Title: Sample, balanced checks, and manipulation tests appendix for "Alternative science against the corrupt elites? The effects of pseudoscience and censorship accusations in health misinformation"
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Note: The material contained herein is supplementary to the article named in the title and published in the Harvard Kennedy School (HKS) Misinformation Review.

Appendix A: Sample, balanced checks, and manipulation tests

Part 1: Sample description

This is an online non-probability sample of adults (min. age 21). Quotas ensured demographic representations aligned with the population makeup. There were 2,070 survey attempts. 40 respondents who indicated they would not be fully honest with their respondents were removed before completing the survey; 413 respondents failed the first attention check; 158 respondents failed the second attention check; and 529 respondents did not complete the survey. In the end, there were 930 successful completes, but 11 of these withdrew consent after debriefing, resulting in 919 valid completes. Nineteen speeders (approximately the top 3% fastest, per the survey company's recommended threshold, which corresponds to those who completed the study under 7 minutes) were removed. We also identified eight laggards who spent more than 10 minutes on the manipulation message page, suggesting multitasking or inattention; however, because this justification was unclear given the slightly varying lengths of the manipulations, we did not exclude them from our reported analysis. The removal of these eight laggards did not change the results.

The average age was *M* = 42.1 years (*SD* = 13), and the median was 40. 51% were female; 77% were Chinese, 10% Malay, 6% Indian, and 7% other ethnicities. 9% of the sample had some high school education at most but no diploma, 18% had a high school diploma or some college but no college degree, 62% had college or equivalent degrees, while 11% had some type of graduate or professional degree. The median household monthly income was 7,001-9,000 SGD. These are comparable to the latest census information (Singapore Department of Statistics, 2025).

While non-probability samples yield experimental results similar to probability-based samples (Krupnikov et al., 2021), the findings cannot be directly generalized to the entire population.

Part 2: Balanced cells check

Table A1 shows our randomization and balanced cell results. Randomization worked successfully for most variables except for social media news exposure. But for our outcome variables, moderators, and demographic variables, no significant differences are observed.

