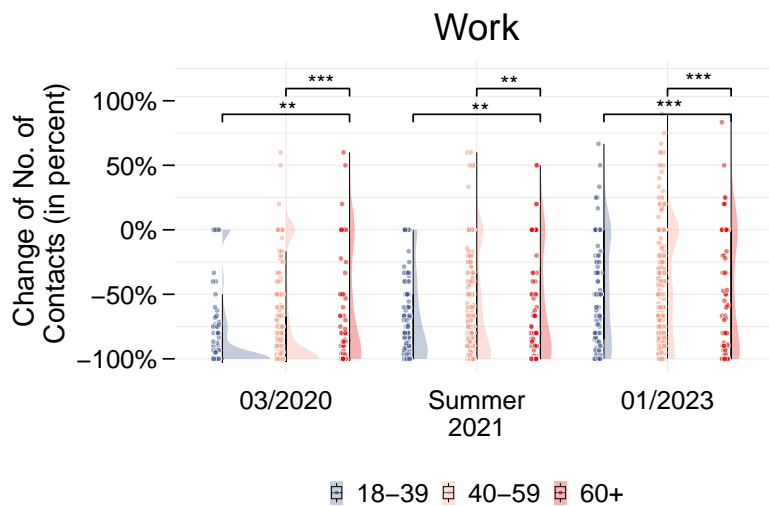
Supplementary Table 12: Age group sizes. The majority of the participants was between 40 and 59 years old. Participants had to be of legal age (18+) to qualify for participation.

	Work 18-39		Work 40-59		Work 60+		Leisure 18-39		Leisure 40-59		Leisure 60+	
	N	%	N	%	N	%	N	%	N	%	N	%
<b>03/2020</b>												
Strong Reduction	88	64.7	269	54.7	38	42.2	69	47.6	260	49.3	45	38.1
Intermediate Reduction	33	24.3	138	28.0	29	32.2	66	45.5	201	38.2	49	41.5
Little Change	15	11.0	82	16.7	20	22.2	10	6.9	64	12.1	22	18.7
None	0	0.0	3	0.6	3	3.4	0	0.0	2	0.4	2	1.7
<b>Summer 2021</b>												
Strong Reduction	57	43.2	200	41.5	37	40.2	20	14.4	83	16.0	19	16.8
Intermediate Reduction	58	43.9	188	39.0	33	35.9	86	61.9	332	64.2	64	56.6
Little Change	17	12.9	88	18.3	18	19.6	28	20.1	97	18.8	20	17.7
None	0	0.0	6	1.2	4	4.3	5	3.6	5	1.0	10	8.9
<b>01/2023</b>												
Strong Reduction	31	23.3	94	19.7	35	38.5	15	11.0	36	7.1	11	10.8
Intermediate Reduction	62	46.6	193	40.4	24	26.4	61	44.8	227	45.0	46	45.1
Little Change	34	25.6	166	34.7	26	28.6	44	32.4	208	41.3	35	34.3
None	6	4.5	25	5.2	6	6.5	16	11.8	33	6.6	10	9.8

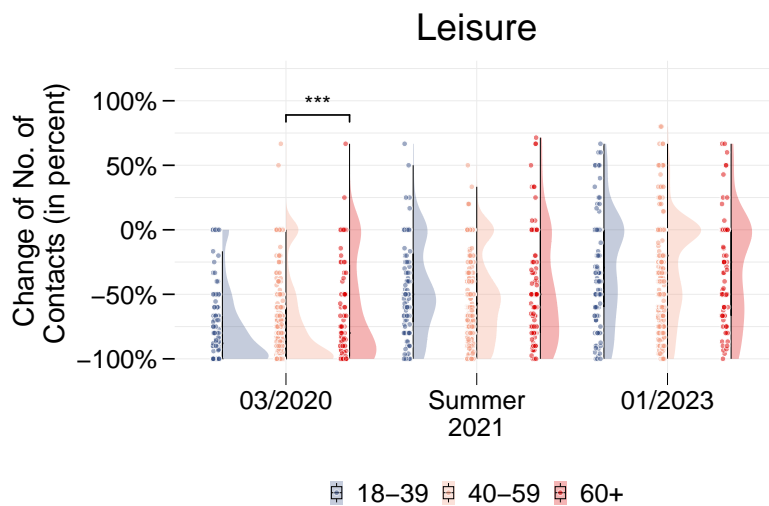
Supplementary Table 13: Group assignment based on the change of no. of contacts (for details see Subsection Statistical Methods). All age groups tended to reduce their work contacts more than their leisure contacts. In 03/2020, the 18-39 year olds had the largest share of participants who completely cut their work contacts, while by 01/2023 they had the smallest share of participants who completely reduced. For leisure, shares are comparable across age groups.

