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Risk perception and optimism during the early stages of the COVID-19 pandemic

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Version 5 added a link to the peer-reviewed publication. Version 4 was uploaded to PsyArXiv on 06.05.2021. Versions 4 and 3 are identical to version 2 apart from minor changes such as correcting typos, adding page numbers, etc. Version 1 (March 2020) was our initial reporting of the first data collection only.

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Abstract

Slowing the spread of COVID-19 requires people to actively change their lives by following protective practices, such as physical distancing and disinfecting their hands. Perceptions about the personal risk of COVID-19 may affect compliance with these practices. In this study, we assessed risk perception and optimism about COVID-19 in a multinational (UK, USA, Germany), longitudinal design during the early stages of the pandemic (16.03.2020; 01.04.2020; 20.05.2020). Our main findings are that 1) people showed a comparative optimism bias about getting infected and infecting others, but not for getting severe symptoms, 2) this optimism bias did not change over time, 3) optimism bias seemed to relate to perceived level of control over the action, 4) risk perception was linked to publicly available information about the disorder (e.g., older people are at a higher risk of getting severe symptoms), and 5) people reported adhering so closely to protective measures that these measures reached ceiling effects. Thus, there was not enough variance in protective measures to appropriately link risk perception and adherence to protective measures. We also collected additional cross-sectional samples, with which we are currently testing which of the findings reported in this preprint replicate. Our results provide detailed descriptions of risk perceptions and optimistic beliefs during the early stages of the COVID-19 pandemic.

1. Introduction

The pandemic of the new Coronavirus COVID-19 requires massive action from governments, industry and citizens to reduce its spread. Best practices, such as minimizing direct physical contact with others ("physical distancing") and increased personal hygiene require individuals to actively change their lifestyles (Fong et al., 2020). For COVID-19, it is especially important that all citizens follow such guidelines, even those without symptoms, because COVID-19 can be spread by asymptomatic people (Hoehl et al., 2020; Li et al., 2020, Tindale et al., 2020). Ultimately, the success of regulations depends on citizens' compliance.

Individuals' beliefs about their probabilities of contracting and transmitting COVID-19 may determine how much they are willing to change their behaviour. In general, self-related subjective beliefs about future events tend to be optimistically biased (Weinstein, 1980; Sharot, 2011; Jefferson, Bortolotti, Kuzmanovic, 2017; Kress & Aue, 2017): people estimate that negative events are less likely to happen to them than to a similar other person, while the opposite is true for positive events. This phenomenon is conceptualized as comparative optimism bias (Shepperd, Klein, Waters, Weinstein, 2013; Oganian, Heekeren, Korn, 2018). Applied to the current situation, individuals might believe that they are less likely to get infected and to infect others with COVID-19 (Xu & Peng, 2015). Such optimism may also extend to subjective beliefs about following best practice guidelines: if people believe they are not as likely to get infected as other people, they might therefore believe that implementing best practices to minimize the risk of COVID-19 is not as necessary for themselves compared to others. On the other hand, it might lead individuals to believe that they will be more able to comply with best practice guidelines such as physical distancing. In addition, COVID-19 adds another complication for accurately estimating personal risk: especially in the beginning of the pandemic, individuals had no access to definitive statistics due to the novelty of this disease—in contrast to other diseases, such as influenza or sexually transmitted diseases, for which reliable statistics have been long established and publicly transmitted. Moreover, the COVID-19 pandemic evolved rapidly, which changed personal experience as well as publicly available information and public policies.

Multiple lines of research have discussed whether and how optimism can be adaptive or maladaptive for the self (Taylor & Brown, 1988; Weinstein & Klein, 1995; Lovallo & Kahneman, 2003; Haselton & Nettle, 2006). Mild optimism can be adaptive. For example, trait optimism predicts physical and mental health (e.g., Scheier et al. 1989), possibly via effects related to coping (Nes & Segerstrom, 2006). Relatedly, depressive patients have reduced levels of optimism relative to healthy controls (Strunk, Lopez, DeRubeis, 2006; Korn et al., 2014). Extreme optimism, however, seems to result in overly high risk taking (Puri and Robinson, 2007).

Optimism about COVID-19 might have adaptive effects (e.g., protection from detrimental levels of anxiety) or maladaptive consequences (e.g., defiance of regulations and accelerating its spread). This will to some extent depend on what exactly people are optimistic about: if individuals naïvely believe that they are at a lower risk of contracting or spreading the disease, they may not see the necessity of following best practices around hygiene and physical distancing. In that sense, optimism about COVID-19 might be maladaptive for self and for others because people who follow best practices less strictly might contribute more to the spread of the disease. On the other hand, physical distancing (and quarantine in the extreme case) can be extremely stressful and problematic for mental health (Brooks et al., 2020). From this point of view, an optimistic belief about one's ability to deal with such a situation might be helpful in following through with physical distancing guidelines, while individuals who think that physical distancing will be very tough for them might be less likely to follow those guidelines. Based on these arguments, optimism for COVID-19 could be adaptive, maladaptive, some combination of the two, or neither.

In this study, we investigated people's risk perceptions and optimism with respect to various measures related to COVID-19, where these perceptions might come from, and whether they predict later adherence to protective measures. To do so, we conducted a longitudinal study during the early stages of the COVID-19 pandemic. In an initial preprint (Kuper-Smith et al., 2020), we reported the findings about comparative optimism from a first data collection time point. Here, we provide the full analysis from all three time points of data collection, including analyses of how risk perception changed and to what extent risk perception is predictive of adherence to protective measures. Parts of these analyses were preregistered (https://osf.io/89ndm, i.e., in the following sections, we specify *a priori* hypotheses and exploratory analyses). At each time point, we also collected data from additional cross-sectional samples, which we are currently using to test which of the findings reported here replicate.

2. Methods

2.1 Overall strategy

We collected two data sets. First, in a within-participants design, data were collected from the same participants at all time points (Sample 1). We used this data set for the initial longitudinal analyses reported here. Second, at the same time points we also collected data from independent participant groups (Samples 2 – 4), which we will use for replicating our exploratory results. **Figure 1** displays which samples were collected when.

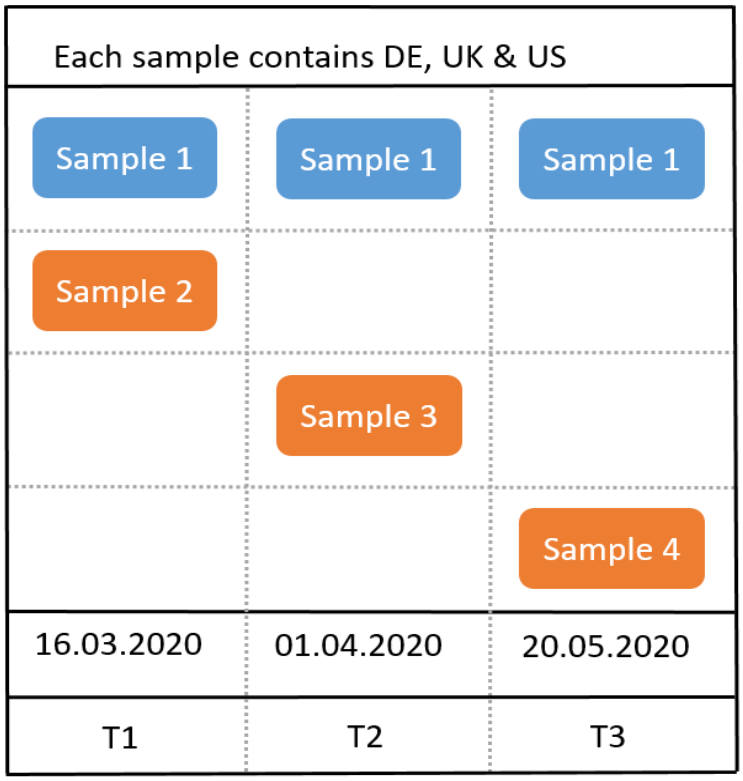

Figure 1 - A schematic of when we collected data from which samples. In the top row, the blue sample shows our within-participants design. These are the 432 participants who took part three times. The orange samples are independent, new samples that we collected at the same time as the blue samples, but each with a completely new set of participants. The bottom of the figure displays the dates at which the data was collected. The lowest row displays the names we will use to refer to the three time points in the main text. Samples 2-4 each contain 98 new participants from Germany, the UK and the US each.

2.2 Ethics

The study was conducted in accordance with the Declaration of Helsinki. All participants gave informed consent before completing the online questionnaire. The study asked no potentially triggering questions and was clearly labelled as a study about the Coronavirus. The George Washington University Institutional Review Board has approved online data collection of this form (IRB#NCR191133).

2.3 Participants

Participants were recruited via www.prolific.ac (Palan & Schitter, 2018). We only included participants who completed the entire questionnaire. Further inclusion criteria were:

1) Participants were current residents of the respective countries. We selected UK, US and Germany for the following (rather pragmatic) reasons: First, there were many (>1,000) active participants available on Prolific. Second, we were able to compile surveys in the participants' native languages quickly enough to start data collection fast. Third, at the time, each country's government had a different approach to dealing with the pandemic.
2) Participants had a prior approval rate of 90-100% on Prolific. When participants participate on prolific, the experimenters can deny payment to the participant (e.g., if they complete the study too fast to have paid attention, if they miss attention tests). By choosing prior approval rates of 90-100%, we can pre-emptively exclude many unserious participants and thereby increase our data quality.
3) For Sample 1, at T2 and T3, we only invited participants who had taken part in all previous data collections (i.e., T1, and T1 and T2); for Samples 2-4, we excluded anyone who had previously taken part in any of our studies.
4) Prolific does not have any participants younger than 18, so this was our imposed lower age limit. We did not set an upper limit.
5) Participants had to take part on a desktop/laptop and were prohibited from taking part on a mobile phone or tablet. This was done to improve data quality, assuming that people sitting at a desktop are not commuting or doing too many other distracting tasks
6) At the end of the survey, people rated how many problems they had with the survey due to language difficulties. Anyone with frequent difficulties was excluded

In Sample 1, 432 participants took part (Germany: 135, UK: 206, USA: 91). Participants had a mean age of 33.3 years (SD = 11.3; range: 18-81); when asked for their gender, 62.5% selected 'female', 37.0% selected 'male', and 0.5% selected 'other'. For a breakdown of demographics for each country, see **Appendix A**: Demographics for all samples. In addition to the longitudinal Sample 1, we also collected cross-sectional data from each country at each time point. These samples are not reported here, but will be used in the published manuscript to replicate the findings reported in this preprint.

2.4 Procedure and questions

Participants saw our study advertised on prolific.ac and were redirected to soscisurvey.de. After consenting to take part in the study, participants filled in the survey. From T1 to T3 we did not exclude any questions, but at T2 and T3 we added several questions towards the end of the survey. Participants were paid £0.85 for 10 minutes at T1, £1.30 for 15 minutes at T2, and £1.84 for 20 minutes at T3.

For a full list of all questions, see **Appendix B**. Participants filled the questionnaire in by selecting the appropriate responses with their cursor. For many questions, the possible answers ranged from 0 to 100. There was no default option (the slider appeared only when participants clicked on the line). This

is important when comparing self to other scores, because this way if there is a difference of 0, this does not mean that participants simply went with the default – instead, answers had to be specifically selected.

Our questions cover the following main topics:

1) Risk perception for self and for an average other person. These are questions about the probability of getting infected with COVID, about the probability of infecting others with COVID (if infected oneself), and about the probability of getting mild or severe symptoms.
2) Control questions for optimism. These included questions about the probability of getting other health issues (getting the flu, getting an STD, breaking a bone), or suffering other health-related negative consequences due to the pandemic (not getting a place at the doctor's/in hospital due to too high demand)
3) Questions about adherence to preventative behaviours, such as physical distancing and hand washing
4) Questions about mental health (e.g., anticipated suffering due to pandemic, general anxiety)
5) Demographics
6) General control questions (such as how many infected people they know, how many people deceased due to COVID they know, whether they had symptoms of COVID, etc.)
7) Other general questions about the (societal, financial, etc.) consequences of the pandemic

2.5 Testing for optimism bias

For testing comparative optimism, we followed a standard procedure in the field (Shepperd, Klein, Waters, Weinstein, 2013): participants separately rated the probability of various events occurring for themselves and for someone similar to them. Optimism scores were always calculated such that a positive number indicates optimism bias (positive events: self-other; negative events: other-self).