Table A1. *Randomization check results.*

Variable	Test (F)	G1 (*N* = 106)	G2 (*N* = 107)	G3 (*N* = 98)	G4 (*N* = 91)	G5 (*N* = 101)	G6 (*N* = 105)	G7 (*N* = 95)	G8 (*N* = 100)	G9 (*N* = 97)
Age	1.823	0.37 (0.22)	0.38 (0.23)	0.40 (0.22)	0.33 (0.22)	0.42 (0.23)	0.33 (0.25)	0.38 (0.21)	0.35 (0.23)	0.37 (0.23)
Female	1.364	0.56 (0.50)	0.50 (0.50)	0.40 (0.49)	0.49 (0.50)	0.49 (0.50)	0.53 (0.50)	0.45 (0.50)	0.58 (0.50)	0.57 (0.50)
Chinese	0.858	0.78 (0.41)	0.83 (0.38)	0.83 (0.38)	0.75 (0.44)	0.73 (0.44)	0.78 (0.42)	0.75 (0.44)	0.74 (0.44)	0.73 (0.45)
Malay	0.849	0.11 (0.32)	0.07 (0.25)	0.07 (0.26)	0.10 (0.30)	0.14 (0.35)	0.08 (0.27)	0.13 (0.33)	0.12 (0.33)	0.13 (0.34)
Indian	0.286	0.07 (0.25)	0.05 (0.21)	0.04 (0.20)	0.07 (0.25)	0.05 (0.22)	0.07 (0.25)	0.05 (0.22)	0.08 (0.27)	0.05 (0.22)
Other race	0.398	0.04 (0.19)	0.06 (0.23)	0.06 (0.24)	0.09 (0.28)	0.08 (0.27)	0.08 (0.27)	0.07 (0.26)	0.06 (0.24)	0.08 (0.28)
Education	0.967	0.61 (0.25)	0.57 (0.23)	0.56 (0.27)	0.62 (0.24)	0.55 (0.28)	0.60 (0.25)	0.61 (0.25)	0.59 (0.26)	0.57 (0.24)
Income	1.167	0.33 (0.25)	0.40 (0.26)	0.42 (0.23)	0.36 (0.26)	0.36 (0.25)	0.40 (0.24)	0.41 (0.26)	0.37 (0.24)	0.37 (0.28)
Liberal	0.797	0.48 (0.21)	0.49 (0.20)	0.50 (0.19)	0.49 (0.21)	0.46 (0.18)	0.51 (0.22)	0.48 (0.21)	0.51 (0.21)	0.50 (0.17)
Pre-vax risk	1.123	0.38 (0.25)	0.36 (0.25)	0.40 (0.26)	0.41 (0.26)	0.33 (0.25)	0.33 (0.28)	0.39 (0.27)	0.37 (0.26)	0.40 (0.27)
Pre-GMO risk	1.487	0.38 (0.24)	0.39 (0.25)	0.40 (0.26)	0.39 (0.24)	0.41 (0.23)	0.35 (0.25)	0.45 (0.29)	0.36 (0.23)	0.40 (0.23)
Pre-AI risk	0.801	0.32 (0.21)	0.34 (0.23)	0.35 (0.26)	0.37 (0.26)	0.32 (0.22)	0.32 (0.22)	0.36 (0.25)	0.37 (0.26)	0.37 (0.25)
Populism	0.739	0.35 (0.16)	0.37 (0.18)	0.38 (0.19)	0.36 (0.20)	0.33 (0.14)	0.36 (0.18)	0.37 (0.20)	0.35 (0.20)	0.37 (0.18)
Subjective numeracy	0.271	0.52 (0.22)	0.51 (0.23)	0.51 (0.21)	0.51 (0.21)	0.49 (0.23)	0.51 (0.21)	0.53 (0.24)	0.52 (0.24)	0.49 (0.21)
Trust scientists	0.999	0.47 (0.19)	0.47 (0.17)	0.47 (0.20)	0.47 (0.22)	0.42 (0.19)	0.50 (0.21)	0.45 (0.25)	0.46 (0.20)	0.45 (0.19)
Trust science	0.722	0.53 (0.22)	0.53 (0.20)	0.50 (0.22)	0.51 (0.25)	0.47 (0.21)	0.51 (0.22)	0.51 (0.28)	0.51 (0.25)	0.49 (0.22)
NFC	1.037	0.49 (0.20)	0.46 (0.20)	0.50 (0.16)	0.45 (0.21)	0.46 (0.20)	0.50 (0.20)	0.48 (0.23)	0.48 (0.20)	0.45 (0.20)
Social news consume	2.221*	0.34 (0.25)	0.30 (0.25)	0.34 (0.22)	0.39 (0.28)	0.32 (0.24)	0.42 (0.25)	0.36 (0.27)	0.39 (0.26)	0.36 (0.23)
Objective numeracy	0.414	0.81 (0.24)	0.84 (0.21)	0.80 (0.22)	0.83 (0.22)	0.83 (0.21)	0.84 (0.22)	0.84 (0.22)	0.82 (0.25)	0.82 (0.24)

*Note: * denotes p < .05.*

Part 3: Manipulation tests

There were four sets of manipulation checks, assessing whether manipulations worked via diverse ways:

1. *Topic identification*

To verify the effectiveness of the topic manipulation, we employed multiple items. The first item included a fictitious distractor topic (History Museums), while the second item presented only the three target topics (GMOs, Vaccination, and Rules of Baseball [Control]). Participants in the eight experimental conditions successfully identified their assigned topics, with accuracy rates exceeding 92% across all groups (χ^2 = 1,377.23, $p < .001$; χ^2 = 1,350.86, $p < .001$).

Although the control conditions yielded more varied responses (accuracy rates of 22% and 66%), this pattern was expected given the control group's baseline nature. Crucially, regarding the control topic itself, participants in the control condition consistently demonstrated greater general knowledge of and interest in baseball compared to those in other conditions (Knowledge: F = 19.76, $p < .001$; Interest: F = 2.93, $p < .001$). Furthermore, on a binary-choice question about the assigned topic, accuracy rates exceeded 98% across all conditions, including controls. Collectively, these results indicate that the topic manipulation was successful.

