1 **Mapping motivational bias in recalling the SARS-CoV-2 pandemic**

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How people recall the SARS-CoV2 pandemic is likely to prove crucial in future societal

debates on pandemic preparedness and appropriate political action. Beyond simple forgetting,

recall may be distorted by strong motivations and anchoring perceptions on the current

situation. Although there is evidence of polarization in how vaccinated and unvaccinated

people perceived the ongoing situation during the SARS-CoV2 pandemic, it remains unclear

how these differences affect recall. Here, based on four studies across 11 countries (total $N =$

11,148), we show that recall of perceived risk, trust in institutions and protective behaviours

depended strongly on current evaluations. While both vaccinated and unvaccinated

individuals were affected by this bias, people who identified strongly with their vaccination

status—whether vaccinated or unvaccinated—tended to exhibit greater and, importantly,

opposite distortions of recall. Biased recall was not reduced by providing information about

common recall errors or small monetary incentives for accurate recall but partially by high

incentives. Thus, it seems that motivation and identity influence the direction in which the

recall of the past is distorted. Biased recall was further related to the evaluation of past

political action and future behavioural intent, including adhering to regulations during any

future pandemics or punishing politicians and scientists. Taken together, the findings indicate

that historical narratives about the COVID-19 pandemic are motivationally biased, sustain

societal polarization and affect preparation for future pandemics. The fact that negative ex-

post evaluations of the pandemic are accompanied by anti-system tendencies and a desire to

punish suggests that future measures must look beyond immediate public health implications

to the longer-term consequences for societal cohesion and trust.

Main Text

44   Since most pandemic restrictions were lifted in early 2023, many societies have been

45   transitioning to a post-pandemic phase.[1] This includes an evaluation of the appropriateness of

46   the measures employed and efforts made to enhance future pandemic preparedness. Any such

47   evaluation necessarily depends on accurate recall of factual data and subjective interpretations

48   at the time (e.g. infection rates and associated risk perceptions). While this information is

49   available from large-scale surveillance and survey data gathered during the pandemic,[2] such

50   evaluations are also influenced by public and media discourses, which are often tinted by

51   personal perceptions and memories. As memory formation is a constructive process,

52   retrospective narratives about historical events such as the pandemic are at risk of significant

53   distortion.[3] Beyond simple forgetting, recall and ex-post evaluation are prone to various forms

54   of bias, reflecting differences in motivation and purpose (e.g. a wish to conform with one's

55   own or prevailing opinion).[3–5] For example, people are more likely to remember true or false

56   information from the past depending on pre-existing beliefs or prior behaviours in the context

57   of vaccination, political campaigns, or political riots.[6–8]

58   We argue here that recall and retrospective evaluations of the COVID-19 pandemic

59   are affected by ubiquitous bias.[9–11] Regardless of whether one complied with governments'

60   recommendations to get vaccinated or chose to remain unvaccinated, the pandemic incurred

61   high costs for everyone. When recalling past events or feelings, both vaccinated and

62   unvaccinated individuals may be subject to bias, motivated by self-affirmation and

63   consistency with today's beliefs, perhaps reinforcing the existing polarization based on

64   vaccination status and discrimination against those who differed in this regard.[12–14]

65   Here, we report four empirical studies exploring the nature and extent of bias in

66   individual historical narratives of the COVID-19 pandemic. Study 1 mapped the extent and

67   direction of recall bias within opinion-based groups and assessed the relationship with

68   evaluations of political action that took place during the pandemic. Studies 2 and 3

69   investigated the robustness of the bias in recall and evaluation vis-a-vis different mitigation

70   measures. Finally, Study 4 assessed the potential societal implications of this bias and the

71   generalizability of the findings across different countries.

72   **Assessing bias in recall and evaluation**

73   To assess the extent and direction of biased recall and evaluation, one must be able to reliably

74   compare current and past perceptions.[15] For the purposes of Study 1, we surveyed a sample of

75   German adults ($N = 1,644$) in late 2022. Of these, 74% had received at least one dose of a

76   COVID-19 vaccine. All respondents had previously been surveyed in summer 2020 or winter

77   2020/2021.[2] At both timepoints, they were asked about their current perceptions of risk (i.e.

78   infection probability and severity, affective risk), trust in government and science, frequency

79   of wearing masks and perceived exaggeration of the pandemic measures, as well as current

80   life satisfaction. In the 2022 survey, respondents were asked to recall their responses to the

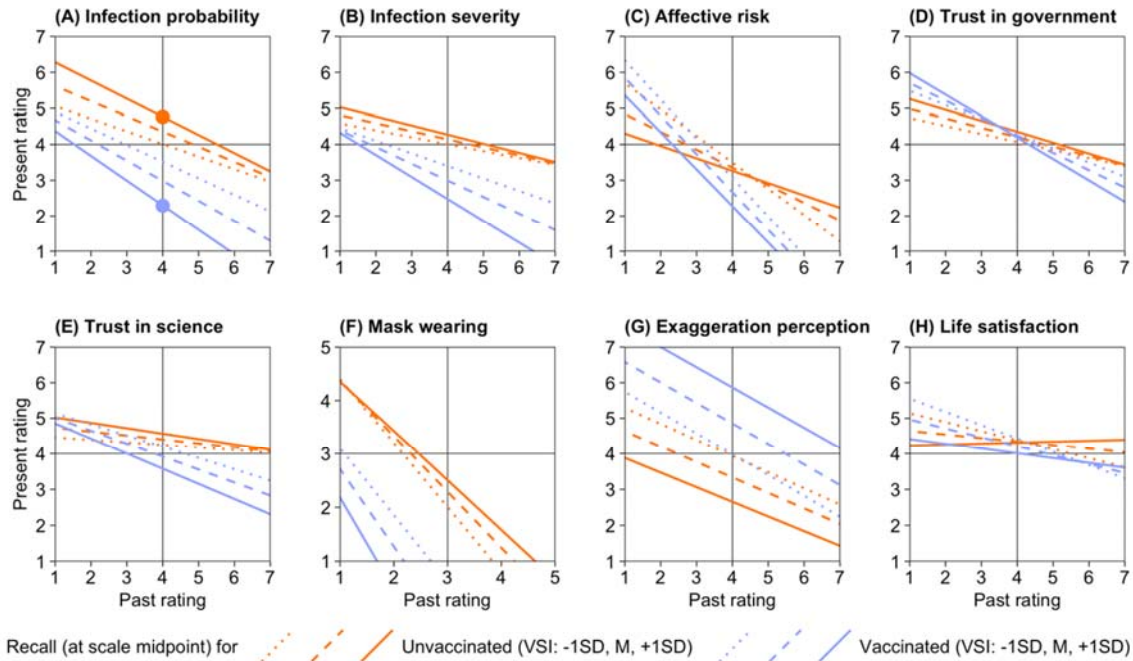81   same items as in the previous survey.