797 27% (40-59 year olds), and 30% (60+ year olds). The comparability and time-dependence of mean reduction  
 798 is once more confirmed by the results of the Bayesian reduction model: For all three time points, the group  
 799 sizes across age groups are comparable. The difference in distribution is only statistically significant for 40-59  
 800 year olds and 60+ year olds in 03/2020 ( $p < 0.1$ , Supplementary Table 14). In sum, all three age groups  
 801 comparably reduced their leisure contacts and incrementally relaxed these reductions over time.

802 The lack of difference in reduction of leisure contacts is reflected by the lack of difference in reported  
 803 number of infections: Of the 18-39 year olds 34% (95% CI [26%, 41%]) reported zero infections vs 32%  
 804 (95% CI [28%, 36%]) of the 40-59 year olds and 43% (95% CI [34%, 52%]) of the 60+ year olds (Supplemen-  
 805 tary Figure 13 A). Consequently, the share of participants who reported one infection was smallest for the  
 806 60+ year olds (53%, 95% CI [44%, 62%]), followed by the 18-39 year olds (56%, 95% CI [48%, 63%]), and  
 807 the 40-59 year olds (57%, 95% CI [52%, 60%]). Two infections were reported by 9% (95% CI [5%, 13%]) of  
 808 18-39 year olds, by 10% (95% CI [8%, 13%]) of 40-59 year olds, and by 5% (95% CI [1%, 8%]) of 60+ year  
 809 olds. The difference in distribution of number of reported infections is statistically insignificant ( $p > 0.1$ ).  
 810 The ECDFs of the timing of the first infection of the three age groups also do not display any significant

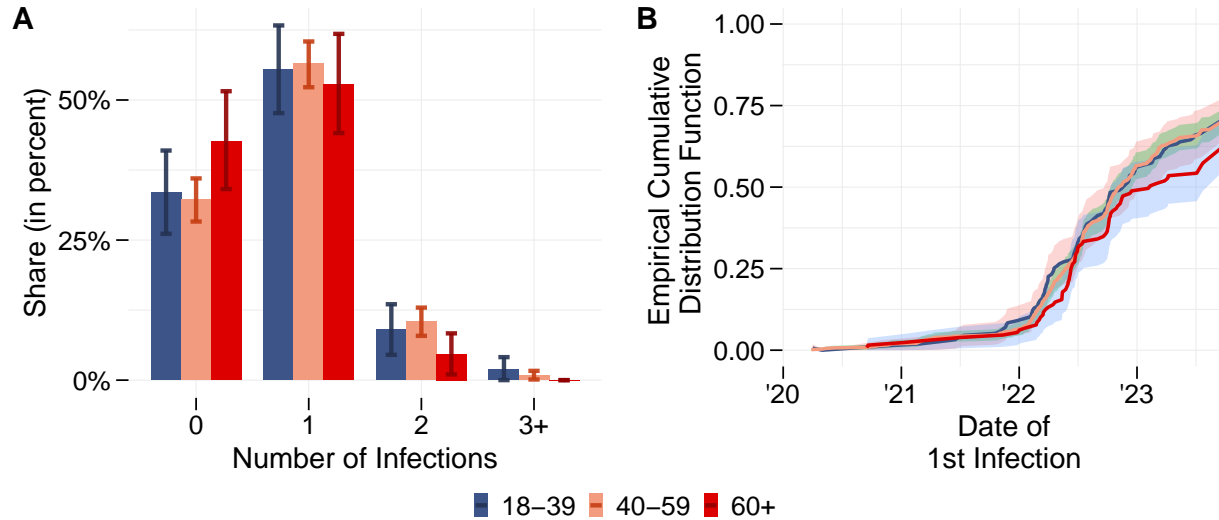


Supplementary Figure 11: Change of number of work contacts (in percent, relative to 2019) for different age groups. Relative number of work contacts. In March 2020, the share of 18-39 year old participants who “strongly” reduced their work contacts was larger than the corresponding share of 40-59 year old and 60+ year old participants.



