Mathsci-comm workshop – Nov 2024

Communicating Mathematical and Data Sciences – What does Success Look Like?

- *Event page*
- *Padlet discussion*

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Resources arising from talks and discussions – Draft

Building the Mathsci-comm network – Rachel Thomas and Marianne Freiberger (University of Cambridge, plus.maths.org)

Watch talk on YouTube

- Plus.maths.org - Practical writing guide (written and revised by Rachel Thomas and Marianne Freiberger in response to Communicating Mathematics for the Public – Newton Gateway event held in January 2023)
- Follow on proposals from January 2023 Gateway event
- Padlet from the Nov 2024 event (now closed)
- Mathsci-comm network
    - Information
    - Application to join

Exploring what works in science communication; Experiments and evidence – David Spiegelhalter (University of Cambridge)

Watch talk on YouTube

- Freeman, A. L. J., Kerr, J., Recchia, G., Schneider, C. R., Lawrence, A. C. E., Finikarides, L., Luoni, G., Dryhurst, S. and Spiegelhalter, D. (2021). Communicating personalized risks from COVID-19: guidelines from an empirical study. R. Soc. open sci.8201721201721 http://doi.org/10.1098/rsos.201721

    - ***Abstract***
      As increasing amounts of data accumulate on the effects of the novel coronavirus SARS-CoV-2 and the risk factors that lead to poor outcomes, it is possible to produce personalized estimates of the risks faced by groups of people with different characteristics. The challenge of how to communicate these then becomes apparent.
      Based on empirical work (total n = 5520, UK) supported by in-person interviews with the public and physicians, we make recommendations on the presentation of such information. These include:
        - *using predominantly percentages when communicating the absolute risk, but also providing, for balance, a format which conveys a contrasting (higher) perception of risk (expected frequency out of 10 000);*
        - *using a visual linear scale cut at an appropriate point to illustrate the maximum risk, explained through an illustrative 'persona' who might face that highest level of risk;*
        - *and providing context to the absolute risk through presenting a range of other 'personas' illustrating people who would face risks of a wide range of different levels. These 'personas' should have their major risk factors (age, existing health conditions) described.*

By contrast, giving people absolute likelihoods of other risks they face in an attempt to add context was considered less helpful. We note that observed effect sizes generally were small. However, even small effects are meaningful and relevant when scaled up to population levels.

- Interesting both as how to design such a study, and for the clear guidelines it produces. DS said it influenced his practice, he puts numbers in context, eg giving comparative risks for different instances, or comparing gaps between different instances (people, regions, etc)

- Schneider, C. R., Freeman, A.L.J., Spiegelhalter, D. and van der Linden, S. (2022). The effects of communicating scientific uncertainty on trust and decision making in a public health context. Judgment and Decision Making, 17(4), pp. 849-882. doi: https://journal.sjdm.org/21/210525b/jdm210525b.pdf

  - **Abstract:**

    Large-scale societal issues such as public health crises highlight the need to communicate scientific information, which is often uncertain, accurately to the public and policy makers. The challenge is to communicate the inherent scientific uncertainty — especially about the underlying quality of the evidence — whilst supporting informed decision making. Little is known about the effects that such scientific uncertainty has on people's judgments of the information.

    In three experimental studies (total N=6,489), we investigate the influence of scientific uncertainty about the quality of the evidence on people's perceived trustworthiness of the information and decision making. We compare the provision of high, low, and ambiguous quality-of-evidence indicators against providing no such cues.
    Results show an asymmetric relationship: people react more strongly to cues of low quality of evidence than they do to high quality of evidence compared to no cue. While responses to a cue of high quality of evidence are not significantly different from no cue; a cue of low or uncertain quality of evidence is accompanied by lower perceived trustworthiness and lower use of the information in decision making. Cues of uncertain quality of evidence have a similar effect to those of low quality. These effects do not change with the addition of a reason for the indicated quality level.
    Our findings shed light on the effects of the communication of scientific uncertainty on judgment and decision making, and provide insights for evidence-based communications and informed decision making for policy makers and the public.

    - DS mentioned ethical question if we *don't* communication Quality of Evidence level: if we don't give QoE people assume the QoE is high.

- *Code of Practice for Statistics*, produced by the UK Office for Statistics Regulation (latest revision 2022) https://code.statisticsauthority.gov.uk/
    - Includes trustworthiness as one of the three pillars it is based on
    - **About the code**
      *The framework for the Code of Practice is based on three pillars – **Trustworthiness**, **Quality** and **Value**.*
      *Each pillar contains a number of principles and detailed practices that producers should commit to when producing and releasing official statistics. On each Code principle page there is a **table with guidance and resources** and links to **case studies**.*
      *The Code also has three cross-cutting themes, areas of practice that don't fit within just one pillar – **collaboration**, **coherence**, and **transparency**.*