82   Based on their past and current perceptions and recall of the past, we estimated the

83   extent to which recall tended towards one end of the respective scale (directional bias) and the

84   extent to which recall was influenced by past or current perceptions.[15] Vaccination status and

85   vaccination status identification[13] were added as potential moderators in linear regressions.

86   Figure 1 shows how recall was influenced by past (x-axis) and present (y-axis) ratings of the

87   variable in question. A perfectly horizontal line would indicate that recall was influenced only

88   by the present rating; a perfectly vertical line would indicate that recall was influenced only

89   by the past rating. A line with a greater distance from the midpoint indicates a stronger

90   directional bias in recall.

91   Across a range of variables related to perceived risk, trust and behaviour, the findings

92   indicate that recall was strongly linked to current perceptions and that the direction of bias

93   differed according to vaccination status and identification with vaccination status (for

94   regression tables, see section S1.3.2 in the supplement). For example, Figure 1A shows that

95   unvaccinated individuals (orange lines) tended to recall the probability of infection as less

96   likely than was actually perceived in the past, as indicated by the line shifting upward away

97   from the midpoint. The tilting indicates that the judgement is influenced by the present

98   perception. Those who identify more strongly with their vaccination status (solid line) were

99   more prone to show this bias than those who weakly identify with their vaccination status

100   (dotted line), as can be seen by the greater shift away from the midpoint. In contrast,

101   vaccinated individuals (blue lines) tended to recall the probability of infection as higher than

102   previously perceived, as indicated by the shift away from the midpoint towards the bottom. It

103   is also affected by how they perceive the infection probability today, as indicated by the tilted

104   line. Again, greater identification with vaccination status was associated with more biased

105   recall—which is confirmed by an interaction effect of being vaccinated and identifying with

106   this status on recalled infection probability (standardized $\beta = 0.23$, $p < 0.001$; see S1.3.2.1 in

107   the supplement).

108   As a further indicator for the motivational basis of recall, individual evaluations

109   differed strongly in terms of whether political measures were perceived as appropriate (i.e.

110   justified, effective and based on an honest desire to protect citizens). A regression analysis

111   revealed that perceived overall appropriateness varied by vaccination status ($\beta = 1.32$, $p <$

112   0.001), vaccination status identification ($\beta = -0.42$, $p < 0.001$) and their interaction ($\beta = 0.77$,

113   $p < 0.001$). For both vaccinated and unvaccinated individuals, appropriateness was rated as

114   medium when identification was low. However, evaluations were increasingly positive among

115   the vaccinated and increasingly negative among the unvaccinated as vaccination status

116   identification increased (for details, see section S1.4.2 in the supplement). These results

117   mirror the results for biased recall. In fact, individual appropriateness ratings related to the

118   extent of directional recall bias ($r = 0.24$, $p < 0.001$; individual estimation of directional recall

119   bias was based on multiple outcome variables; see Methods section for details). This indicates

120 that greater bias when recalling the past was associated with a more extreme evaluation of

121 political action—in either direction.

122

Recall (at scale midpoint) for ⋯ – — Unvaccinated (VSI: -1SD, M, +1SD)   ⋯ – — Vaccinated (VSI: -1SD, M, +1SD)

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124

125 **Figure 1. Biased recall of pandemic perceptions and behaviours in Study 1.**
126 *Note*: Each panel shows the results of a linear regression predicting individual recall of past perceptions based on
127 actual past ratings (x-axis) in 2020/2021 and present ratings (y-axis) in late 2022, as well as interactions with
128 vaccination status (colours) and vaccination status identification (VSI; dashed/dotted lines) of $N = 1,644$
129 participants. Each line indicates the predicted recall at a fixed value (scale midpoint, e.g. line represents recall =
130 4 for infection probability, recall = 3 for mask wearing, as predicted by past and present ratings). Direction and
131 strength of bias are indicated by the line's position relative to the midpoint of the scale; the angle indicates the
132 extent to which recall is influenced by past and present perceptions (the more tilted towards horizontality, the
133 more influenced by present ratings; the more tilted towards verticality, the more influenced by past ratings). Dots
134 in 1A illustrate the recall of the value 4 given the actual past rating of 4 for highly identified vaccinated and
135 unvaccinated people; a detailed example is provided in the text; see Methods section for more information on the
136 regression models. Regression tables are provided in section S1.3.2 in the supplement.
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138 **Attempts to reduce recall bias**

139 Assuming that recall and evaluation of the pandemic affect each other,[5] it seems important to

140 explore possible techniques for reducing memory distortion. To that end, Study 2 investigated

141 whether recall bias is reduced (i) when monetary incentives are introduced to encourage

142 accurate recall or (ii) when metacognitive information about widespread recall bias is

143   provided. Both incentives[16,17] and information[18,19] are known to instigate the correction of

144   one's own judgements in other domains.