Supplementary Figure 12: Change of number of leisure contacts (in percent, relative to 2019) for different age groups. Relative number of leisure contacts. The share of 60+ year olds who “strongly” reduced their leisure contacts is smaller than the corresponding share of 18-39 and 40-59 year olds in 03/2020. For the two later time points, reductions are comparable across age groups.

## Bimodal Contact Reductions and Social Homophily during COVID-19



Supplementary Figure 13: **A.** Share of respondents who reported 0/1/2/3+ infections, differentiated by age groups. Error bars represent 95% confidence intervals (see Subsection Statistical Methods for computation and motivation). The share of participants who reported no infections, is largest for 60+ year olds. **B.** Timing of participant's (first) infection(s); differentiated by age group. Ribbons represent 95% confidence intervals (see Subsection Statistical Methods for computation and motivation). The ECDF of 60+ year olds is from mid-2021 onwards constantly below the ECDF of the other two age groups.

811 difference ( $p > 0.1$ , Supplementary Figure 13 B). Overall, the two younger age groups reduced their work  
 812 contacts more strongly than the 60+ year olds, but this difference in reduction can neither be found for  
 813 reduction of leisure contacts, nor for the number of infections or the timing of first infection.

	18-39 vs 40-59		18-39 vs 60+		40-59 vs 60+	
	D	p-value	D	p-value	D	p-value
<b>Work</b>						
03/2020	0.11	0.11	0.19	0.01**	0.18	0.003***
Summer 2021	0.06	0.67	0.18	0.02**	0.14	0.02**
01/2023	0.09	0.35	0.25	0.0003***	0.25	4.75e-06***
<b>Leisure</b>						
03/2020	0.05	0.94	0.15	0.11	0.13	0.08*
Summer 2021	0.11	0.11	0.15	0.12	0.07	0.78
01/2023	0.07	0.63	0.04	1.0	0.06	0.88

Supplementary Table 14: Output of Kolmogorov Smirnov tests comparing the ECDF of change of number of contacts between age groups. Statistic D takes the largest absolute difference between the two empirical cumulative distribution functions. Stars indicate that distributions differ at a significance level of \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .

### 814 Subgroup Analysis by Gender

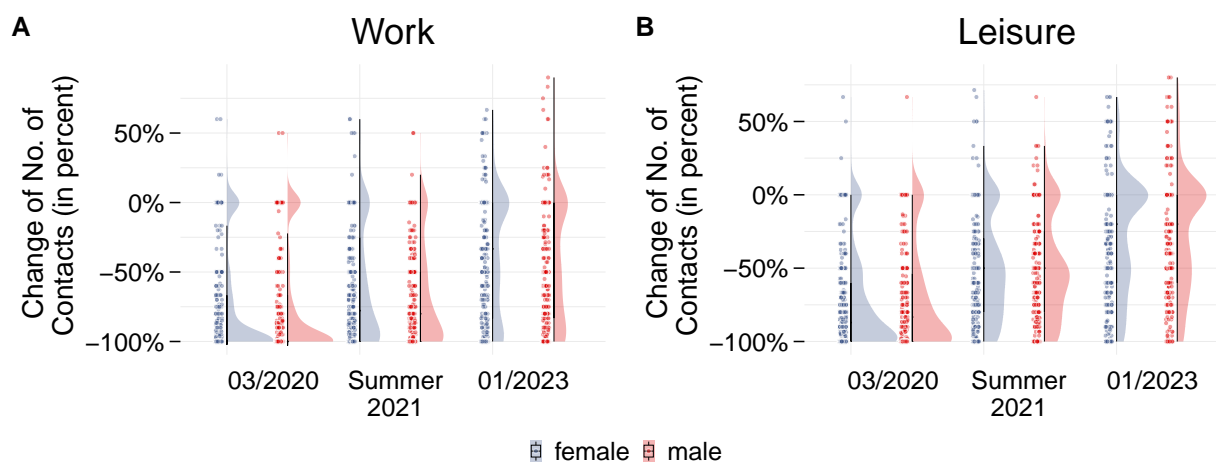
815 Relative to 2019, both genders reduced their work contacts in 03/2020, in summer 2021, and in 01/2023.  
 816 Both genders relaxed their work reductions over time: Relative to 2019, female participants reported an  
 817 average reduction of work contacts of 75% (male participants: 74%) in 03/2020, of 61% (male participants:  
 818 67%) in summer 2021, and of 39% (male participants: 44%) in 01/2023 (Supplementary Figure 14 A). This  
 819 negligibly small difference between genders is reflected by the group assignments of the Bayesian reduction  
 820 model: With the exception of summer 2021, when a slightly smaller share of female than male participants