To introduce and describe the concept of a 'similar other person', we used similar age, sex and city/area in this study. These variables are key factors with respect to COVID-19: older people (Bonand et al., 2020; Davies et al., 2020, Williamson et al., 2020) and men are more at risk from suffering severe symptoms (Gebhard et al., 2020), and due to human-to-human transmission, the spread of infected people is not distributed evenly, but in clusters (Desjardins et al., 2020). If the other person is in the same age bracket, has the same sex and is from the same area, we can exclude that any difference is due to perceived differences in those COVID-relevant categories. At T1, we only mentioned age and location in the description of the average person, for T2 and T3, we added biological sex as third factor.

3. Results

3.0. Overall approach and preregistered analyses

Our main analysis is divided into three sections: first, we characterise people's absolute and relative risk perceptions for three questions about COVID-19. Second, we characterize factors that might have influenced these perceptions, such as known risk factors (e.g., age, gender, overall health), and more personal characteristics (e.g., media consumption, overall comparative optimism). Third, we test whether risk perception at one time point predicts self-reported engagement in protective measures at a later time point. For all of these sections, we use the longitudinal Sample 1 only.

This study includes preregistered analyses (https://osf.io/89ndm) for T2. Specifically, our three preregistered hypotheses were: First, people would show an optimism bias at T2 for the questions *Get*

COVID (for the time horizon 'next 2 weeks') and *Infect Others*. Second, these optimism biases would reduce from T1 to T2. Third, there would be a negative correlation between these optimism biases at T1 and the reported reduction of physical contacts at T2. Although the preregistration only explicitly mentioned T2, the same logic can be extended to T3. We therefore also test these preregistered hypotheses for the data from T3. As specified in our preregistration, our cut-off for significance testing was $p < 0.005$. All analyses not explicitly labelled as preregistered hypotheses are treated as exploratory analyses; for these exploratory analyses we use a cut-off for significance testing of $p < 0.05$.

3.1. Absolute and relative risk perception

Participants were asked three main questions directly related to their risk perception about COVID-19: 1) the probability of getting infected with COVID-19 (hereafter: *Get COVID*), 2) if infected themselves with COVID-19, the probability of infecting someone else (hereafter: *Infect Others*), and 3) if infected themselves with COVID-19, the probability of developing severe symptoms that require hospitalisation (hereafter: *Severe Symptoms*). While *Severe Symptoms* is a single-item question, the first two questions were asked across different contexts: *Get COVID* was rated separately for 4 different time horizons (within the next 2 weeks, within the next 2 months, within the next year, within your lifetime); *Infect Others* was asked separately for 6 different social contexts (family, friends, colleagues, strangers during a leisure activity, strangers during vacation, strangers while doing public chores (commuting, buying groceries, etc.). In the following, when referring to *Get COVID*, we refer to the average rating per participant across the 4 time horizons, unless specified otherwise; likewise, when referring to *Infect Others* we are referring to an average per participant over the 6 social contexts, unless specified otherwise.

All three questions were asked for self and for a person similar to the self. When referring to 'absolute risk perception', we refer to the probability of an event happening to oneself; when referring to 'relative risk perception', we refer to the difference in probability of an event happening to someone like you and the probability of that event happening to oneself (i.e., p_{other}-p_{self}). A positive score for relative risk perception indicates a comparative optimism bias (i.e., the probability for these negative events is rated as higher for the average person than for oneself).

Get COVID

Participants in our study believed that there was a substantial risk that they would get infected with COVID (see **Figure 2** for an overview of the three risk perception questions). The mean score for *Get COVID* averaged across the four time horizons for 'self' was 49% at T1, 46% at T2, and 35% at T3. For the time horizon 'lifetime', the mean score was always above 50%, indicating that participants thought they were more likely than not to get infected with COVID-19 during their lifetimes.

For relative risk perception, a clear picture emerged: for all time horizons across all time points, the mean response for 'self' was always lower than for 'other', suggesting an overall optimism bias for *Get COVID*, such that people estimated this negative event to be more likely to happen to someone else than to themselves. We therefore found evidence for the first part of our first preregistered hypothesis: risk perception for 'self' was statistically significantly lower than that for 'other' at T2 for the time horizon 'next 2 weeks' ($t(431) = -11.69$, $p < 0.001$, $d = -0.56$).

To test whether risk perceptions and comparative optimism bias changed during the early stages of the pandemic for *Get COVID*, we ran a 2 (person: self/other) * 3 (time point: T1-3) repeated-measures ANOVA. We found a significant main effect of person ($F(1, 862) = 177.00$, $p<0.001$, $\eta_p^2 = 0.3046$), which

suggests an optimism bias, and a significant main effect of time point ($F(2, 862) = 109.71$, $p<0.001$, $\eta_p^2 = 0.6438$), which suggests that risk perception decreased over time. The interaction between person and time ($F(2, 862) = 3.07$, $p = 0.0471$, $\eta_p^2 = 0.0071$) was only significant at the $p = 0.05$ level though and would not be significant after adjusting for mulitple comparisons; additionally, the effect size of this interaction was small. Testing our second preregistered hypothesis (which was specifically about the time horizon 'next 2 weeks', rather than the average of all 4 time horizons), we did not find a statistically significant reduction between T1 and T2 for the optimism bias scores for the time horizon 'next 2 weeks' ($t(431) = -1.55$, $p = 0.122$, $d = -0.075$).

Taken together, this suggests that although absolute risk perception reduces over time, there does not seem to be a substantial change in people's optimism bias for *Get COVID* during the early stages of the pandemic. **Figure 3** illustrates these findings for all three optimism bias scores for all three time points.

Infect Others

Participants believed that there was a substantial risk that they would infect someone else with COVID (if they themselevs were infected): the mean risk for Infect Others averaged across all social contexts was always above 20% (T1: 39%; T2: 26%; T3: 25%).

For the relative risk perception of *Infect Others* a clear picture emerged (see **Figure 2**): for all social contexts across all time points, the mean response for 'self' was always lower than for 'other', suggesting an overall optimism bias for *Infect Others.* We thus found evidence for the second part of our first preregistered hypothesis: the risk perception for 'self' was statistically significantly lower than that for 'other' at T2 for the average across all six social contexts for *Infect Others* too ($t(431) = -21.99$, $p < 0.001$, $d = -1.058$).

To test whether risk perceptions and comparative optimism bias changed during the early stages of the pandemic for *Infect Others*, we ran a 2 (person: self/other) * 3 (time: T1-3) ANOVA. There was a main effect of person ($F(1, 862) = 806.23$, $p<0.001$, $\eta_p^2 = 0.7150$), which suggests an optimism bias, a main effect of time ($F(2, 862) = 139.66$, $p<0.001$, $\eta_p^2 = 0.5870$), which suggests that risk perception decreases over time, and an interaction between person and time ($F(2, 862) = 4.54$, $p = 0.0109$, $\eta_p^2 = 0.0104$). As for *Get COVID*, this interaction effect for *Infect Others* was only significant at the $p = 0.05$ level and would not be significant if corrected for mulitple comparisons. Additionally, the effect size of this interaction was small.

Taken together, this suggests that although absolute risk perception reduced over time, there was no substantial change in people's optimism bias for *Infect Others* during the first two months of the pandemic. See **Figure 3** for optimism bias scores for all three time points. Testing our second preregistered hypothesis (which specified comparing T1 and T2 only, with a repeated-measures t-test), we did not find a statistcally significant reduction between T1 and T2 for the optimism bias scores for the *Infect Others* ($t(431) = -0.11$, $p = 0.9118$, $d = -0.005$).

Severe Symptoms

As with *Get COVID* and *Infect Others*, we ran a 2 (person: self/other) * 3 (time: T1/T2/T3) ANOVA, to test for risk perceptions and comparative optimism bias change during the early stages of the pandemic for *Severe Symptoms*. There was no main effect of person ($F(1, 862) = 1.45$, $p=0.2299$, $\eta_p^2 = 0.0062$), which suggests no optimism bias, a main effect of time ($F(2, 862) = 17.85$, $p<0.001$, $\eta_p^2 = 0.1163$), which suggests that risk perception increased over time, and no significant interaction between person and time ($F(2, 862) = 2.32$, $p = 0.0993$, $\eta_p^2 = 0.0053$). Taken together, this suggests

that risk perception for *Severe Symptoms* differed from risk perception for *Get COVID* or *Infect Others*: while the other two showed strong optimism biases and decreasing absolute risk perception, *Severe Symptoms* showed no optimism bias, and absolute risk perception seemed to increase slightly over time (significant, but with small effect size). **Figure 3** provides raincloud plots for the optimism bias scores over time.

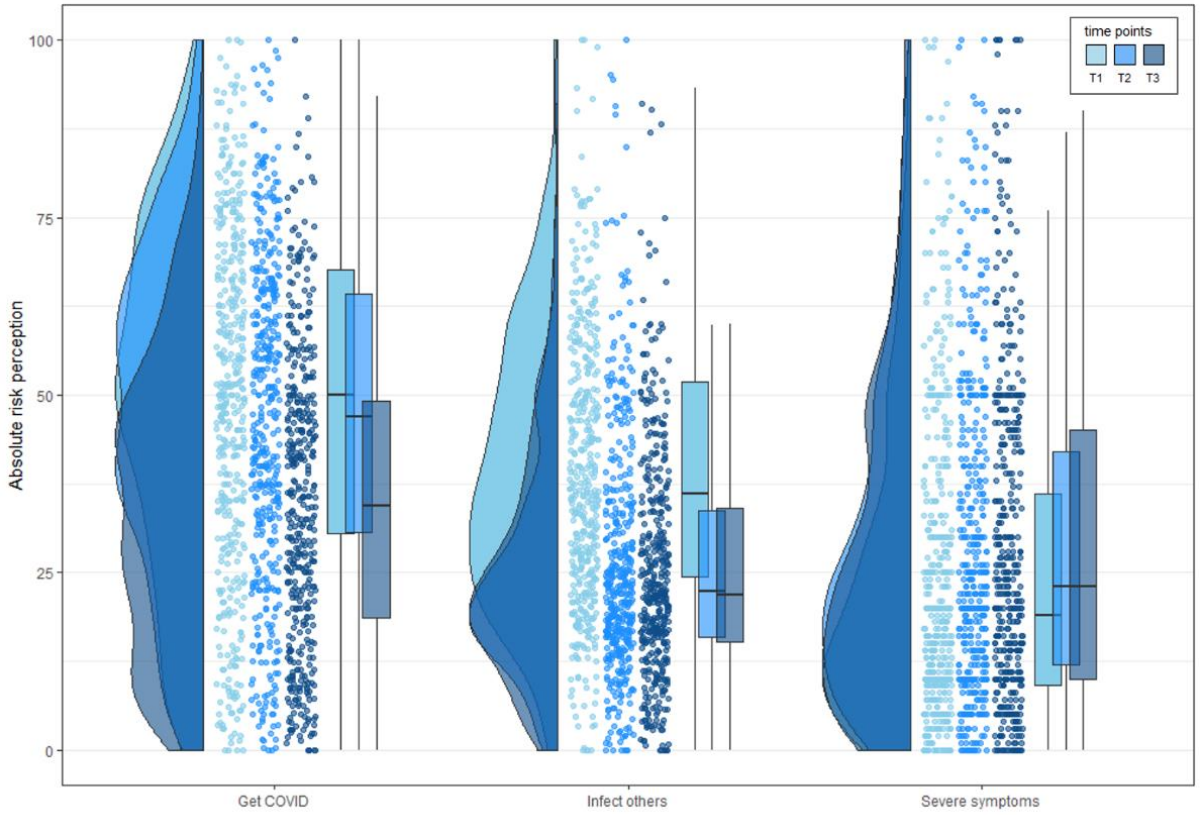

Figure 2 - Raincloud plots for absolute risk perception, separately for the three COVID-related risk perception questions, separately for each time point. Each dot represents the data from one participant. For Get COVID*, we averaged across the 4 different time horizons (Next 2 weeks, Next 2 months, Next year, Lifetime) and for* Infect Others *we averaged across the six social contexts (Family, Friends, Colleagues, Strangers during leisure activities, Strangers during vacation, Strangers during daily chores like commuting and grocery shopping);* Severe Symptoms *is a single-item questions. All raincloud plots in this paper were based on Allen et al. (2019).*