145   As these techniques might have differing effects on vaccinated and unvaccinated

146   individuals, our sample included a disproportionally high percentage of unvaccinated

147   individuals[13] and reassessed 3,105 participants from Germany and Austria in January 2023

148   (71% of whom had received at least one dose of a COVID-19 vaccine). Before asking

149   respondents to recall their perceptions and behaviours from December 2021, they were

150   randomly assigned to one of two intervention conditions or a control group (no intervention).

151   To test the effect of incentives, participants were told that more accurate recall would

152   increase their chances of winning a cash prize: 100 euros were raffled among all participants,

153   and more accurate recall resulted in participating more often in the lottery. To test the effect

154   of metacognitive information on the existence of recall bias, participants were told about the

155   extent of this bias in others. Following these interventions, we tested participants' recall and

156   assessed their perceptions of the appropriateness of political action (as in Study 1).

157   The analysis used the same linear regression as in Study 1; the only difference was

158   that the experimental condition replaced vaccination status identification as a moderating

159   variable (for visual presentation and regression tables, including analyses with vaccination

160   status identification as additional predictors, see section S2.3 in the supplement). Across all

161   variables, the direction of recall bias again differed by vaccination status. Vaccinated

162   respondents tended to overestimate their previous risk perceptions and protective behaviours,

163   with main effects of being vaccinated on infection probability ($\beta = 0.30$, $p < 0.001$) and

164   severity ($\beta = 0.25$, $p < 0.001$) and avoiding contacts ($\beta = 0.33$, $p = 0.022$). Unvaccinated

165   respondents underestimated their previous trust in government and science, with main effects

166   of being vaccinated on trust in government ($\beta = 0.32$, $p < 0.001$) and trust in science ($\beta =$

167   0.28, $p < 0.001$). For mask wearing, no significant differences were found between vaccinated

168   and unvaccinated individuals ($\beta = 0.33$, $p = 0.122$). Importantly, recall accuracy was not

169   significantly improved by incentivizing accurate recall or providing information about

170   widespread bias. While the effects of both interventions and their interaction with

171   participant's vaccination status were negligible, equivalence tests indicated they were not

172   equal to zero as confidence intervals overlapped but also exceeded regions of practical

173   equivalence (ROPE; see section S2.3.2 in the supplement).

174   As stronger interventions may be more successful in correcting recall bias,[16] Study 3

175   investigated the effects of considerably higher incentives. In July 2023, 906 vaccinated

176   German participants were asked to recall their perceptions and behaviours from summer and

177   autumn 2021. Half of the participants were told that a more accurate recall would increase

178   their chances of winning a cash prize. Participants learned that one of their recall values was

179   randomly selected and compared with their past answer. When both were equal, they received

180   a bonus of 25 euros. The chance of winning the bonus decreased the more the recalled and the

181   true answer diverged (binarized scoring rule[20]).

182   The analysis utilized similar linear regressions as in the previous studies; the recall of

183   six variables was predicted by past and present answers, condition and their interactions with

184   condition. Figure 2 shows that while participants again overestimated past risk perceptions,

185   protective behaviours and trust in the government, recall of some variables improved when

186   incentives were offered (for regression tables, see section S3.2.3 in the supplement). For

187   example, the incentive improved the recall of mask wearing and trust in government, as it

188   reduced the influence of present perceptions (mask wearing: $\beta = -0.15$, $p = 0.021$; trust: $\beta = -$

189   0.12, $p = 0.025$) and increased the influence of past perceptions (trust: $\beta = 0.19$, $p < 0.001$).

190   For infection probability, even a main effect was found: directional bias was reduced when an

191   incentive was offered ($\beta = -0.25$, $p < 0.001$). Interestingly, the incentive also reduced recalled

192   exaggeration perceptions (main effect; $\beta = -0.21$, $p < 0.001$). Combining all six variables in a

193   mixed effects regression (controlling for multiple answers from the same individual) revealed

194   that offering an incentive decreased directional bias ($\beta = -0.07$, $p = 0.001$) and increased the

195   influence of past ratings (β = 0.07, *p* = 0.002), indicating a reduction of recall bias. As in

196   Studies 1 and 2, greater identification with vaccination status was associated with more biased

197   recall (see section S3.2.4 in the supplement).

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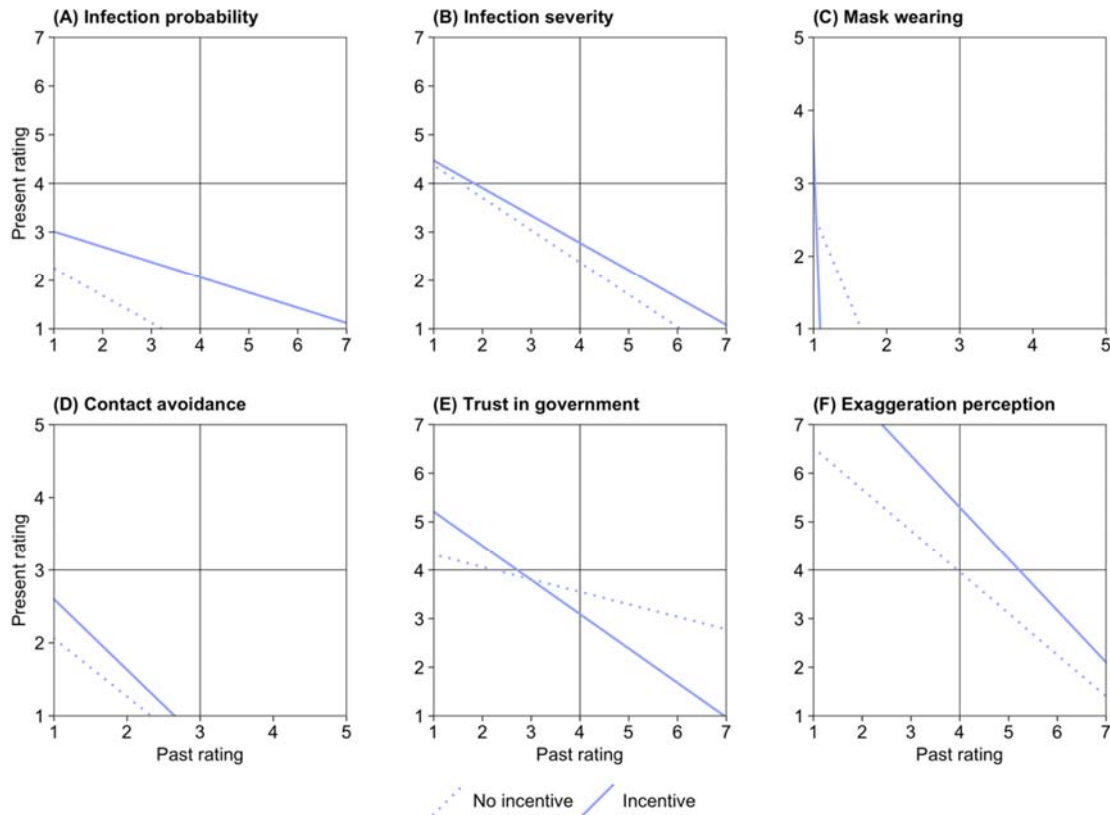
Figure 2. Effects of monetary incentives on reducing recall bias in Study 3.