2. *Pseudoscientific content manipulation*

To assess the effectiveness of the pseudoscientific content manipulation, participants were asked whether the messages contained statistics or numerical findings, tables, or figures, and to indicate their level of certainty. Chi-square tests of independence indicated that the manipulation was successful: χ^2 = 130.68, $p < .001$; χ^2 = 523.54, $p < .001$; and χ^2 = 135.55, $p < .001$. Participants in the pseudoscientific content conditions correctly identified the presence of statistics or numerical findings at rates ranging from 82% to 98%. Table A2, part I, presents the distribution of certainty levels. Participants exposed to messages containing pseudoscientific content reported significantly greater certainty about the presence of pseudoscientific information than those in control or no-pseudoscientific-content conditions.

We also examined whether the inclusion of pseudoscientific information affected the perceived difficulty of understanding the messages. Participants in the conditions containing pseudoscientific content were consistently less likely to rate the messages as "very easy" (rating 1) compared to those in the non-statistical and control conditions (χ^2 = 973.96, $p < .001$).

3. *Censorship manipulation*

The censorship manipulation was assessed using two questions measuring the presence of censorship cues. A chi-square test of independence confirmed that the manipulation was successful (χ^2 = 468.63, $p < .001$), with more than 89% of participants in the censorship conditions correctly identifying the cues. Participants in the censored conditions reported significantly greater certainty that the messages contained censorship claims than those in the non-censored conditions (see Table A2, part II).

4. *Pseudoscience and censorship claim recognition*

Finally, we assessed whether participants had encountered pseudoscientific statistics and censorship claims in their surveys (see Table A2, part III). Asked at the very end of manipulation checks, we showed the partial screenshots of actual message components to the respondents and asked if they had seen those during the exposure. The results demonstrated highly significant differences across conditions for both the pseudoscientific stats check (χ^2 = 621.406, $p < .001$) and the censorship claims check (χ^2 = 477.111, $p < .001$). These results indicate that participants accurately identified the presence or absence of pseudoscientific stats and censorship accusations across experimental conditions, with recognition rates exceeding 90% in the intended conditions for both features.

Table A2. *Distribution of certainty levels and manipulation checks across experimental conditions.*

Condition	Control	Vaccination topic				GMO topic			
		No stats No cens	No stats Cens	Stats No cens	Stats Cens	No stats No cens	No stats Cens	Stats No cens	Stats Cens
Total N	106	107	98	91	101	105	95	100	97
I. Certainty of statistics presence									
(1) Not at all certain	24%	28%	33%	7%	11%	27%	28%	5%	7%
	13%	19%	17%	9%	14%	13%	12%	11%	11%
	21%	14%	15%	9%	12%	10%	9%	16%	24%
	15%	8%	13%	21%	16%	15%	8%	14%	12%
	6%	12%	4%	5%	5%	9%	8%	10%	7%
	9%	4%	9%	14%	12%	10%	15%	16%	16%
to (7) Extremely certain	12%	15%	8%	35%	31%	16%	19%	28%	22%
II. Certainty of censorship presence									
(1) Not at all certain	27%	36%	7%	16%	7%	33%	5%	20%	6%
	12%	14%	8%	18%	8%	9%	6%	12%	10%
	12%	16%	5%	12%	10%	10%	13%	20%	14%
	13%	11%	19%	18%	14%	14%	5%	14%	11%
	13%	11%	8%	11%	7%	10%	7%	13%	11%
	6%	2%	14%	11%	16%	10%	18%	8%	12%
to (7) Extremely certain	16%	10%	38%	14%	39%	12%	45%	13%	34%
III. Tables/Figures manipulation checks									
Statistics check									
Present	11%	11%	13%	98%	97%	10%	19%	97%	94%
Absent	89%	89%	87%	2%	3%	90%	81%	3%	6%
Censorship Check									
Present	11%	22%	93%	37%	99%	19%	96%	40%	98%
Absent	89%	78%	7%	63%	1%	81%	4%	60%	2%