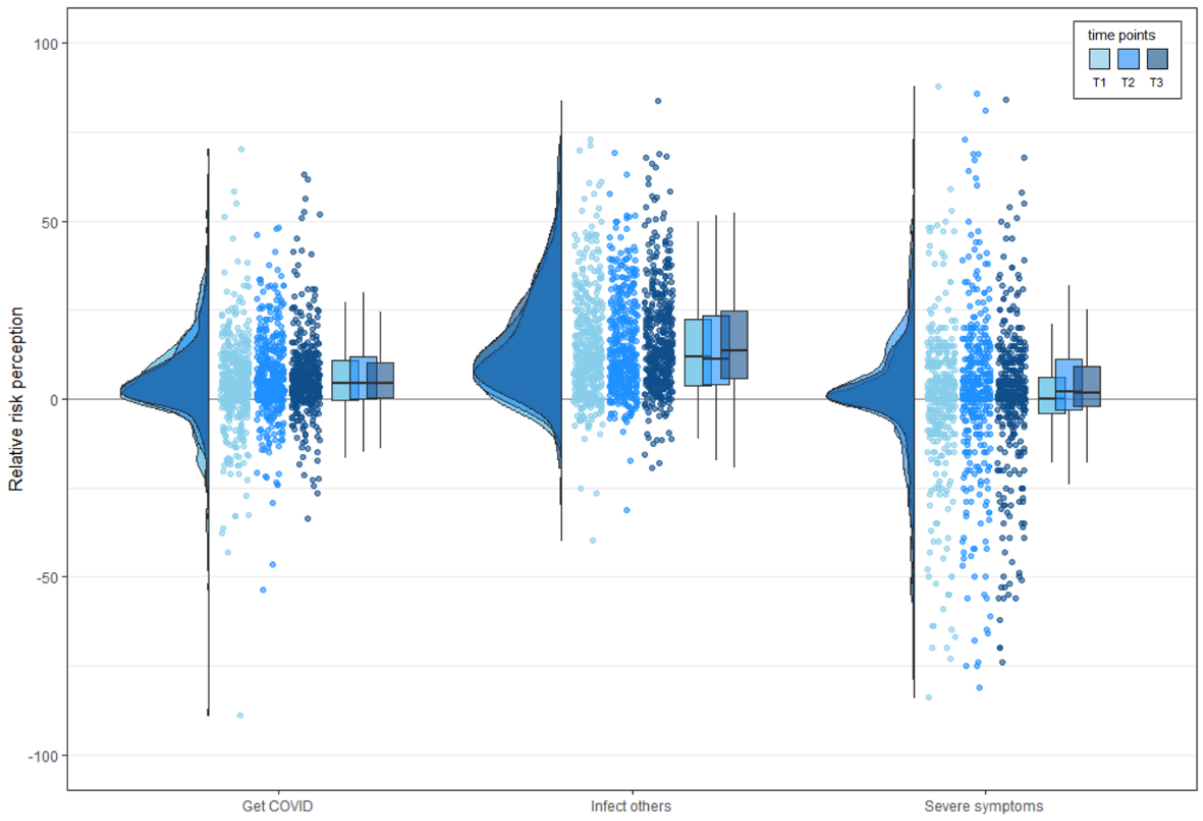

Figure 3 – Raincloud plots for relative risk perception (optimism bias; Other-Self), separately for the three COVID-related risk perception questions, separately for each time point. Each dot represents the data from one participant. For Get COVID*, we averaged across the 4 different time horizons (Next 2 weeks, Next 2 months, Next year, Lifetime) and for* Infect Others *we averaged across the six social contexts (Family, Friends, Colleagues, Strangers during leisure activities, Strangers during vacation, Strangers during daily chores like commuting and grocery shopping);* Severe Symptoms *is a single-item questions.*

Comparing optimism scores for COVID-related questions, other diseases, and proximity

When comparing optimism scores across the three optimism questions (*Get COVID, Infect Others, Severe Symptoms)*, we find significant differences. Given that optimism scores did not change over time for any of the three questions, we calculated the mean optimism score per participant per question over the three time points, and compared this aggregate optimsm score across questions. A one-way repeated-measures ANOVA revealed an overall significant effect of Question (*Get COVID, Infect Others, Severe Symptoms*; $F(1, 862) = 173.38$, $p<0.001$, $\eta_p^2 = 0.2869$). Post-hoc tests revealed a significantly higher optimism bias for *Infect Others* than for the *Get COVID* (mean difference: 9.7551 (95% CI: 7.8980-11.6121); $p<0.001$) and *Severe Symptoms* (mean difference: 14.4644 (95% CI: 12.6073-16.3214); $p<0.001$), and a significantly higher optimism bias for *Get COVID* than for *Severe Symptoms* (mean difference: 4.7093 (95% CI: 2.8522-6.5664); $p<0.001$).

One interpretation of these differences is that optimism bias is affected by the perceived sense of control over the outcome. At the time of data collection, there was no known cure against COVID-19, so the probability of experincing severe symptoms depended mostly on a person's immune system, something that depends to a considerably degree on genetics and other biological factors, and is thus largely outside of one's control. For getting infected however, there is quite a lot one can do to prevent this outcome, such as staying home as much as possible, washing hands, maintaining distance, and wearing masks. Despite all this, one cannot easily guarantee to not get infected unless one quarantines oneself for an undetermined time. Arguably, one should have the most control over one's actions for

Infect Others (at least if one is clearly positive for COVID): as long as a person abides perfectly by the health guidelines and quarantines themself, one can all but guarantee that no one else will get infected. Other findings from our study support the interpretation that a sense of control affects the degree to which people are optimistically biased:

First, in an additional set of risk perception questions about other diseases (probability of getting influenza/getting an STD/breaking a bone), there were significant differences between the optimism biases of these questions ($F(1, 862) = 198.65$, $p<0.001$, $\eta_p^2 = 0.3155$). Post-hoc tests revealed that people reported a lower optimism bias for getting influenza than for getting an STD (mean difference: 10.6682 (95% CI: 9.3395-11.9969); $p<0.001$) and for breaking a bone (mean difference: 2.1082 (95% CI: 0.7796-3.4369); $p=0.006$), and a significantly lower optimism bias for breaking a bone than for getting and STD (mean difference: 8.5600 (95% CI: 7.2313-9.8887); $p<0.001$; see **Appendix C**). Although we did not ask participants for their perceived sense of control over these items, it seems reasonable that people feel the most control over whether they will get an STD, followed by whether they will break a bone, and whether they will contract influenza. Thus, the control optimism questions seem to align with the COVID optimism questions in terms of perceived sense of control.

Second, it seems that more proximal (and therefore, presumably, controllable) aspects show a larger optimism bias than more distal ones: within the subitems of *Get COVID*, the shorter the time horizon, the larger the optimism bias ($F(3, 1724) = 8.57$, $p<0.001$; see **Fig. 2**). We also asked participants, if they were to get infected, to what extent different people had done all they could to prevent their infection from happening. We varied who these people were, from the participant themselves to friends and family, employer, local authorities, and national government. Again, we find that the more proximal someone is the stronger the optimism bias is: comparing the different people, we find that the closer someone is to the participant, the larger the optimism bias is ($F(4,2155) = 35.69$, $p<0.001$; the mean optimism bias for each item increases monotonically from the person themselves to government, with most individual comparisons statistically significantly different; see **Appendix C**).

Third, for *Infect Others*, the subitem Family has the lowest optimism bias (one-way repeated measures ANOVA between social contexts: $F(5,2786) = 28.1$, $p<0.001$; post-hoc comparisons showed family as having the smallest optimism bias; for all comparisons with family $p<0.0012$) and due to many of our participants living with their family (74% of participants report living with children, partner, and/or parents), one can control to a much lesser degree whether one will interact with one's family relative to the other subitems. Taken together, the findings from these questions suggest that optimism bias might relate to perceived control.

3.2. Potential influences on risk perception

Next, we investigated the potential influences of risk perception. As described above, there are many different reasons why people might show a comparative optimism. In this section, we analysed what might explain these perceptions. To keep the number of tests tractable, we do not report changes over time here; we therefore analyse risk perception averaged over the three time points, each for absolute and relative risk perception.

Personal risk factors

At the time of data collection several risk factors for COVID-19 were already known, including age, gender, overall health, and geographical location (Williamson et al., 2020). Being older, male, and in poor health was known to be associated with higher probabilities of developing severe symptoms once

infected. For all sections, we summarise the main results here and full results and figures are presented in **Appendix D**.

Age: At the time of data collection, it was widely reported in the media that being older was a known risk factor for developing severe symptoms and dying from a COVID-19 infection (Bonand et al., 2020; Davies et al., 2020). To test the effect of age on perceived risk, we analysed pairwise correlations between age and absolute and relative risk scores in each of the 3 main risk perception questions. For *Get COVID*, there were no evidence for a relationship between age and absolute risk perception ($r = -0.0393$, $p = 0.4157$) or age and relative risk perception ($r = 0.0274$, $p = 0.5696$). For *Infect Others*, older participants perceived less absolute risk ($r = -0.1776$, $p < 0.001$), but there was no evidence for a relationship between age and relative risk perception ($r = 0.0130$, $p = 0.7875$). For *Severe Symptoms*, older participants had higher scores of absolute risk ($r = 0.1731$, $p < 0.001$) and lower scores of relative risk ($r = -0.1723$, $p < 0.001$). Thus, our participants seemed to have particularly incorporated the information that older people are more likely to suffer from severe symptoms once infected. Although relative risk perception is relative to someone of the same age, older people seem to show a reduced optimism bias with respect to getting severe symptoms.

Gender: At the time of data collection, it was reported that men suffered from higher rates of severe symptoms and death due to COVID than women. To test the effect of gender on risk perception, we used Welch's t-test (t_{Welch}), due to the different number of men and women in our sample. Further, only two selected 'other' such that there weren't enough people from this group to run proper analyses, and we had to exclude them.

For *Get COVID*, men ($M = 38.2531$, $SD = 19.4670$) showed lower absolute risk perception than women ($M = 46.6901$, $SD = 18.6814$; $t_{Welch}(323.0304) = 4.4094$, $p < 0.001$, $d = 0.445$). This was not the case, however, for relative risk perception ($t(388.2063) = -0.4095$, $p = 0.6824$, $d = -0.039$), indicating a baseline shift: women reported generally higher risk perception, irrespective of whether it concerns themselves or someone else. For *Infect Others*, absolute risk perception did not differ between men and women ($t_{Welch}(308.6878) = 0.8142$, $p = .4161$, $d = 0.083$), but women ($M = 16.2932$, $SD = 11.6474$) had larger relative risk perception than men ($M = 13.9701$, $SD = 10.4912$; $t_{Welch}(361.9566) = 2.1292$, $p = 0.0339$, $d = 0.207$). For *Severe Symptoms*, women had higher perceived absolute risk perception ($M = 29.4173$, $SD = 19.9943$) than men ($M = 25.0563$, $SD = 17.9717$; $t_{Welch}(362.5108) = 2.3313$, $p = 0.0203$, $d = 0.226$), but there was no difference in relative risk perception ($t(384.0029) = -0.9032$, $p = 0.3670$, $d = -0.086$).

Overall health: People with pre-existing health conditions were at higher risk of getting severe symptoms if infected with COVID. We thus asked participants to rate their overall health from 1 (very poor) to 5 (very good). The responses were highly unevenly distributed (very poor: 7, poor: 24, OK: 109, good: 205, very good: 87), so we used a Kruskal-Wallis test after excluding the small fraction of participants who reported very poor health.

For *Get COVID*, there were no significant differences between people with different levels of health (absolute: $H(3) = 7.78$, $p = 0.0507$; relative: $H(3) = 5.2$, $p = 0.1575$). For *Infect Others*, there were no significant differences for absolute risk perception ($H(3) = 4.3$, $p = 0.2308$), but for relative risk perception, there were significant differences ($H(3) = 9.86$, $p = 0.0198$). Post-hoc tests revealed that people with poor health reported significantly higher optimism bias of infecting someone else than people with good ($p = 0.0184$) or very good ($p = 0.0293$) health.