Note: Each panel refers to a linear regression predicting individual recall based on past (summer and autumn 2021) and present (July 2023) ratings and their interactions with the experimental condition (*N* = 906 vaccinated individuals). Each line visualizes directional bias and how past and present perceptions affect recall at a fixed value (scale midpoint, i.e. recall = 4 for infection probability, recall = 3 for mask wearing) when recall was (not) incentivized in the experiment. Regression tables are provided in section S3.2.3 in the supplement.

206

207   As a neutral control item, participants were asked to recall the time of day when they

208   had participated in the survey in 2021. We assumed that there was no motivational basis for

209   distorting one's recall of this item. Indeed, while recall was positively related to the actual

210   time in 2021 (β = 0.21, *p* < 0.001) as well as the present time (β = 0.25, *p* < 0.001), these

211   influences did not interact with participants' identification with their vaccination status (see

212 supplement S3.2.5 for details). Importantly, for the control item, we found no significant

213 effect of the incentive on recall (the main effect of incentive was 50% in ROPE, the

214 interaction effect with past completion time was 66% in ROPE and the interaction effect with

215 current time was 100% in ROPE).

216   Overall, the results of Studies 2 and 3 indicate that biased recall is relatively stable.

217 Meta-cognitive information about common biases and minor incentives were not sufficient to

218 increase recall accuracy. However, stronger incentives could reduce but not eliminate bias.

219 Importantly, incentives appear to only increase recall accuracy when people can be assumed

220 to have some motivation for distortion in pandemic-related variables but not for a neutral

221 control variable. These results thus provide evidence for the motivational nature of biased

222 recall. Finally, individual directional bias again related to the evaluation of the

223 appropriateness of past political action in Study 2 ($r = 0.31$, $p < 0.001$) and Study 3 ($r = 0.36$,

224 $p < 0.001$).

225 **Generalizability across countries**

226 As polarization can be observed in many countries,[12,21] Study 4 investigated the relation

227 between biased estimates of the pandemic and post-pandemic evaluations on a more global

228 scale. We also wanted to explore any correlates that might indicate societal tension. Dryhurst

229 et al.'s study[22] conducted in March/April 2020 served as a benchmark, providing data on

230 pandemic perceptions in 10 countries (Australia, Germany, Italy, Japan, Mexico, South

231 Korea, Spain, Sweden, the United Kingdom and the United States) that differ in terms of

232 culture, pandemic impact and government response. We collected data from new samples in

233 these countries ($N = 5,493$), of whom 88% had received at least one dose of a COVID-19

234 vaccine. Respondents were asked to estimate how many people perceived a high probability

235 and severity of infection and high government effectiveness at the beginning of the pandemic.

236 A pretest with additional data from Study 1 (see section S1.6 in the supplement) showed that

237   such population-level estimates of the past can be seen as a proxy for individual-level recall,

238   as used in Studies 1–3.

239   Comparing estimates with the benchmark values,[22] we found that participants in all

240   countries overestimated perceived probability of infection, while participants in all countries

241   except Japan underestimated perceived severity of the illness in 2020 (Figure 3A). Bias

242   regarding government effectiveness varied by country. As in the previous studies, we

243   identified associations between bias and post-pandemic evaluation, but this varied by country

244   (for details, see section S4.2 in the supplement). For instance, in most countries, estimating

245   COVID-19 as more severe than it had actually been perceived in the past by a representative

246   country sample was associated with the evaluation of political action as more appropriate

247   (ranging from $r = 0.03$ in Germany to 0.21 in Sweden; exceptions: $r = -0.01$ in Japan; $r = -$

248   0.15 in the United States).

249   Evaluations of the appropriateness of political action during the pandemic were

250   broadly similar across the included countries (Figure 3B). Importantly, in all countries other

251   than Japan and Mexico, evaluations of political measures were more positive among the

252   vaccinated and more negative among the unvaccinated as vaccination status identification

253   increased (Figure 3C; see section S4.3 in the supplement for regression tables), echoing the

254   results of the previous studies. Regarding post-pandemic societal tension, we found that the

255   evaluation of past political action as less appropriate was associated with a stronger desire to

256   punish politicians (ranging from $r = -0.32$ in Mexico to -0.70 in Germany) and scientists ($r = -$

257   0.47 in Mexico to -0.77 in the United States) for their handling of the pandemic. Those who

258   evaluated political actions more negatively were also less inclined to vote ($r = 0.06$ in the

259   United States to 0.21 in Germany) and had a greater desire to dismantle the entire political

260   order (need for chaos[23]: $r = -0.35$ in Germany to -0.59 in Sweden). Finally, post-pandemic

261   evaluations were positively related to intended compliance in a future pandemic in all

262   countries except Japan ($r = 0.18$ in Mexico to 0.56 in Germany). For all correlations, see

263   section S4.2 in the supplement.