Part 4: Characterizing pseudoscience and examples of misinformation

Pseudoscience definitions vary widely. Pseudoscience is a multidimensional, complex construct, and there is a longstanding *demarcation* problem between science and pseudoscience in the philosophy of science and the theoretical literature (determining what can be defined as distinctly pseudoscience as opposed to science) (Boudry, 2022; Hansson, 2025). In line with these, we characterized pseudoscientific health misinformation in a way that can include examples of both completely made-up statistics and misleading/unverified representations of publicly available (generally epidemiological) datasets, among a list of some common features that philosophers and theorists laid out, which include strong deviations from scientific procedures, norms such as cherry-picking (hand-picking examples) and disregard of refuting information (Hansson, 2025). Others highlighted science denialism as a form of pseudoscience too (Hansson, 2017). Recent work recognizes and compares these diverse forms of pseudoscience in the context of misinformation research (Kuru, 2026a).

Pseudoscientific reports that exhibit these characteristics have proliferated, particularly during the COVID-19 pandemic in recent years. Pseudoscience was used to spread misinformation about vaccines and to market health products and false/unproven remedies for infectious diseases (Chavda et al., 2022; Skafle et al., 2022). Our hypothetical misinformation messages were modelled after some high-profile examples (e.g., claims of large-scale excess deaths across countries correlating with vaccination rates, and the like; see illustrative examples further below in this Appendix) and included both completely made-up and misrepresentation/misinterpretation elements to test their potential effects. Messages did not include any source cues, real or fake; they focused only on comparing the presence vs. absence of pseudoscience in the misinformation.

Hence, our study's aim is not to settle or contribute to theoretical debates about what constitutes pseudoscience, nor to single out specific examples that can be characterized as pseudoscience, but to offer evidence on the potential effects of pseudoscientific content through carefully designed, scientifically looking messages, within the context of health misinformation.

Excess mortality statistics and causal claims regarding COVID-19 vaccines:

- https://alexberenson.substack.com/p/florida-tells-young-men-to-avoid
- https://jamescintolo.substack.com/p/new-study-found-a-9-times-increased?publication_id=548165&isFreemail=true&utm_medium=email
- https://dailysceptic.org/2022/12/24/huge-spikes-in-neonatal-deaths-following-vaccine-rollout-data-from-major-israeli-health-insurer-show/
- https://kirschsubstack.com/p/new-big-data-study-of-145-countries
- https://kirschsubstack.com/p/it-is-now-known-that-the-covid-vaccines?utm_source=profile&utm_medium=reader2
- https://kirschsubstack.com/p/two-top-cardiologists-implicate-covid?utm_source=profile&utm_medium=reader2
- https://www.reuters.com/article/factcheck-gbnews-excessdeaths-idUSL1N3180Q7
- https://www.snopes.com/fact-check/vaccination-rate-excess-deaths/
- https://healthfeedback.org/claimreview/covid-19-vaccines-reduce-risk-death-contrary-to-mark-steyns-misleading-interpretation-mortality-data-gb-news/
- https://healthfeedback.org/claimreview/scientific-evidence-shows-covid-19-vaccination-reduces-risk-infection-mortality-analysis-cases-deaths-from-145-countries-methodologically-flawed-steve-kirsch/
- https://stevekirsch.substack.com/p/exclusive-proof-that-the-top-israeli
- https://www.factcheck.org/2022/08/scicheck-widespread-claims-misrepresent-effectiveness-of-covid-19-vaccines/
- https://www.heart.org/en/news/2022/08/22/covid-19-infection-poses-higher-risk-for-myocarditis-than-vaccines

GMO safety and misconceptions:

- World Health Organization: https://www.who.int/news-room/questions-and-answers/item/food-genetically-modified
- https://www.mdpi.com/2304-8158/9/4/522
- https://journals.sagepub.com/doi/10.1177/209660831900200407
- "The author noted that an analysis by Heilongjiang Soybean Association had shown that GM soybeans were highly correlated with the incidence of tumours, and the results were shocking. The article also mentioned that foreign countries had already disclosed information on the correlation between them, citing studies by Russian scientist Alexey Surov in 2010 and French

scientist Gilles-Eric Seralini in 2012 as evidence. This article attracted considerable attention. Despite denials by professional media and scientists the following day, the rumour that 'GM soybeans cause cancer' spread rapidly."

- https://news.harvard.edu/gazette/story/2023/09/is-organic-better/