For severe symptoms, there was a negative relationship between health and absolute risk perception: the worse someone's health was, the higher they rated their probability of experiencing severe symptoms if infected with COVID ($H(3) = 78.54$, $p<0.001$), with a monotonic decrease from one level

of health to the next (poor/OK p = 0.0207, OK/good p = 0.0073, all other comparisons p<0.001). For relative risk perception, the reverse was true: the better someone's health, the higher their optimism bias (H(3) = 81.46, p<0.001), with a monotonic increase from one level to the next (poor/OK p = 0.0093, good/very good p = 0.0116, all other comparisons p<0.001). Thus it seems as if our participants were highly aware of the relationship between pre-existing health conditions and a higher probability of getting severe symptoms once infected with COVID.

Country

The participants in our study came from three different countries. Due to the different number of participants in each country (DE: 135, UK: 206, USA: 91), we used a Kruskal-Wallis test to determine whether there were any significant differences between countries for absolute and relative risk perception for the three COVID-related risk perception questions.

There were no significant differences between countries for all absolute and relative risk perception scores (all p-values > 0.06), with the exception of relative risk perception for *Infect Others* (H(2) = 9.5, p = 0.0087). Post-hoc tests revealed that participants from the USA had significantly higher optimism bias scores than participants from the UK (p = 0.0085) and Germany (p = 0.0287), but that there was no difference between Germany and the UK (p = 0.9686). For a table of results and for figures for risk perception in each country see **Appendix E**.

Proximity to infections and deaths

Another factor that might affect risk perception is the personal proximity to people who have been infected or who have died from COVID. Although our question allowed people to say how many people they knew who had been infected or had died from COVID, about half of people didn't know a single person who had gotten infected or who had died. Thus, for the analysis we made these variables binary (no one known vs. at least one person known). Because the number of people who knew at least one person who was infected/had died increased over time, we only used the data from T3 for analyses regarding proximity (see **Appendix F** for details).

For *Get COVID*, those who knew at least one person who had died/gotten infected with COVID showed higher absolute risk perception than those who knew no one who had been infected (see **Appendix G** for details for this section). While this pattern was evident for all items for *Get COVID* (infections known directly, infections known indirectly, deaths known), for *Infect Others* this pattern was only evident for infections known directly (no significant differences for the other two items). For relative risk perception, for both *Get COVID* and *Infect Others* only the item infections known indirectly showed a significant effect: those who indirectly knew at least one person who had gotten infected with COVID showed lower relative risk perception than those who knew no one indirectly who had gotten infected. For *Severe Symptoms*, there were no significant differences between those participants who knew at least one person and those participants who knew no one who had gotten infected or died.

General optimism bias

Another factor that might affect people's risk perception, especially their comparative optimism bias, is their personalised general optimism bias for other diseases. Put differently, people might have a certain baseline optimism bias, and this might in turn affect how they perceive risks around COVID-19.

To test for this possibility, our survey included three questions related to getting health problems other than COVID: contracting the flu, getting a sexually-transmitted disease (STD), and breaking a bone (see **Appendix H** for statistical details). As with *Get COVID*, we asked this question for four different time horizons (next 2 weeks, next 2 months, next year, lifetime). For the analysis in this section, we calculated the average across all four time horizons for each question, and then calculated the average across the three questions, to reach an average optimism score for non-COVID health issues. We then correlated this overall score with the absolute and relative risk perception scores for our three questions. A clear picture emerged: the overall optimism score was not related to absolute risk perception for the COVID risk perception questions, but showed a significant and positive correlation with relative risk perception. In other words, people seem to have an overall optimism bias profile that applies to COVID-related questions.

Media consumption

A final potential influence on risk perception that we assessed is how much media people consume about COVID. For *Get COVID*, absolute risk perception increased with more media consumption ($r = 0.1384$, $p = 0.0040$), but there was no relationship between media consumption and relative risk perception ($r = 0.0556$, $p = 0.2492$). For *Infect Others*, there were no significant relationships between risk perception and media consumption (absolute: $r = 0.0301$, $p = 0.5325$; relative: $r = 0.0276$, $p = 0.5670$). For *Severe Symptoms*, absolute risk perception increased with more media consumption ($r = 0.1362$, 0.0046), but relative risk perception decreased with more media consumption ($r = -0.1030$, $p = 0.0324$). It should be added that for media consumption the direction of causality could go either way: people might believe there to be a higher risk of getting infected because they consume more media, or they might be at an objectively higher risk of getting infected, and therefore follow media reports on the topic more closely.

3.3. Potential consequences of risk perception

Having described risk perception and potential influences, we now turn to the consequences of risk perception. What does risk perception (potentially) lead to? Initially, we intended to predict adherence to protective measures (physical distancing and hand washing) from risk perception. We preregistered the hypothesis that optimism bias at T1 for *Get COVID* and *Infect Others* would correlate negatively with hygiene measures and the reduction of physical contacts at T2. As with the previous sections, we also planned on expanding this hypothesis to T3 (i.e., correlating risk perception at T2 with protective measures at T3). Unexpected ceiling/floor effects, however, precluded us from running these analyses (see below): our participants reported almost complete adherence to protective measures such that the variance in the data is not sufficient for a meaningful correlation.

Reduction of physical contacts

In our preregistration, we hypothesised that risk perception at T1 would negatively predict adherence to protective measures at T2. To test this, we specified to correlate optimism bias at T1 for *Get COVID* and *Infect Others* with the subjective reduction of physical contacts since the beginning of the pandemic. During data analysis, however, we realised that without an objective baseline, it is unclear what this difference actually measures: if someone does not report a reduction of physical contacts, is this due to them not wanting to, or due to them not being able to reduce contacts (for example because they have to care for their elderly parents, or because they already have no contacts)? Thus, we added a different question at T2 and used this one instead to assess the reduction of physical

contacts: participants reported on how many days per week they had physical contacts with people, for their usual life before the pandemic and for their lives during the pandemic, both times separately for the six social contexts (family, friends, colleagues, strangers during leisure activities, strangers during travel, strangers doing chores such as commuting and grocery shopping). This provides a baseline (pre-COVID), the number of contacts during the pandemic, and their difference. In the following, we use this question to assess reduction of physical contacts during the pandemic.

At T2 (almost identical for T3), the vast majority of participants reported zero days with physical contacts for the contexts 'friends' (68%), 'colleagues' (70%), 'recreation' (76%), and 'travel' (82%). For public chores (which includes commuting and grocery shopping), the distribution is also skewed, albeit less than the other four contexts mentioned above (70% report zero or one day with physical contacts). The context 'family' shows a bimodal distribution, such that around 70% of people report either zero physical contacts (34%) or daily physical contacts (32%) with their family members Thus, almost all participants reported reducing their physical contacts as far as possible (see **Appendix I** for figures).

Due these floor effects, the difference ($Contacts_{Normal}$-$Contacts_{COVID}$) is almost identical to the pre-COVID numbers (because for most participants and most contexts, zero is subtracted). Thus, the amount contacts pre-COVID and the reduction of contacts during COVID (i.e., the difference) show very high correlations (Rs of ~0.7-0.8 for friends, colleagues, recreation, and travel). Thus, taking the difference between pre-COVID and during COVID does not measure the reduction of physical contacts in a meaningful way. Everyone reduced as much as they could. While this might be good for society (and was in part due to governmental restrictions), this lack of variability in physical reductions precluded us from assessing the relationship between risk perception and reduction of physical contacts.

Hygiene behaviour

Similar to the reduction of physical contacts, we originally planned to correlate risk perception with adherence to hygiene recommendations. But the item *Hygiene* is also heavily skewed, such that at T2 42% of participants selected the maximum score (100 out of 100), and 55% selected a score of at least 95 (see **Appendix J**). Given that there still many people who did not select the maximum (or close to the maximum), we grouped participants: those who claim to abide entirely or almost entirely by the hygiene recommendations (>= 95%), and everyone else (<95%). Instead of correlating hygiene with risk perception, we compared those two groups, testing whether there were differences in risk perception at T1/2 for those who report >= 95%/<95% adherence to hygiene recommendations at T2/3.

Comparing absolute and relative risk perceptions, only one test was statistically significant at the p = 0.005 level as preregistered, but this would no longer be significant when correcting for multiple comparisons (see **Appendix J** for the results to all tests).

3.4. Replication

In addition to the longitudinal data from Sample 1, we also collected cross-sectional data from new samples at each time point (Samples 2-4). We have not yet analysed this dataset and will use it to test whether the results reported here replicate. To do so, we will write a preregistration based on this preprint and systematically attempt to replicate all analyses, if possible (some analyses, such as predicting adherence to protective measures from risk perception requires within-participant

longitudinal data and cannot be attempted to replicate with these samples). These replication efforts will be reported in the final publication of this paper.

4. Discussion

To successfully avert the COVID-19 pandemic, citizens need to abide by protective measures, such as reducing physical contacts, disinfecting hands, and wearing masks. Their willingness to actually adhere to such guidelines might depend on their risk perception of the situation. During the first 2 months of the pandemic, we asked people in Germany, the UK, and the USA to rate perceived risks for COVID-19, engagement with protective measures, and various related factors. Overall, several main findings emerged:

First, most participants reported almost complete engagement with protective measures, such that most participants reported an almost complete reduction in physical contacts, and complete adherence to maintaining hygiene recommendations, such as washing hands frequently.

Second, participants based their absolute risk perceptions in large part on the knowledge publically available at the time (such as a higher incidence of severe symptoms for older people). Overall, it seems as if our participants were aware of the relevant factors for COVID-19: the relationship between *Get COVID*, *Infect Others*, and *Severe Symptoms* on the one hand with possible predictors such as age, gender, and general health on the other hand all matched the known risk factors associated with COVID-19. Thus, although COVID-19 is a new disease, and information was sparse and changed over time, it seems as if our participants were well informed about possible risks. In addition, personal factors such as a general optimism bias, seemed to also play a role in determining people's risk optimism about COVID-19. These absolute risk perceptions varied quite drastically over time, with a strong reduction from T1 (16.03.2020) to T2 (01.04.2020).

Third, people showed a strong comparative optimism bias with respect to getting infected with COVID-19, and for infecting others (if infected themselves); this bias was not present for the probability of getting severe symptoms. The biases seem stable over time during our data collection, despite absolute risk perception changing during the same time. An interesting and unexpected observation is that the strength of the comparative optimism scores differed between the three questions about the personal impact of COVID-19: *Infect Others* had the largest effect, followed by *Get COVID*; *Severe Symptoms* had no comparative optimism bias. A speculative interpretation of these results might be that the strength of one's comparative optimism relates to the perceived control over the outcome: while it is possible to almost guarantee to not infect someone else if infected with COVID oneself (one can stay at home alone almost all the time, always disinfect hands, and always wear a mask when buying groceries), one has less control over whether one will get infected if one has to leave the house for necessary trips such as buying groceries (even when doing the same as above, one cannot control whether a stranger will cough in one's face without wearing a mask themselves), and for getting severe symptoms if infected, at the time of data collection there was no vaccine and no cure for COVID-19, such that the probability of experiencing severe symptoms if infected could not be changed. It thus seems possible that this perceived sense of agency over the outcome might have affected to what extent people showed comparative optimism. Additionally, participants showed a similar ranking of optimism biases for other questions. Thus, our exploratory results seem to show that perceived sense of control might affect to what extent (if at all) one experiences an optimism bias.

When comparing our findings to those of similar studies, there are substantial similarities: for example, Wise et al. (2020), Raude et al. (2020), and Globig et al. (2020), all found evidence for comparative

optimism for getting infected with COVID-19. One notable difference between our findings and those of the existing literature is the change of the optimism bias over time: while Wise et al. found that the optimism bias for getting infected with COVID-19 reduced during the early stage of the pandemic, we found no evidence for such a reduction. In our study, none of the comparative optimism biases changed over time. There might be a simple explanation for this difference: while Wise et al. collected data from 11.03 until 16.03, our data collection started on 16.03. Thus, the last day in the Wise et al. study is the first day in our study. It is possible that for our participants there was a reduction in optimism bias in the week before our data collection started, which then remained stable thereafter. It is thus possible that had we begun data collection a week earlier we would also have found a reduction in optimism bias in the beginning. Globig et al. (2020) also found that people's sense of agency predicted comparative optimism bias, which supports our exploratory results that sense of control might explain the differences between the comparative optimism scores for *Infect Others*, *Get COVID*, and *Severe Symptoms* and influence optimism biases in general. As far as we're aware, there is currently no study that has assessed optimism bias with respect to infecting other people. In that light, it is particularly noteworthy that the optimism bias for *Infect Others* is the strongest one related to COVID in our study.