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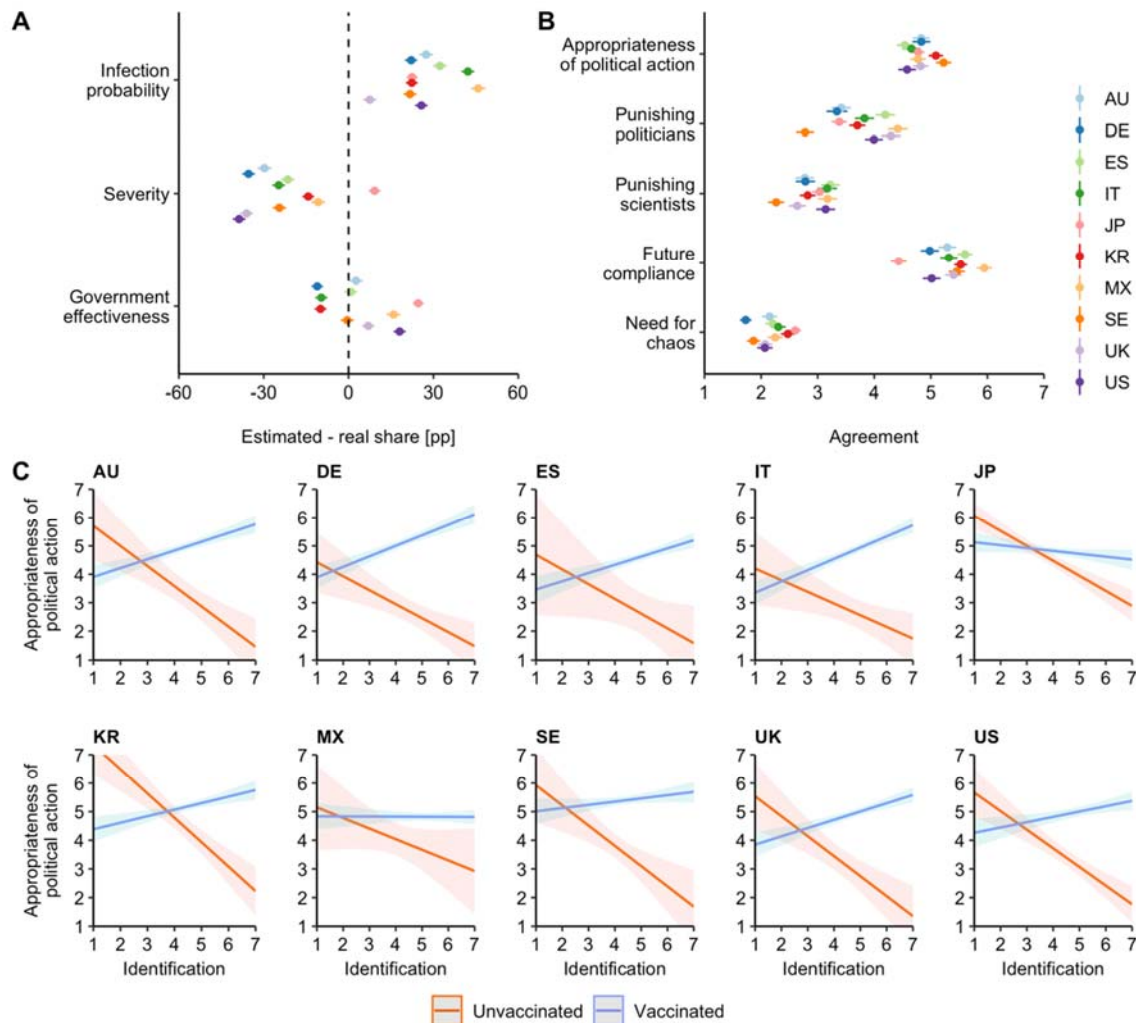
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267   **Figure 3. Pandemic perceptions and behavioural intentions across countries in Study 4.**
268   *Note*: Results from Australia (AU, $n = 534$), Germany (DE, $n = 514$), Spain (ES, $n = 528$), Italy (IT, $n = 519$),
269   Japan (JP, $n = 623$), South Korea (KR, $n = 515$), Mexico (MX, $n = 559$), Sweden (SE, $n = 562$), the United
270   Kingdom (UK, $n = 551$) and the United States (US, $n = 588$). (A) Participants' estimates of the share of
271   perceived high levels of infection probability, severity and government effectiveness as reported in a 2020
272   survey.[22] Dots depict differences between these estimates and observed values; error bars indicate 95%
273   confidence intervals (CIs; significant differences between two countries can be inferred from non-overlapping
274   CIs). (B) Evaluation of appropriateness of political action, desire to punish politicians and scientists for their
275   handling of the pandemic and intended compliance with regulations and recommendations in any future
276   pandemic, ranging from 1 (very much disagree) to 7 (very much agree); dots depict means, and error bars
277   indicate 95% CIs (significant differences between countries can be inferred from non-overlapping CIs). (C)
278   Linear regression analyses of vaccination status, vaccination status identification and their interaction, predicting
279   the evaluation of the appropriateness of political action. Lines represent linear fit, with ribbons visualizing 95%
280   CIs. See section S4.3 in the supplement for regression tables.