- Blastland, M., Freeman, A. L., van der Linden, S., Marteau, T. M., & Spiegelhalter, D. (2020). Five rules for evidence communication. Nature 587, 362-364 https://www.nature.com/articles/d41586-020-03189-1
    - *Avoid unwarranted certainty, neat narratives and partisan presentation; strive to inform, not persuade.*
    - Gives quick tips for sharing evidence, alongside the five rules:
        - Inform, not persuade
        - Balance, but not false balance
        - Disclose uncertainties
        - State evidence quality
        - Pre-bunk misinformation

    - Incorporated into *RESIST 2: Counter Disinformation Toolkit,* produced by UK Government Communication Service (latest version 2021)

- Kerr, J. R., Schneider, C. R., Freeman, A. L., Marteau, T., & van der Linden, S. (2022). Transparent communication of evidence does not undermine public trust in evidence. PNAS Nexus. https://doi.org/10.1093/pnasnexus/pgac280

    - **Abstract**
      Does clear and transparent communication of risks, benefits, and uncertainties increase or undermine public trust in scientific information that people use to guide their decision-making? We examined the impact of reframing messages written in traditional persuasive style to align instead with recent "evidence communication" principles, aiming to inform decision-making: communicating a balance of risks and benefits, disclosing uncertainties and evidence quality, and prebunking misperceptions.

In two pre-registered experiments, UK participants read either a persuasive message or a balanced and informative message adhering to evidence communication recommendations about COVID-19 vaccines (Study 1) or nuclear power plants (Study 2).
We find that balanced messages are either perceived as trustworthy as persuasive messages (Study 1), or more so (Study 2). However, we note a moderating role of prior beliefs such that balanced messages were consistently perceived as more trustworthy among those with negative or neutral prior beliefs about the message content. We furthermore note that participants who had read the persuasive message on nuclear power plants voiced significantly stronger support for nuclear power than those who had read the balanced message, despite rating the information as less trustworthy. There was no difference in vaccination intentions between groups reading the different vaccine messages.

    - DS said: "Those who were pro-vaccination or pro-nuclear beforehand, they just trusted the material anyway. No difference. But for those who were skeptical about vaccination or nuclear power, they trusted the inform-not-persuade version a lot more."

- Case study: Communicating the potential benefits and harms of the Astra-Zeneca COVID-19 vaccine (David Spiegelhalter John Aston and Alex Freeman)
    - https://wintoncentre.maths.cam.ac.uk/news/latest-data-mhra-blood-clots-associated-astra-zeneca-covid-19-vaccine/
    - Illustrates many of the ideas discussed in David's talk

- Julian Champkin, Interview with Lord Krebs, Significance, Volume 10, Issue 5, October 2013, Pages 23–29, https://doi.org/10.1111/j.1740-9713.2013.00694.x
    - **Abstract:**
      How do you explain to the public the risk that the meat they have been eating for years may pass on a lethal disease? Or to parents that the milk they are giving their children may contain dioxins? Or to politicians that killing badgers may not be an efficient way to control TB? Lord Krebs has succeeded in two out of these three enterprises in statistical communication. Julian Champkin spoke to him at the height of a trial badger cull.

    - DS: *John Krebs recommends saying*
        - what we know;
        - what we don't know;
        - what we are doing to find out;
        - what people can do in the meantime to be on the safe side;
        - **that advice will change.**

- Full list of Winton Centre publications are here
    - https://wintoncentre.maths.cam.ac.uk/about/publications/

Getting through: Communicating complex information – Matthew Naylor (Bank of England)

Watch talk on YouTube

- Michael McMahon and Matthew Naylor, Getting through: communicating complex information. Staff working papers, Bank of England (2023)
    - https://www.bankofengland.co.uk/working-paper/2023/getting-through-communicating-complex-information
    - **Abstract**:
      Policymakers communicate complex messages to multiple audiences; we investigate how complexity impacts messages 'getting through' effectively. We distinguish 'semantic' complexity – the focus of existing empirical studies – from 'conceptual' complexity, which better reflects information-processing costs identified by theory.
      We conduct an information-provision experiment using central bank communications; conceptual complexity – captured by a novel quantitative measure we construct – matters more for getting through. This is true even for technically trained individuals.
      Bank of England efforts to simplify language have reduced traditional semantic measures, but conceptual complexity has actually increased. Our findings can direct efforts for effective policy communication design.

    - *Semantic complexity*: long worlds and sentences. *Conceptual complexity*: jargon and technical terms, difficult ideas.

    - Results:
        - True complexity reduces attention paid to Central Bank messages, reducing the accuracy of beliefs formed.
        - Conceptual complexity matters more than semantic complexity for both informedness and trust (even for those with economics degrees)

Communicating science to be helpful - beyond transparency – David Schley (Sense about Science)

- Understanding Children's Heart Surgery Outcomes - website co-developed with parents by UCL, Cambridge, KCL, Sense about Science and Children's Heart Foundation.

- An international framework for **communicating risk information**, and relevant mathematical concepts, in ways that are useful and enable them to use it in context by giving them Risk know-how https://riskknowhow.org/

- A short guide to **involving the public in how you communicate your research**: Our 5-step approach: https://senseaboutscience.org/activities/public-engagement-guide/.