Our study has strengths and weaknesses. While we collected data in three countries that are largely similar (all are WEIRD (Henrich et al., 2010)), but had different governmental reactions to the pandemic, and different trajectories for the case numbers, we do not have enough participants in each country to make particularly valid claims about the differences between each country on a nuanced level (e.g., how county/state-wide regulations affected people's beliefs and behaviours). Larger samples and more frequent data collection in each country would have been useful to study the effects of local regulations. Further, our samples are not representative (with respect to age and gender; we did not measure SES, political affiliation, etc.), and it would be advisable for future studies to use representative samples from different cultures to draw stronger conclusions about how well findings generalise within and between populations. At the time of the first data collection, it was also not known widely that wearing facemasks would play such a pivotal role in reducing transmission, such that we did not ask people about wearing masks at the first two time points (but we added it at T3). Considering how contentious mask wearing became in the proceeding months in some places, it would have been interesting to see how its use in our samples changed over time. While in hindsight it seems obvious that covering one's airways is a sensible way to stop an airborne disease, when we began data collection there was a much larger focus on hand washing and hand disinfecting, which is why even at T3 we considered face masks an additional item (as part of hygiene measures), rather than a separate question. In hindsight, it would have been better to ask for each hygiene-related item separately, rather than as part of the same question. Finally, asking specific questions about physical contacts in different social contexts lead to more reported physical contacts than asking a global question about physical contacts in general, and it would have been advisable to use this approach for more of our questions (such as individual questions about hygiene). On the plus-side, at each time point, we collected both a rich data set with many questions for exploratory analyses, as well several independent data sets that we will use to replicate our own findings. This ability to test which of our findings replicate is particularly crucial considering that world-wide pandemics do not occur particularly frequently, such that replications cannot be done at will. Due to our additional data sets, we are able to do test which of our exploratory findings replicate and these replication attempts will be included in the final publication.

5. Appendix

A: Demographics for all samples

Sample	Time point	Country	N	Age: mean (SD), range	Gender: % female/male/other
Sample 1 (Within)	T1-3	Total	432	33.3 (11.3), 18-81	62.5/37.0/0.5
		UK	206	35.8 (11.6), 18-71	74.3/25.2/0.5
		USA	91	32.5 (12.6), 18-81	61.5/37.4/1.1
		Germany	135	30.0 (8.9), 18-60	45.2/54.8/0.0
Sample 2 (Between)	T1	Total			
		Germany			
		UK			
		USA			
Sample 3 (Between)	T2	Total			
		Germany			
		UK			
		USA			
Sample 4 (Between)	T3	Total			
		Germany			
		UK			
		USA			

Table 1 –Demographics for Sample 1. The demographics for Samples 2-4 will be added after running the replication analyses

B: All questions asked in the survey

Below is a table with all questions we asked in this study. If a questions contains '<u>you</u>', then that question was also asked for the average person similar to the participant (someone living in the same area, more or less the same age, and of the same biological sex).

For questions with continuous options (e.g., '0-100'), the following words in parentheses (e.g., '(Definitely not – Definitely)') indicate the extremes of the scale.

'T1-3' indicates that the question was asked during all three time points, 'T2-3' indicates that the question was not asked during the first time point, but at the second and third, and 'T3' indicates that the question was only asked during the last time point.

<u>1: Risk perception for COVID</u>			
Question	Question items	Scale or options for answers	Time
What do you think is the probability that *<u>you</u>* will be infected with the new corona virus …	…in the next 2 weeks? …in the next 2 months? …in the next year? …in your lifetime?	0-100 (Definitely not – Definitely)	T1-3
If *<u>you</u>* were infected with the new corona virus, how probable would it be that *<u>you</u>* transmit the virus to ...	...a family member? ...a friend? ...a work colleague? ...a stranger during recreational activities in public spaces (e.g. eating at restaurants, going to concerts or sporting events)? …a stranger during travelling for leisure? …a stranger during commuting to work or shopping necessities?	0-100 (Not at all – Definitely)	
If *<u>you</u>* were to be infected with the new corona virus, how probable would it be that *<u>you</u>* get ...	...only mild symptoms that would not be worse than a mild flu? ...severe symptoms that would require a hospital stay?		
<u>2: Control questions for optimism</u>			
Question	Question items	Scale or options for answers	Time
What do you think is the probability that *<u>you</u>* will break a bone in an accident ...	…in the next 2 weeks? …in the next 2 months? …in the next year? …in your lifetime?	0-100 (Definitely not – Definitely)	T1-3
What do you think is the probability that *<u>you</u>* will be infected with the flu (i.e., influenza)...			
What do you think is the probability that *<u>you</u>* will get a sexually transmitted			

disease (STD) such as chlamydia, gonorrhoea, HIV/AIDS, etc...			
How probable are *you* to suffer indirectly from the spread of the new corona virus? That is, how probably is it that *you* will need to ...	...see a doctor due to a different disease and be denied treatment? ...stay at a hospital due to a different disease and be denied treatment?	0-100 (Not at all – Definitely)	
3: Adherence to protective measures			
Question	Question items	Scale or options for answers	Time
To avoid the spread of the new corona virus, how much have *you* reduced the following activities or are *you* planning to do so within the next weeks *of your own accord* (i.e., not because of government regulations or because certain places are closed, but because *you* decided to)?	Meeting family members Meeting friends Meeting a work colleagues Recreational activities in public spaces (e.g. eating at restaurants, going to concerts or sporting events) Travelling for leisure Commuting to work or shopping necessities	0-100 (Not at all – Very much)	T1-3
How much do you think that *you* are or will be *forced* to reduce the following activities within the next weeks (because of government regulations or because certain places are closed)?			
To what extent…	…do you follow hygiene recommendations (e.g., handwashing and wearing a face mask in public)?	0-100 (Not at all – Completely)	T1-3 [masks added at T3]
Compared to usually (before the Corona-pandemic), how much did you voluntarily reduce physical contacts in the past week with…	…family members? …friends? …work colleagues …strangers during recreational activities in public spaces (e.g., eating at restaurants, going to concerts or sporting events)? …strangers during travelling for leisure? …strangers during commuting to work or shopping necessities?	0-100 (Not at all – Completely)	T2-3
Compared to usually (before the Corona-pandemic), how much were you forced to reduce physical contacts in the past week with…			

In a normal week <u>before</u> the Corona-pandemic, on how may days per week did <u>you</u> usually have direct physical contact with… During the <u>last week</u> on how many days did <u>you</u> have direct physical contact with…	...a family member? ...a friend? ...a work colleague? ...a stranger during recreational activities in public spaces (e.g. eating at restaurants, going to concerts or sporting events)? …a stranger during travelling for leisure? …a stranger during commuting to work or shopping necessities?	0-7	
<u>4: Mental health</u>			
Question	Question items	Scale or options for answers	Time
Do you think that *<u>your</u>* life will suffer (compared to before the Corona-pandemic) from corona-virus-related reductions in ... How much do *<u>you</u>* usually enjoy ...	...meeting family members? ...meeting friends? ...meeting work colleagues? ...recreational activities in public spaces (e.g. eating at restaurants, going to concerts or sporting events)? …travelling for leisure? …commuting to work or shopping necessities?	0-100 (Not at all – Very much)	T1-3
To what extent…	…does the current situation put <u>you</u> under stress and anxiety? …do <u>you</u> worry about <u>your</u> financial future and/or about losing <u>your</u> job?	0-100 (Not at all – Completely)	T2-3
In the <u>past week</u>, how much did <u>your</u> personal life suffer from corona-virus-related reductions in contacts with…	...family members ...friends ...work colleagues ...strangers during pleasurable events (e.g. restaurants, concerts sport events, etc.) …strangers during commuting or shopping …strangers during travelling		
Over the last weeks, how often have you been bothered by the following problems?	Little interest in doing things Feeling down, depressed or hopeless Feeling nervous anxious or on edge Not being able to stop or control worrying	- Not at all - Several days - More than half the days - Nearly every day	T3
Please answer the following statements	I am most afraid of the Coronavirus It makes me uncomfortable to think about the Coronavirus My hands become clammy when I think about the Coronavirus I am afraid of losing my life because of the Coronavirus When watching news and stories about the Coronavirus, I become nervous or anxious	- Strongly disagree - Disagree - Neither agree nor disagree - Agree - Strongly agree	

	I cannot sleep because I'm worrying about getting the Coronavirus My heart races or palpitates when I think about getting the Coronavirus		
5: Demographics			
Question	Question items	Scale or options for answers	Time
Please enter your age in years			T1-3
What is your gender?		- Male - Female - Other	
What is your highest level of education (or equivalent)?		- No degree - GCSEs - A-levels - Bachelor's - Master's - Doctorate *Note: this question was changed to match the education system of each country; the options mentioned here are only for the UK*	
Where do you live?		- Country: - State: (only for USA) - City:	
Due to my level of English/German...		- I had no problems understanding the questions - I had some problems understanding the questions - I had frequent problems understanding the questions	
6: General control questions			
Question	Question items	Scale or options for answers	Time
How many people do you directly know who are/were definitely		- 0 - 1	T1-3

infected with the new corona virus?		- 2-5 - 5-20 - >20	
How many people do you know who know at least one person who is/was definitely infected with the new corona virus?			
How many people do you directly know who have died due to the new corona virus?			T2-3
How would you describe *your* overall health?		- Very poor - Poor - OK - Good - Very good	T1-3
If you know anyone who has been infected with the Coronavirus, how close do they live to you? (Select all that apply)		- Same flat - Same house - Same neighbourhood - Same city - Same country	T2-3
Which of the following is a symptom of the new corona virus? If you are unsure about an item, answer in the middle of the range (50%).	Cough Fever Runny nose Diarrhoea Headache Rash Restlessness Fatigue Difficulty breathing Sore throat	0-100 (Definitely not – Definitely)	T1-3
Have you had any of these symptoms in the past month?		- No - Yes	
Have you been tested for an infection with the new corona virus?		- No, I have <u>not</u> been tested - Yes, I have been tested. <u>I am not infected</u> - Yes, I have been tested. <u>I am infected</u>	
Do you live (select all that apply)…		- Alone - With your children - With your partner - With your parents - In a flatshare - Other	T2-3
Do you have a spouse/romantic partner?		- Yes - No	

7: Other			
Question	Question items	Scale or options for answers	Time
Usually, how often do *you* have direct physical contacts with ...	...family members? ...friends? ...work colleagues? ...strangers during recreational activities in public spaces (e.g. eating at restaurants, going to concerts or sporting events)? …strangers during travelling for leisure? …strangers during commuting to work or shopping necessities?	0-100 (Not at all– Very often)	T1-3
To what extent…	...is it easy for *you* to minimise physical contact with others? ...do *you* deem it necessary to minimise physical contact with others? ...do *you* follow media reports on the current situation? ...do *you* have safe living conditions (e.g., housing, electricity, water, etc.)? ...do *you* trust the government to respond adequately to the situation? ...do *you* trust scientists to do their best in the current situation? ...do *you* think that the current situation reduces global warming? ...do *you* think that the social cohesion and solidarity in society in general will be reduced? …do *you* help others cope with the situation (e.g., run errands for elderly neighbours)?	0-100 (Not at all – Completely)	T1-T3
How much do you think the following statements are true for you if you were infected or are infected with COVID-19:	The government of my country did everything they could to prevent this from happening The local authorities did everything they could to prevent this from happening My employer/company I work for did everything they could to prevent this from happening My friends and family did everything they could to prevent this from happening I did everything I could to prevent this from happening	0-100 (Not at all - Completely	T2-3

Please indicate to what extent you agree with each statement	I am convinced that most people have good intentions You can't rely on anyone these days In general, people can be trusted	- Don't agree - Agree a bit - Agree somewhat - Agree mostly - Agree completely	T3
How likely do you think it is that…	…the UK [US/Germany] will get "back to normal" as it was before the Corona-pandemic within the next year …there will be a "second wave" in the UK [US/Germany] with renewed restrictions?	0-100 (Not at all – Very)	