281   Overall, Germany and Italy exhibited the strongest associations between negative ex-

282 post evaluation of political actions and critical societal tendencies. The results suggest that

283 while a vaccinated majority has a more positive view of the measures taken during the

284 pandemic, as warranted by respective perceptions of the past, a small segment of society has a

285 strong desire to take revenge on those who spoke out or took responsibility during the

286 pandemic. In summary, we observed polarized evaluations of the pandemic and indicators of

287 social tension in many countries and across continents.

288 **Discussion**

289 The COVID-19 pandemic has had a profound impact on global society. Around the world,

290 governments and individuals have experienced significant upheaval, and tough decisions were

291 made to mitigate the spread of the virus. The four studies presented here illuminate how past

292 behaviour and today's perceptions influence how individuals recall their attitudes, perceptions

293 and behaviours during the pandemic and how their biased memories continue to affect

294 everyday life and influence future public health responses. In line with previous research,[16,24]

295 the bias was found to be strong, as it could not be reduced by bias-awareness information or

296 minor monetary incentives; only large incentives partially increased accurate recall.

297   On a societal level, the observed recall bias is problematic because it may lead to

298 systematically different ideas of how effective and appropriate pandemic interventions were.

299 In addition, the desire to punish those responsible for past pandemic measures may make it

300 difficult to build on 'lessons learnt'. The strong directional character of this bias and the

301 influence of identity in this regard have major implications that warrant further exploration.

302 For instance, memory distortions can be functional in coping with major life events.[25]

303 Therefore, future research could investigate whether people with a larger (vs. smaller)

304 tendency for biased recall of the COVID-19 pandemic may have had some advantages on

305 other psychological dimensions, including psychological functioning during or after the

306 pandemic. Yet, catastrophic events typically require a rapid response, and this works best

307   when people can agree on a way forward. It follows that diverging representations of the past

308   may impede effective future action, and it would be useful to investigate this problem in other

309   crisis contexts, such as climate change.

310   The studies reported here have some limitations. First, although the tested

311   interventions addressed metacognitive processes, our findings suggest that it may prove more

312   useful to target motivational issues such as identity. Second, the estimate of others' past

313   ratings used in Study 4 can be considered a proxy for individual recall. However, the two

314   concepts may differ, as estimates for the general population may also depend on other factors,

315   such as feelings and thoughts about this population. Third, in Study 4, the observed single

316   effects may further reflect country-specific factors beyond the scope of the present study, and

317   these invite further investigation. Finally, previous research suggests a bidirectional link

318   between identity and (biased) recall of the past.[5] Although our results support the motivational

319   nature of recall bias, it is beyond the scope of the present research to tease the causal

320   directions apart.

321   In conclusion, the four studies reported here highlight the complex nexus of attitudes,

322   memories and behaviours surrounding the COVID-19 pandemic. Motivational factors related

323   to identity and behaviour in extreme situations seem pivotal in this context, linking the past to

324   biased memories and future behaviours. Researchers and policymakers must pursue a better

325   understanding of these connections to develop more fruitful ways of learning from the past to

326   improve crisis preparedness and response.

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387   **Methods**

388   **Study 1**

389   *Participants*

390   Participants were surveyed for the first time in summer 2020 or winter 2020/21 (within the

391   COVID-19 Snapshot Monitoring project, COSMO) and for the second time in late 2022. In

392   total, 1,644 individuals participated. They were aged 18–74 years during the first survey ($M =$

393   52.68, $SD = 12.75$); 49% were male, and 51% were female. Unvaccinated participants were

394   oversampled compared to the general population to assess the interaction of vaccine status

395   and vaccination status identification.

396   *Measures*

397   *Vaccination status and vaccination status identification*

398   Participants were asked how many vaccines they had received against COVID-19 (recoded to

399   (un-)vaccinated if they received at least one (no) vaccine). Identification with vaccination

400   status was assessed using the 5-item scale by Henkel et al.[1] (sample item: 'I am proud (not) to

401   be vaccinated against COVID-19', measured on a 7-point scale from 'do not agree at all' to

402   'very much agree').

403   *Pandemic perceptions and behaviours*

404   At both time points, participants were asked how likely it was that they would get infected

405   (*infection probability*, measured on a 7-point scale from 'very unlikely' to 'very likely') and

406   how severe the infection would be (*severity*, measured on a 7-point scale from 'completely

407 harmless' to 'very severe'). *Affective risk* was assessed by mean-averaging answers to three 7-

408 point items: how often participants thought about the coronavirus, how much they worried

409 about it and how scary they found it (Cronbach's $\alpha = 0.84$ at the first and 0.91 at the second

410 time point).

411   Participants also indicated how often they had worn a face mask in the previous week

412 (measured on a 5-point scale ranging from 'never' to 'always'), how much they trusted the

413 federal government and science to manage the pandemic (measured on 7-point scales ranging

414 from 'no trust at all' to 'very much trust') and to what extent they agreed with the statement 'I

415 think the measures that are currently being taken are greatly exaggerated' (measured on a 7-

416 point scale ranging from 'do not agree at all' to 'agree very much'). Finally, participants were

417 asked to assess their overall life satisfaction (on a 7-point scale ranging from 'not at all

418 satisfied' to 'very satisfied').

419   At the second time point, participants were asked to estimate the share of people who

420 perceived high infection severity, high exaggeration of pandemic measures, high life

421 satisfaction (values 5–7 on the respective 7-point scale presented above) and low trust in

422 government (values 1–3 on the 7-point scale presented above) in a summer 2020 survey. This

423 served to validate the usability of population estimates as individual recall proxies (see

424 supplemental analyses in section S1.6).

425 *Pandemic recall*

426 At the second time point, participants were asked to recall the time of the first survey. To help

427 them recall the period in question, they were provided with some details of the pandemic

428 situation and a visual showing COVID-19 cases over time. They were asked to recall their

429 perceptions of risk, their trust in government and science, their mask-wearing behaviour, how

430 exaggerated they had perceived the policies and their life satisfaction during that period

431 (using the same 5- or 7-point scales as before).