## Bimodal Contact Reductions and Social Homophily during COVID-19

821 “strongly” reduced their work contacts (41% vs 44%), hardly any difference between the genders can be  
 822 noted (Supplementary Table 16). Kolmogorov-Smirnov-tests classify the difference in distribution of change  
 823 of number of work contacts as statistically insignificant for all time points ( $p > 0.1$ , Supplementary Table 17).

Gender	N	Percent
Female	464	54.2
Male	385	45.0
Diverse	7	0.8
Missing	10	—

Supplementary Table 15: Gender distribution of the survey participants. As people who reported their gender as “diverse” make up less than 1% of the sample size and only include 7 people, they were excluded from the subanalysis.



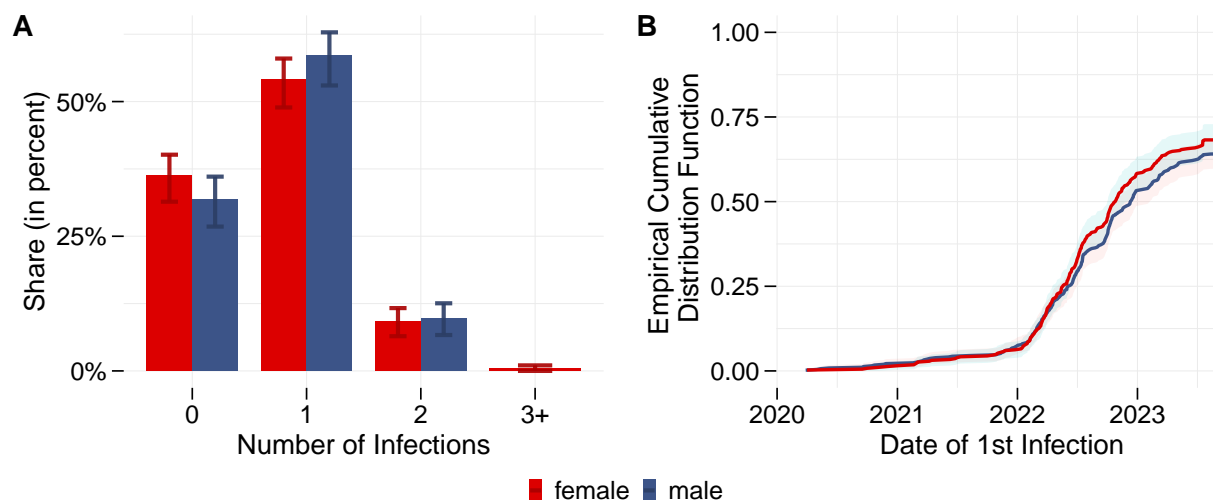
Supplementary Figure 14: Change of number of contacts (in percent, relative to 2019) for different genders. As a percentage increase from zero cannot be computed, individuals who reported zero work/leisure contacts in 2019, were excluded from the corresponding context. **A.** Relative number of work contacts. Both gender reported comparable reductions of work contacts. **B.** Relative number of leisure contacts. Both gender reported comparable reductions of leisure contacts.

824 Analogously to their work contacts, both genders reduced their leisure contacts at all three time points.  
 825 Female participants reported an average reduction of 73% (male participants: 71%) in 03/2020, of 50%  
 826 (male participants: 50%) in summer 2021, and of 28% (male participants: 26%) in 01/2023 (Supplemen-  
 827 tary Figure 14 B). The results of the Bayesian reduction model are comparable (Supplementary Table 16)  
 828 and according to the Kolmogorov-Smirnov-Test the difference in distribution did not reach statistical signif-  
 829 icance at any time point ( $p > 0.1$ , Supplementary Table 17).