C: Figures for the control optimism bias questions

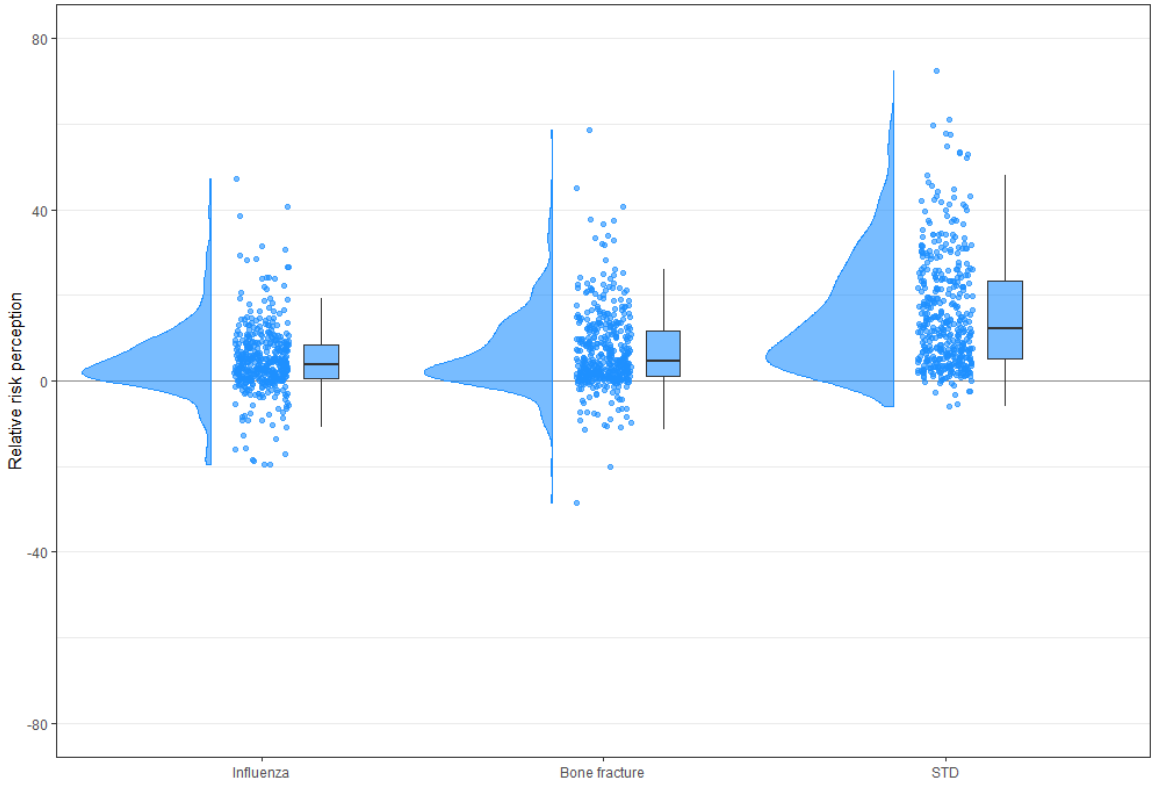

Figure 4 - Relative risk perception for the three control questions (probability of getting influenza, breaking a bone, or getting an STD). For each question, we averaged both across the four time horizons (next 2 weeks, next 2 months, next year, lifetime), and across the three time points (T1-3).

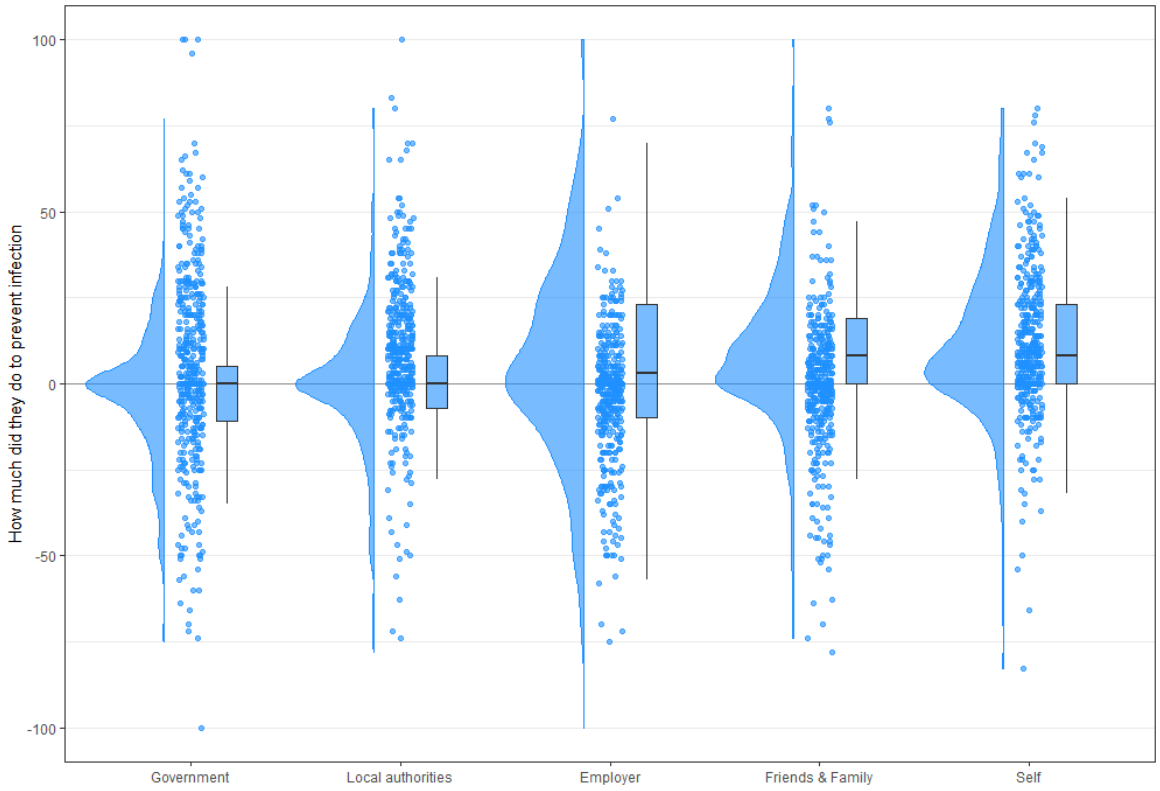

Figure 5 – Relative judgments (self-other) for the question 'If you were to get infected with COVID, how much did X to do prevent this from happening', where X is each of the contexts specified on the x-axis. All questions are for T3.

D: Figures for personal risk factors and risk perception

Age:

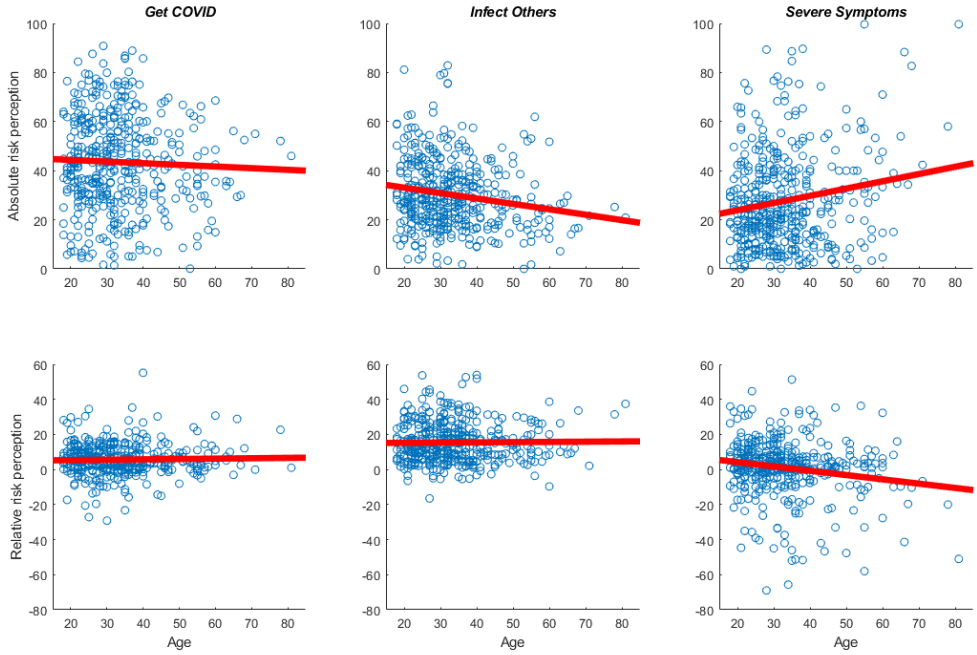

Figure 6 - Scatter plots for age, and absolute and relative risk perception for the three COVID-related risk perception questions. The red line displays the least squares line. For Get COVID *and* Infect Others*, we averaged across each sub-item (*Severe Symptoms *was a single-item question). For each question, we averaged across the three time points (T1-3).*

Gender:

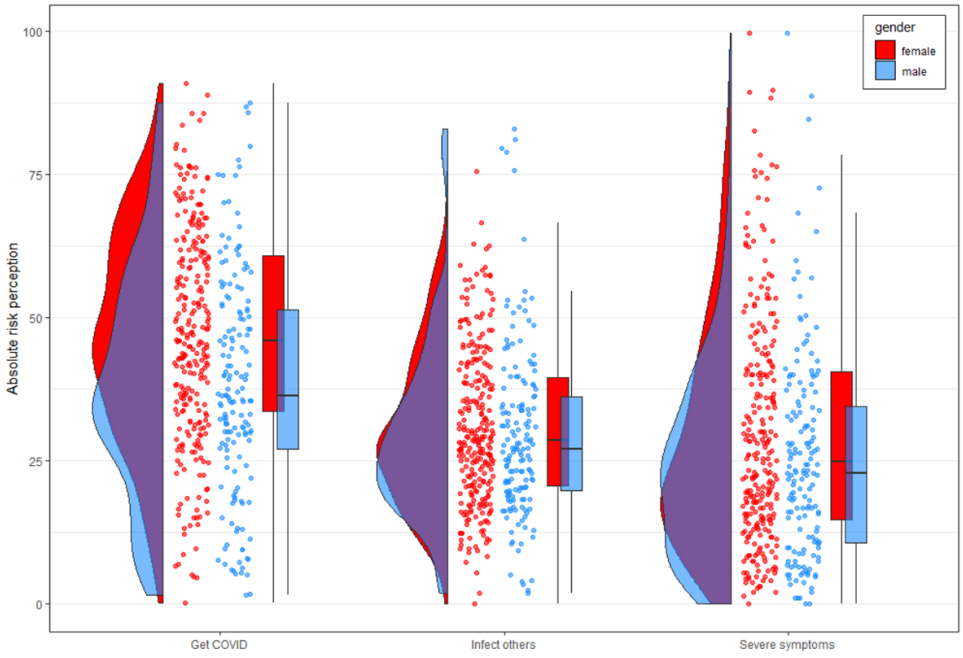

Figure 7 - Absolute risk perception for the three COVID-related risk questions, separately for women (red) and men (blue); only 2 people selected 'other' and were excluded from this analysis due to limited sample size. For Get COVID *and* Infect Others*, we averaged across each sub-item (*Severe Symptoms *was a single-item question). For each question, we averaged across the three time points (T1-3).*

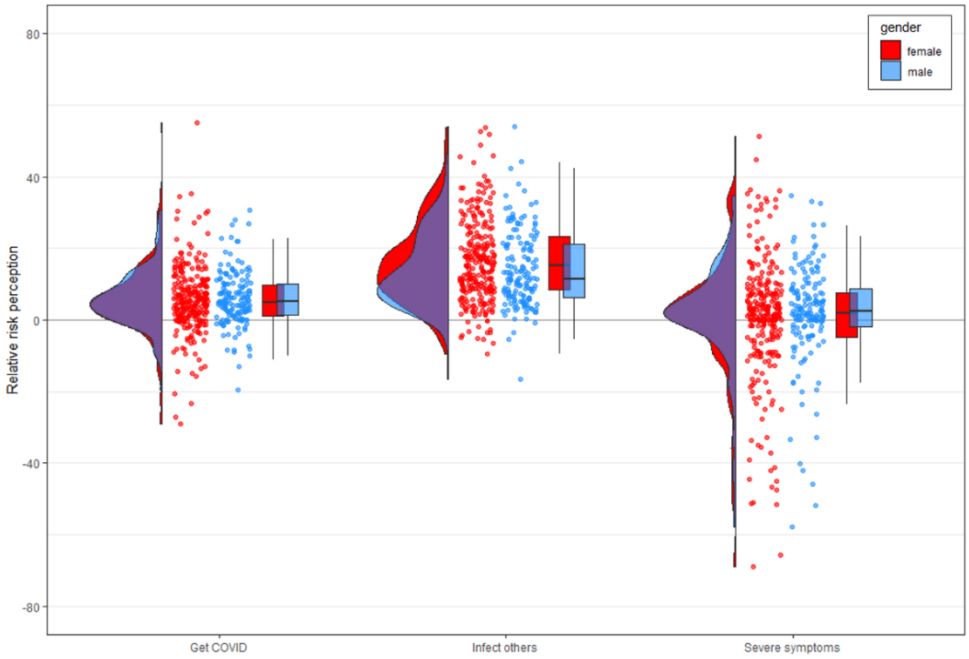

Figure 8 - Relative risk perception for the three COVID-related risk questions, separately for women (red) and men (blue); only 2 people selected 'other' and were excluded from this analysis due to limited sample size. For Get COVID *and* Infect Others*, we averaged across each sub-item (*Severe Symptoms *was a single-item question). For each question, we averaged across the three time points (T1-3).*