432

433 *Appropriateness of political action*

434 Participants were asked to respond to nine items evaluating how the pandemic was handled,

435 measured on 7-point scales ranging from 'do not agree at all' to 'agree very much' (example

436 items: 'It has been proved that most corona measures have not worked', 'The Corona

437 measures were a pretext to restrict civil liberties', Cronbach's $\alpha = 0.92$). The items were

438 inspired by a newspaper report.[2]

439 **Analyses**

440 *Population models*

441 To assess the effects of past and present ratings on recall for each variable, eight Truth and

442 Bias (T&B) models[3] were estimated. In each model, recall of one variable (e.g. infection

443 probability) was regressed on past and present ratings, along with all their possible

444 interactions with vaccination status and vaccination status identification. For visualization

445 purposes (Figure 1), we plotted all intersections of present and past values that resulted in a

446 predicted recall at the respective variable's scale midpoint (separately for vaccinated and

447 unvaccinated individuals with different levels of identification). Modelling showed the effects

448 of vaccination status and vaccination status identification on directional bias (the extent to

449 which responses tended towards scale endpoints, model intercept) and the force of past ('truth

450 force') and present ('bias force') ratings. To be able to interpret directional bias as an over- or

451 underestimation of recall compared to the past, all models were estimated for a second time,

452 with recall, past and present ratings being centred by the grand mean of past ratings (for

453 regression tables, see section S1.3.2 in the supplement).

454 *Individual models*

455 Assuming that recall at the individual level is similarly biased for all variables, we estimated

456 directional bias and the biasing force of past and present ratings for each participant. In

457 calculating each participant's T&B model, only seven variables were included; life

458 satisfaction was excluded, as this hardly differed between participants, and recall was based

459   almost entirely on current life satisfaction at population level. Perceptions of exaggeration

460   were inverted (as they correlated negatively with the other variables). All variables were

461   rescaled to range from 0 to 1 before model estimation (see section S1.5 in the supplement).

462   **Study 2**

463   *Participants*

464   Participants were surveyed at two time points: December 2021 and early 2023. In total, 3,105

465   individuals aged 18–97 years ($M = 49.90$, $SD = 16.02$) participated, of whom 50% were male

466   and 50% were female. Participants were recruited from a panel containing Austrian and

467   German participants who had already taken part several times in surveys around vaccination.[1]

468   The panel included more unvaccinated participants than the general population to reliably

469   observe potential changes in vaccination-related perceptions, intentions and behaviours over

470   time.

471   *Experimental manipulation*

472   At the second time point, participants were randomly assigned to one of three groups. Those

473   in the *incentive* group were told that accurate recall increased their chances of winning a 100

474   euro prize. For a given variable, correct recall was awarded 5 points; if recall varied by 1

475   scale unit, 4 points were awarded, and so on. Each respondent's total points determined how

476   often they would participate in the prize lottery. This intervention aimed at incentivising

477   correct recall (i.e. giving people the chance to overrule motivated thinking by valuing a

478   financial win as higher than confirming with one's current opinions). Participants assigned to

479   the *information* group were provided with some written details of another study, in which a

480   selected group of 100 people were asked to recall their perceptions of infection severity, their

481   trust in government and their mask wearing behaviour during December 2021. The

482   information group participants were then asked to guess what proportion of that other group

483   underestimated those three variables. Each of our participants was then given an answer

484   ranging from 10% to 90% (in 10% increments) based on randomly selected individuals from

485   the other study. Thus, some participants were told that 10% of people underestimated

486   perceived infection severity, trust in government and mask-wearing behaviours; others were

487   told that 20% had underestimated these variables, and so on. This procedure generated

488   random variation in the information received. The control group received no such information

489   or incentive. The intervention aimed to raise people's awareness of bias, triggering accuracy

490   concerns.

491   *Measures*

492   As in Study 1, vaccination status and vaccination status identification (Cronbach's $\alpha = 0.75$)

493   were assessed at the second time point. Present and past risk perceptions, trust and protective

494   behaviours, as well as their recall, were assessed. Items queried infection probability, severity,

495   trust in government and science and mask wearing again, plus frequency of avoiding close

496   contact (7-point scale ranging from 'never' to 'always'). Appropriateness of political action

497   was assessed as in Study 1 (Cronbach's $\alpha = 0.92$).

498   *Analyses*

499   Again, as in Study 1, population T&B models[3] were estimated for each of the six variables.

500   On this occasion, however, recall was regressed on past and present values for each variable,

501   along with potential interactions with vaccination status and experimental manipulation. As in

502   Study 1, recall, past and present ratings were again centred by the grand mean of past ratings.

503   Extended models, including vaccination status identification as an additional moderator, were

504   also explored (see section S2.3.2 in the supplement). Individual T&B models were again

505   calculated to estimate individual directional bias (see section S2.5 in the supplement).

506   **Study 3**

507   *Participants*

508   Participants were surveyed for the first time between May and October 2021 (within

509   COSMO) and for the second time in July 2023. As the panel provider was not able to reach

510   enough unvaccinated individuals for group comparisons, only vaccinated individuals were

511   invited to participate in the second survey. In total, 906 individuals participated. They were

512   aged 18–74 years during the first survey ($M = 50.67$, $SD = 14.11$); 45% were male, and 55%

513   were female.

514   *Experimental manipulation*

515   At the second time point, participants were randomly assigned to one of two groups. Those in

516   the *incentive* group were told that accurate recall increased their chances of winning a 25 euro

517   prize. For payment, for each participant in this group, one recall variable was randomly

518   selected and compared to the original answer they provided in 2021. The probability of

519   winning the prize was then calculated by applying a binarized scoring rule[4] using the

520   following formula: $p = 100 - 100 \times (|\frac{Original\ answer}{y} - \frac{Recalled\ answer}{y}|)$, with $y = 6$ for 7-

521   point scale items and $y = 4$ for 5-point scale items. That is, when recall met the original

522   answer, participants received the prize with certainty, and the larger the deviation, the lower

523   the probability of winning the prize. In total, 64% of participants in the incentive group

524   received the prize. Recall in the *control* group was not incentivized.