830 Comparing the number of reported infections reveals that 36% of female participants (95% CI: [31%,40%])  
 831 vs 31% of male participants (95% CI: [27%,26%]) reported never having been infected (Supplementary Fig-  
 832 ure 15 A). As a consequence, the share of female participants who reported one infection is slightly smaller.  
 833 Female participants: 54% (95% CI: [49%,58%]), male participants: 58% (95% CI: [54%,63%]). The difference  
 834 in distribution, however, is not statistically significant ( $p > 0.1$ , Supplementary Table 17). Analogously, the  
 835 ECDFs of the timing of the first infection for female and male participants coincide (Supplementary Fig-  
 836 ure 15 B). Again, the difference in distribution is not statistically significant ( $p > 0.1$ ).

	Work Female		Work Male		Leisure Female		Leisure Male	
	N	%	N	%	N	%	N	%
<b>03/2020</b>								
Strong Reduction	212	54.4	180	55.6	205	47.2	162	46.0
Intermediate Reduction	113	29.0	87	26.9	180	41.5	141	40.1
Little Change	61	15.6	55	17.0	46	10.6	48	13.6
None	4	1.0	2	0.5	3	0.7	1	0.3
<b>Summer 2021</b>								
Strong Reduction	155	40.7	142	44.2	70	16.7	52	15.1
Intermediate Reduction	142	37.3	131	40.8	261	62.1	218	63.2
Little Change	77	20.2	45	14.0	80	19.0	65	18.8
None	7	1.8	3	1.0	9	2.2	10	2.9
<b>01/2023</b>								
Strong Reduction	83	22.1	73	22.6	34	8.4	25	7.5
Intermediate Reduction	140	37.2	139	43.0	177	43.8	152	45.5
Little Change	131	34.8	96	29.7	163	40.3	129	38.6
None	22	5.9	15	4.7	30	7.5	28	8.4

Supplementary Table 16: Group assignment based on the change of no. of contacts (for details see Subsection Statistical Methods). Both genders reduced their work contacts more strongly than their leisure contacts. With the exception of summer 2021, for which more male than female participants were assigned to the “strong reduction” group, hardly any differences between the genders can be noted.



Supplementary Figure 15: **A.** Share of respondents who reported 0/1/2/3+ infections, differentiated by gender. Error bars represent 95% confidence intervals (see Subsection Statistical Methods for computation and motivation). Female participants reported less infections than male participants. **B.** Number and timing of respondent's (first) infection(s); differentiated by gender. Ribbons represent 95% confidence intervals (see Subsection Statistical Methods for computation and motivation).

	<b>D</b>	<b>p-value</b>
<b>Work</b>		
03/2020	0.04	0.84
Summer 2021	0.06	0.37
01/2023	0.07	0.29
<b>Leisure</b>		
03/2020	0.06	0.56
Summer 2021	0.05	0.75
01/2023	0.02	1.0

Supplementary Table 17: Output of Kolmogorov Smirnov tests comparing the ECDF of change of number of contacts between female and male participants. Statistic D takes the largest absolute difference between the two empirical cumulative distribution functions. For no time point and neither context does the test deem the difference in distribution statistically significant.

## Bimodal Contact Reductions and Social Homophily during COVID-19

### 837 Subgroup Analysis by Comorbidities

838 The survey gave participants the possibility to report the following comorbidities:

- 839 • high blood pressure (hypertension),
- 840 • diabetes (diabetes mellitus),
- 841 • cardiovascular disease (e.g. coronary heart disease, any condition following a heart attack, heart  
842 failure, cardiac arrhythmia, any condition following a stroke),
- 843 • chronic lung disease (e.g. asthma, chronic bronchitis, chronic obstructive pulmonary disease (COPD),  
844 emphysema),
- 845 • current immunodeficiency (e.g. due to an illness, organ transplant, chemotherapy or currently taking  
846 other medication such as cortisone),
- 847 • cancer for which you are currently being treated or have been treated in the last year,
- 848 • post-COVID-19 condition.