Overall health:

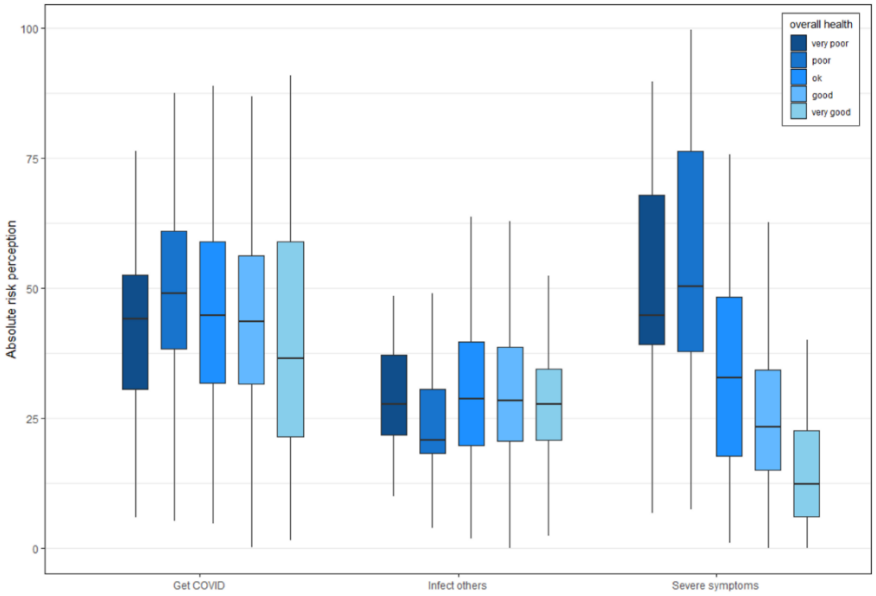

Figure 9 - Absolute risk perception for the three COVID-related risk questions, separately for the five response options for overall health from Very Poor (darkest blue) to Very Good (lightest blue). Note that only seven people selected Very Poor and were excluded from the main analysis; but we represent them here for completeness. For Get COVID *and* Infect Others*, we averaged across each sub-item (*Severe Symptoms *was a single-item question). For each question, we averaged across the three time points (T1-3). Box plots display the minimum and maximum (end of the lines), the first and third quartile (end of boxes), and the median (horizontal line within the box).*

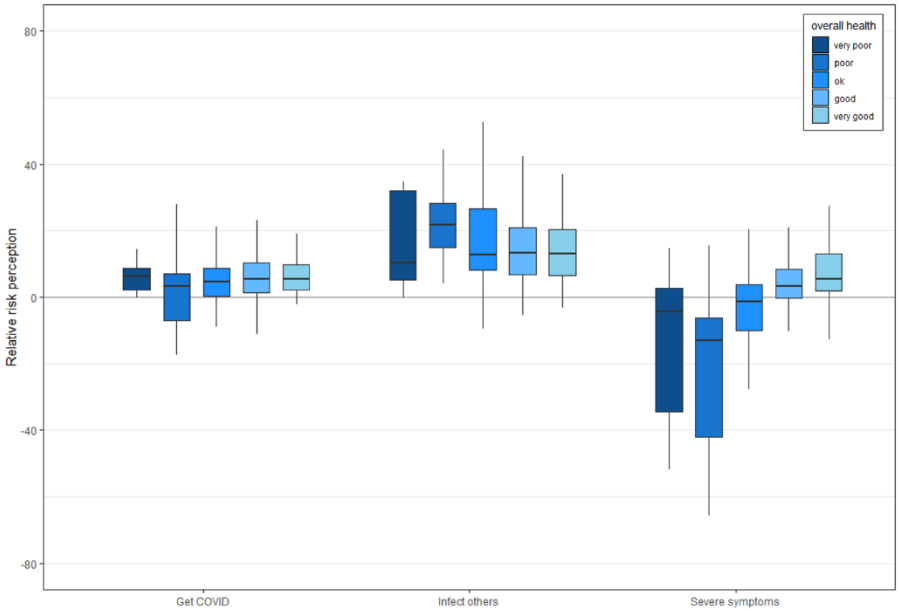

Figure 10 - Relative risk perception for the three COVID-related risk questions, separately for the five response options for overall health from Very Poor (darkest blue) to Very Good (lightest blue). Note that only seven people selected Very Poor and were excluded from the main analysis; but we represent them here for completeness. For Get COVID *and* Infect Others*, we averaged across each sub-item (*Severe Symptoms *was a single-item question). For each question, we averaged across the three time points (T1-3). Box plots display the minimum and maximum (end of the lines), the first and third quartile (end of boxes), and the median (horizontal line within the box).*

E: Differences between countries

		df	H	p
Get COVID	Absolute	2	5.39	0.0676
	Relative	2	2.77	0.2505
Infect Others	Absolute	2	0.89	0.6415
	Relative	2	9.50	0.0087
Severe Symptoms	Absolute	2	2.82	0.2438
	Relative	2	0.08	0.9612

Table 2 - Results for the Kruskal-Wallis tests comparing absolute and relative risk perception across the 3 countries in our sample

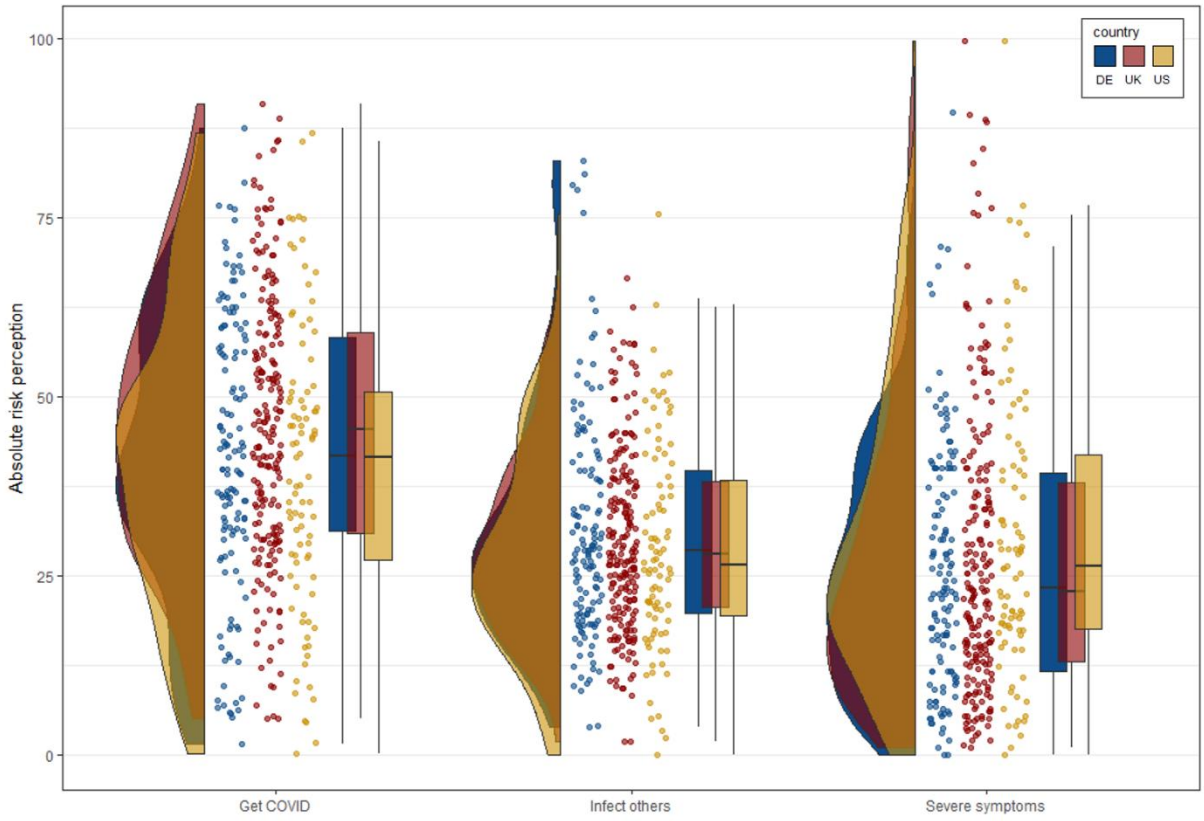

Figure 11 - Absolute risk perception for the three COVID-related risk questions, separately for the three countries: Germany (blue), UK (red) and USA (beige). For Get COVID *and* Infect Others*, we averaged across each sub-item (*Severe Symptoms *was a single-item question). For each question, we averaged across the three time points (T1-3).*

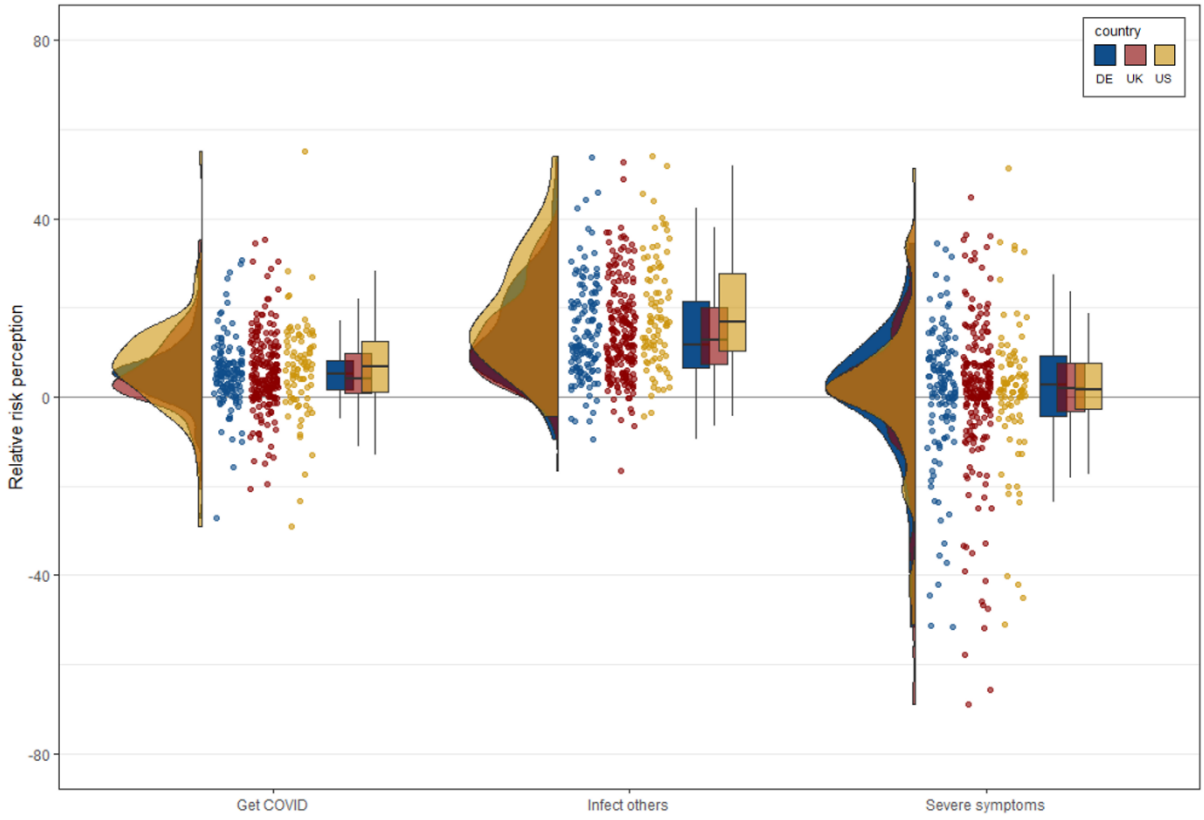

Figure 12 = Relative risk perception for the three COVID-related risk questions, separately for the three countries: Germany (blue), UK (red) and USA (beige). For Get COVID *and* Infect Others*, we averaged across each sub-item (*Severe Symptoms *was a single-item question). For each question, we averaged across the three time points (T1-3).*

F: Proximity to infections and deaths, counts

Number of people in each question and time point		0	1	2-5	5-20	>20
Infections, known directly	T1	410	18	4	0	0
	T2	320	67	44	1	0
	T3	265	72	84	11	0
Infections, known indirectly	T1	305	69	49	6	3
	T2	206	92	109	23	2
	T3	155	99	129	44	5
Deaths, known directly	T2	414	16	1	1	0
	T3	373	42	15	2	0

Table 3 - Participants were asked how many people they knew (in)directly who had gotten infected/had died from the coronavirus. There were five possible responses: no one, 1 person, 2-5 people, 5-20 people, and more than 20 people. The question about deaths was added at T2.