525   *Measures*

526   As in Studies 1 and 2, present and past perceptions and behaviours, as well as their recall,

527   were assessed. Items queried infection probability, severity, trust in government, exaggeration

528   perception (7-point scales), mask wearing and contact avoidance (5-point scales). Participants

529   were further asked to recall the time they completed the 2021 survey (choosing one of seven

530   time intervals). Appropriateness of political action was assessed as in Study 1 (Cronbach's α

531   = 0.89).

532   *Analyses*

533   Again, population T&B models[3] were estimated for each of the six pandemic-related

534   variables and the survey completion time. On this occasion, however, recall was regressed on

535   past and present values for each variable, along with interactions with the experimental

536   manipulation. Except for visualization (Figure 2), recall, past and present ratings were again

537   centred by the grand mean of past ratings. Extended models, including vaccination status

538   identification as an additional moderator, were also explored (see section S3.2.3 in the

539   supplement). As in Studies 1 and 2, individual T&B models were calculated to estimate

540   individual directional bias (see section S3.3 in the supplement).

541   **Study 4**

542   *Participants*

543   Participants from 10 countries were assessed once between March and April 2023 (N =

544   5,493). The included countries were Australia (n = 534), Germany (n = 514), Italy (n = 519),

545   Japan (n = 623), Mexico (n = 559), South Korea (n = 515), Spain (n = 528), Sweden (n =

546   562), the United Kingdom (n = 551) and the United States (n = 588). Participants were aged

547   18–89 years (M = 46.25, SD = 16.00); of these, 49% were male and 51% were female. The

548   selection of countries and the criteria for representativeness matched those in the 2020 study

549   by Dryhurst et al.[5]

550   *Measures*

551   Vaccination status and vaccination status identification (Cronbach's α = 0.72) were assessed

552   as in Study 1.

553   *Pandemic recall*

554   Participants were asked to guess responses (0–100%) to the following items in a survey

555   conducted by Dryhurst et al.[5] between mid-March and mid-April 2020: the seriousness of

556   COVID-19 ('What percentage of respondents (do you think) said in March/April 2020 that

557   getting sick with COVID-19 can be serious?'), the probability of getting sick with COVID-19

558   ('What percentage of respondents (do you think) said in March/April 2020 that they would

559   probably get sick with COVID-19?') and the effectiveness of the government's response to

560   the pandemic ('What percentage of respondents (do you think) said in March/April 2020 that

561   the official response in their country was an effective way of dealing with the pandemic up to

562   that point in time?'). Participants were told that we defined 'agreement' in the original study

563 as a rating of 4 or 5 for infection severity and probability (originally measured on a 5-point

564 scale) and a rating of 6 or 7 for government effectiveness (originally measured on a 7-point

565 scale). For each of the items, we compared our participants' guesses with the actual

566 percentage of people, as found by Dryhurst et al.[5]

567 *Appropriateness of political action*

568 This issue was explored using two items from Study 1: 'The corona measures were a pretext

569 to restrict civil liberties' and 'Evidence shows that most corona measures have not worked'

570 (measured on 7-point scales ranging from 'do not agree at all' to 'agree very much').

571 *Punishment intention*

572 To measure punishment intention, we asked participants to respond to two statements:

573 'Politicians should be punished for how they handled the corona pandemic' and 'Scientists

574 who gave advice to the government should be punished for how they handled the corona

575 pandemic' (measured on 7-point scales ranging from 'strongly disagree' to 'strongly agree').

576 *Voting intentions*

577 Future voting intentions were assessed using the following yes/no question: 'If there was an

578 election next week, would you vote?'

579 *Compliance in a future pandemic*

580 Compliance in a future pandemic was assessed in terms of the following statement: 'If there

581 was a similar but new pandemic coming up, I would comply with measures and regulations.'

582 (measured on a 7-point scale ranging from 'strongly disagree' to 'strongly agree').

583 *Need for chaos*

584 Participants were asked about their agreement with three items developed by Petersen et al.:[6]

585 'Sometimes I just feel like destroying beautiful things', 'I think society should be burned to

586 the ground' and 'I fantasize about a natural disaster wiping out most of humanity such that a

587 small group of people can start all over' (measured on a 7-point scale from 'strongly disagree'

588 to 'strongly agree', Cronbach's $\alpha = 0.82$).

Analysis assumptions

For all analyses, the necessary preconditions were met.

Data availability statement

Data are available at https://osf.io/bxg7v/. Study 2 (https://aspredicted.org/KGF_SNN) and Study 3 (https://aspredicted.org/kk33k.pdf) were preregistered (links for peer review).

Code availability statement

Data analysis scripts are available at https://osf.io/bxg7v/.

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623 **Author contributions**

624 All authors designed and performed the research. PS and LH performed the data analysis. All

625 authors wrote and revised the manuscript.

626 **Competing interest declaration**

627 The authors declare no competing interests.

628 **Additional information (containing supplementary information line (if any) and**

629 **corresponding author line)**

630 Supplementary information is available at https://osf.io/bxg7v/.

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634 **Ethical approval**

635 The study was conducted in accordance with German Psychological Association guidelines.

636 Ethical clearance was obtained from the University of Erfurt's institutional review board

637 (#20200302/20200501/20211215) and the University of Bamberg's institutional review board

638 (#2023-07/31). All participants provided informed consent to use and share their data for

639 scientific purposes without disclosing their identities. Participants were compensated for their

640 participation by the panel providers.