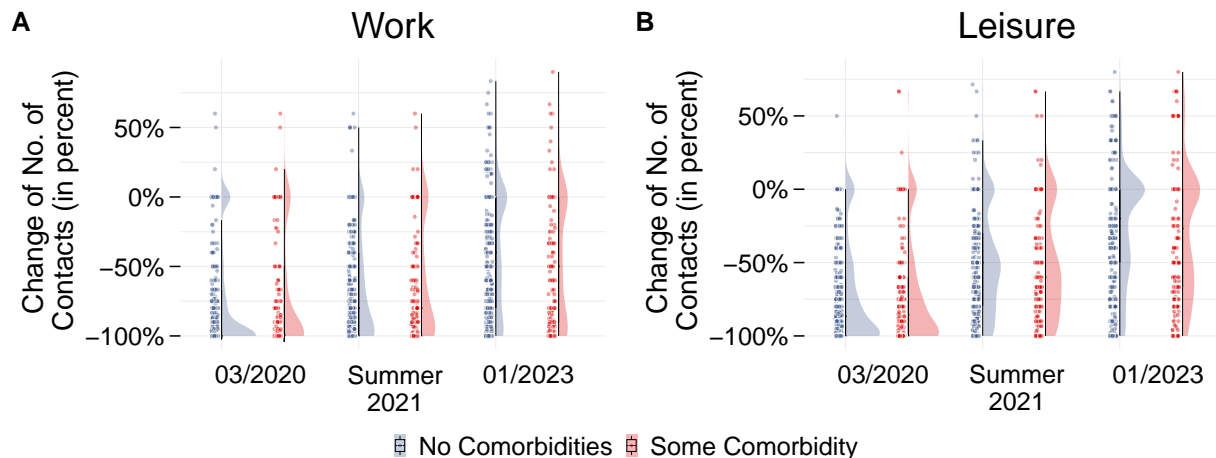
Subgroup	N	Percent
No Comorbidity	593	68.8
Some Comorbidity	269	31.2
Missing	5	—

Supplementary Table 18: Number and shares of participants who reported no/some comorbidity.

849 As individuals with comorbidities are at a higher risk of developing severe COVID-19, they may reduce  
850 their social contacts stronger than the general population [DMFdPCV22]. In our sample, however, partici-  
851 pants without comorbidity and participants with some comorbidity reduced their work and leisure contacts  
852 comparably. In 03/2020, participants without comorbidities reduced their work contacts on average by 76%  
853 (some comorbidity: 71%) and their leisure contacts on average by 73% (some comorbidity: 72%). Both  
854 groups relaxed their reduction over time, leading to an average work reduction of 65% for participants with-  
855 out comorbidity and 61% for participants with some comorbidity in summer 2021. In the leisure context, the  
856 difference in average reduction is even slimmer in summer 2021 with 51% (no comorbidities) vs 50% (some  
857 comorbidity). Relaxations of reductions from summer 2021 to 01/2023 are similar for both groups (Sup-  
858 plementary Figure 16). For 03/2020 and summer 2021, the lack of difference is confirmed by the Bayesian  
859 reduction model (Supplementary Table 19). In 01/2023, however, a larger share of participants without  
860 comorbidity showed strong reduction ( $p < 0.05$ , Supplementary Table 20). Overall, participants with and  
861 without comorbidity reduced contacts similarly in 03/2020 and summer 2021, while in 01/2023, participants  
862 without comorbidity reduced more strongly.

863 This lack of difference in contact reductions propagates to a lack of difference in number of reported  
864 infections: 35% (95% CI: [32%, 38%]) of participants without comorbidity reported no infections vs 32%  
865 (95% CI: [28%, 36%]) of participants with comorbidity. This small difference then leads to a small difference  
866 in share of participants who reported one infection (no comorbidity: 55%, 95% CI: [50%, 59%], some comor-  
867 bidity: 58%, 95% CI: [51%, 65%]). The share of participants who reported two infections is comparable (no  
868 comorbidities: 9%, 95% CI: [9%, 10%], some comorbidity: 9%, 95% CI: [8%, 10 %]). Less than 1% of either