G: Proximity to infections and deaths, table of analyses

		df	t	p	d
Get COVID, absolute	Infect, direct	344.7148	-4.2254	<0.001	-0.420
	Infect, indirect	312.6090	-3.6004	<0.001	-0.364
	Death	79.8508	-3.0682	0.0029	-0.413
Get COVID, relative	Infect, direct	338.5211	1.9259	0.0550	0.193
	Infect, indirect	319.7371	2.0392	0.0422	0.204
	Death	78.9925	-0.4172	0.6777	-0.057
Infect Others, absolute	Infect, direct	362.0417	-3.0322	0.0026	-0.297
	Infect, indirect	304.1634	-1.2691	0.2054	-0.129
	Death	85.6637	-0.4994	0.6188	-0.062
Infect Others, relative	Infect, direct	357.5308	1.3881	0.1660	0.137
	Infect, indirect	307.8576	2.0031	0.0460	0.203
	Death	86.3037	1.8352	0.0699	0.226
Severe Symptoms, absolute	Infect, direct	317.5510	-0.3640	0.7161	-0.037
	Infect, indirect	315.1665	1.0956	0.2741	0.110
	Death	74.2288	-0.7827	0.4363	-0.117
Severe Symptoms, relative	Infect, direct	329.3319	1.7357	0.0835	0.175
	Infect, indirect	292.1939	0.6907	0.4903	0.071
	Death	73.4298	-0.0050	0.9960	-0.001

H: General optimism bias

		Rho	P
Get COVID	Absolute	0.0656	0.1735
	Relative	0.4222	<0.001
Infect Others	Absolute	0.0550	0.2537
	Relative	0.4271	<0.001
Severe Symptoms	Absolute	0.0867	0.0719
	Relative	0.1889	<0.001

Table 4 - The correlations between the overall optimism score (average across influenza, bone fracture, and STD) and each of the risk perception questions about COVID

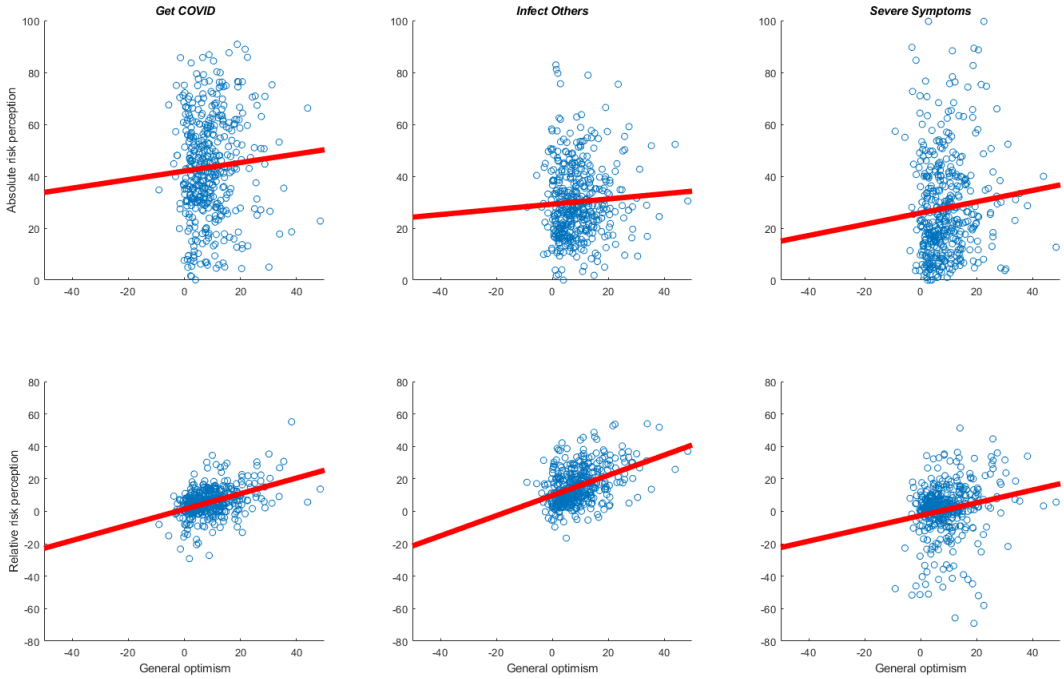

Figure 13 - Scatter plots for general optimism and the three COVID-related risk perception questions. For visualisation, we fit a least-squares regression line. For Get COVID *and* Infect Others*, we averaged across each sub-item (*Severe Symptoms *was a single-item question). For each question, we averaged across the three time points (T1-3).*

I: Subjective reduction of physical contacts is highly skewed

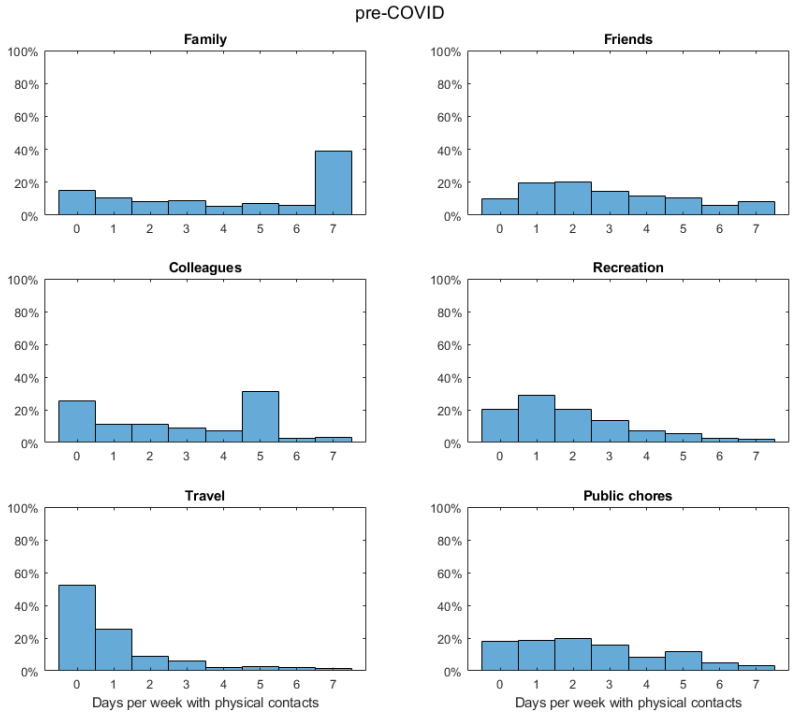

Figure 14 - Proportions of the number of days per week during which participants had physical contacts pre-COVID. All questions here are from T2, but those for T3 are very similar

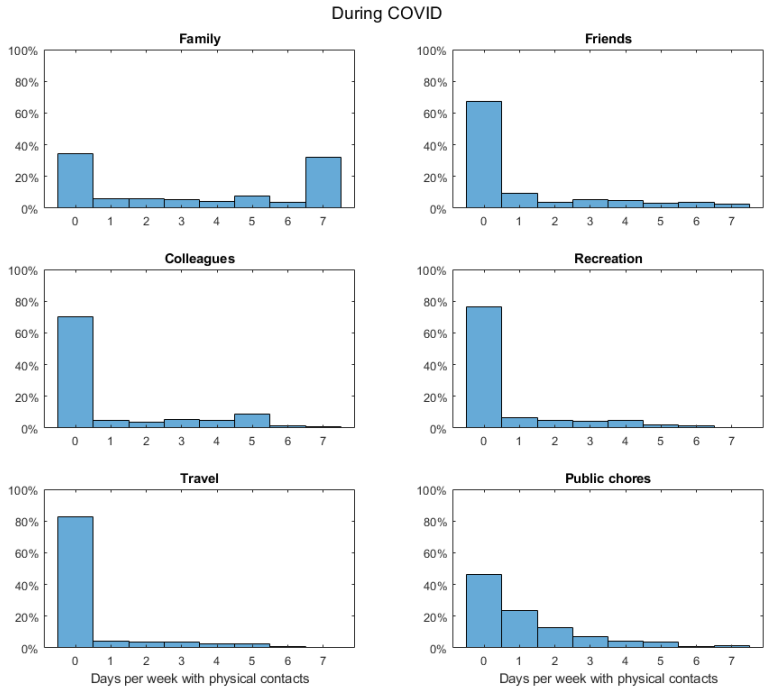

Figure 15 - Proportions of the number of days per week during which participants had physical contacts during COVID. All questions here are from T2, but those for T3 are very similar

J: Hygiene is highly skewed

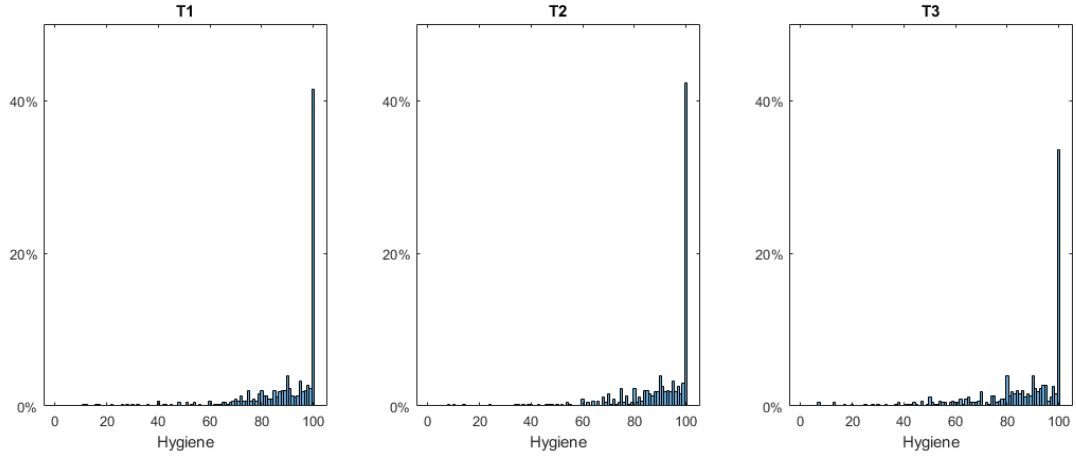

Figure 16 - Proportions of how much people abide by the hygiene recommendations, separately for each time point. The slight drop at T3 is likely due to us adding 'wearing face masks' as an example, rather than people sticking less to the previous examples of hand washing and disinfecting

	Risk		Hygiene	df	t	p	d
Get COVID	T1	Absolute	T2	426.0557	-0.4558	0.6487	-0.0437
		Relative		429.4655	0.1396	0.8890	0.0132
Infect Others		Absolute		423.8184	-0.0500	0.9601	-0.0048
		Relative		429.4992	1.7546	0.0800	0.1672
Severe Symptoms		Absolute		429.7794	0.5375	0.5912	0.0512
		Relative		429.3459	0.9178	0.3592	0.0869
Get COVID	T2	Absolute	T3	366.9361	0.7705	0.4415	0.0763
		Relative		323.7123	1.1252	0.2613	0.1143
Infect Others		Absolute		352.7039	0.3145	0.7534	0.0314
		Relative		369.4212	2.9674	0.0032	0.2933
Severe Symptoms		Absolute		338.1592	2.8203	0.0051	0.2841
		Relative		336.5334	-1.3703	0.1715	-0.1381

Table 5 - Results from comparing risk perceptions for those who report >=95% and those who report <95% adherence to hygiene guidelines

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