Bimodal Contact Reductions and Social Homophily during COVID-19

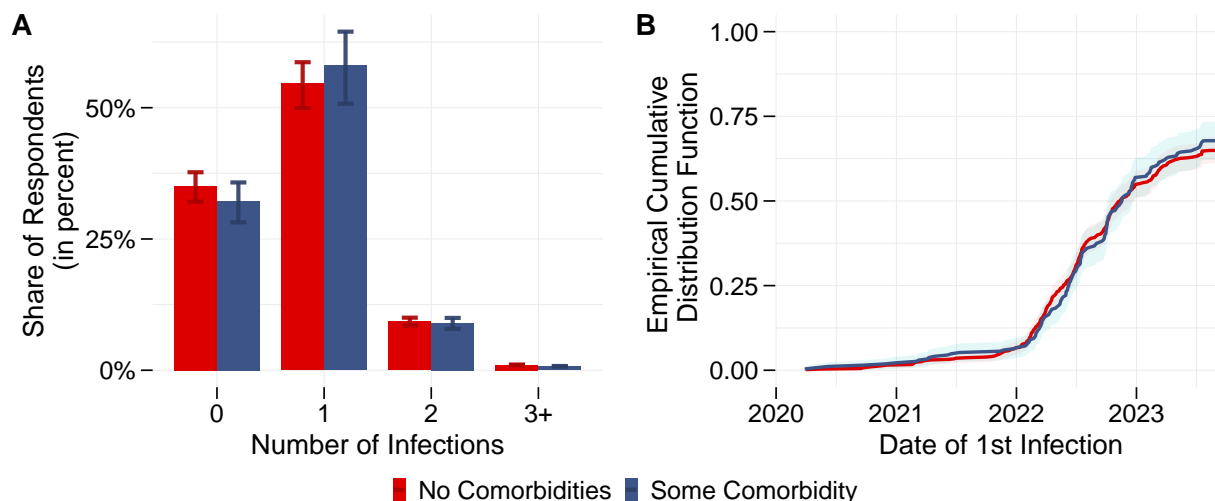


Supplementary Figure 16: Violin plots of change of number of contacts (relative to 2019) by with/without comorbidity. The difference in mean is not significant for the three points in time and for both work and leisure contacts.

	Work No Com.		Work Some Com.		Leisure No Com.		Leisure Some Com.	
	N	%	N	%	N	%	N	%
<b>03/2020</b>								
Strong Reduction	282	55.6	113	52.3	254	46.4	112	45.0
Intermediate Reduction	145	28.6	59	27.3	228	41.6	102	41.0
Little Change	77	15.2	41	19.0	65	11.9	32	12.9
None	3	0.6	3	1.4	1	0.1	3	1.1
<b>Summer 2021</b>								
Strong Reduction	206	41.7	94	43.7	82	15.4	42	17.4
Intermediate Reduction	212	42.7	66	30.7	345	64.6	141	58.3
Little Change	72	14.5	51	23.7	94	17.6	52	21.5
None	6	1.3	4	1.9	13	2.4	7	2.8
<b>01/2023</b>								
Strong Reduction	50	36.0	60	28.4	44	8.5	16	6.8
Intermediate Reduction	40	28.8	73	34.6	223	43.3	113	48.3
Little Change	40	28.8	69	32.7	209	40.6	85	36.3
None	9	6.4	9	4.3	39	7.6	20	8.6

Supplementary Table 19: Group assignment based on the change of no. of contacts (for details see Subsection Statistical Methods). Both groups tended to reduce their work contacts more than their leisure contacts.

869 group reported having been infected at least three times (Supplementary Figure 17 A). The difference in  
 870 distribution is not statistically significant ( $p > 0.1$ ). Finally, the ECDFs of the timing of the first infection  
 871 for participants with/without comorbidity are indistinguishable (Supplementary Figure 17 B,  $p > 0.1$ ).



Supplementary Figure 17: **A.** Share of respondents who reported 0/1/2/3+ infections, differentiated by with/without comorbidity. Error bars represent 95% confidence intervals (see Subsection Statistical Methods for computation and motivation). **B.** Number and timing of participant's (first) infection(s); differentiated by whether they reported a COVID-19 relevant comorbidity. Ribbons represent 95% confidence intervals (see Subsection Statistical Methods for computation and motivation).

	D	p-value
<b>Work</b>		
03/2020	0.05	0.75
Summer 2021	0.08	0.18
01/2023	0.11	0.02**
<b>Leisure</b>		
03/2020	0.02	1.00
Summer 2021	0.06	0.60
01/2023	0.10	0.07*

Supplementary Table 20: Output of Kolmogorov Smirnov tests comparing the ECDF of change of number of contacts between participants without/with some comorbidity. Statistic D takes the largest absolute difference between the two empirical cumulative distribution functions. Stars indicate that distributions differ at a significance level of \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$ .