  Sense about Science also can also support you in achieving this for major project through a **Public Engagement Partnerships** (PEP) https://senseaboutscience.org/activities/public-engagement-partnerships/ - please email hello@senseaboutscience.org for more details.

- **Voice of Young Science** is an international community of over 5,000 Early Career Researchers (ECRs) and ECMs who are inspired and motivated to take responsibility for the public conversation about science and evidence. We provide training, resources, and ongoing opportunities to build the confidence and skills to engage the public, media and policy makers https://senseaboutscience.org/voys/

- **The John Maddox Prize** recognises researchers who stand up and speak out for science and evidence-based policy, advancing public discussion around difficult topics, despite challenges or hostility, and successfully making a change in public discourse or policy. Please consider nominating someone for the 2025 when submission open in the new year: https://www.nature.com/immersive/maddoxprize/index.html .

- **The Harding Prize** for Trustworthy Communications recognises pieces, in whatever format, that are helpful and give people the mathematical and scientific understanding they need. Nominations for the 2024 will open soon so do nominate an article, video or other public communication that you think deserves recognition: https://wintoncentre.github.io/harding-prize/

- (For updates on all of the above, please sign up to Sense about Science newsletter here: https://senseaboutscience.org/.)

Communicating complex models to aid decision making – Veronica Bowman (Defence, Science and Technology Laboratory)

- The Nolan principles - The seven principles of public life
  - First set out by Lord Nolan in 1995
  - VB spoke about taking these on board as a modeller:
    - *Selflessness – My model is not "best"*
    - *Integrity – My model is valid in these areas*
    - *Objectivity – My assumptions are…*
    - *Accountability – I take responsibility for what my model is used for*
    - *Openness – I will share my model for others to review*
    - *Honesty – There are the following issues…*
    - *Leadership – Let me help you through the thought process*

Linking vision science to decision making in safety-critical scenarios – Andrew Meso (King's College London)

Watch talk on YouTube

- Chung, S.T.L. and Legge, G.E., Comparing the Shape of Contrast Sensitivity Functions for Normal and Low Vision. Invest. Ophthalmol. Vis. Sci. 2016;57(1):198-207.
- Kwon, M. and Legge, G.E., (2013) Higher-contrast requirements for recognizing low-pass–filtered letters. Journal of Vision 2013;13(1):13
- Owsley C., Sekuler R., Siemsen D., Contrast sensitivity throughout adulthood. Vision research 23, 7 (1983), 689–699. 3
- Nicholls, V. I., Wiener, J. M., Meso, A. I., & Miellet, S. (2022). The relative contribution of executive functions and aging on attentional control during road crossing. Frontiers in psychology, 13, 912446.
- Nicholls, V. I., Wiener, J., Meso, A. I., & Miellet, S. (2024). The impact of perceptual complexity on road crossing decisions in younger and older adults. Scientific Reports, 14(1), 479.
- rnib.org.uk/research
- Rosser D.A., Laidlaw D.A.H, Murdoch, IE., (2001) The development of a “reduced logMAR” visual acuity chart for use in routine clinical practice. British Journal of Ophthalmology 2001;85:432-436.
- Shao, S., Li, Y., Meso, A.I. and Holliman, N. S (2024), Does Empirical Evidence from Healthy Aging Studies Predict a Practical Difference Between Visualizations for Different Age Groups? Computer Graphics & Visual Computing (CGVC) 2024

How do we Communicate Potential Treatment Harm to the Public: Lessons from a Public Involvement Meeting – Rachel Philips (Imperial College London)

Watch talk on YouTube

- UK Standards for Public Involvement in Research website
- People in Research website
- Briefing notes for researchers - public involvement in NHS, health and social care research – NIHR guidance
- Information for researchers - Be Part of Research – NIHR Be Part of Research website
- Case study discussed in this talk:
    - Phillips, R., Bi, D., Goulão, B. et al. Public perspective on potential treatment intervention harm in clinical trials—terminology and communication. Trials 25, 573 (2024).
    - https://doi.org/10.1186/s13063-024-08418-w
- Further case studies:

    - PoINT Programme: Public Involvement in Numerical aspects of Trials, Dr Beatriz Goulao at the University of Aberdeen https://doi.org/10.1186/s13063-021-05451-x
    - Starting a conversation about estimands with public partners involved in clinical trials: a co-developed tool, Dr Suzie Cro at Imperial College London https://doi.org/10.1186/s13063-023-07469-9
    - PPI-SMART group led by Professor Laura Gray at University of Leicester looking at public involvement for statistical methodology https://leicesterbrc.nihr.ac.uk/ppismart/

- Guidance for reporting patient and public involvement in research
    - GRIPP2 reporting checklists: tools to improve reporting of patient and public involvement in research
- Public Involvement in Research Impact Toolkit (PIRIT) - Marie Curie Research Centre - Cardiff University

Co-production in epidemic modelling – Liz Fearon (University College London)

Watch talk on YouTube

- Marshall GC, Skeva R, Jay C et al. Public perceptions and interactions with UK COVID-19 Test, Trace and Isolate policies, and implications for pandemic infectious disease modelling [version 1]. F1000Research 2022, 11:1005 (doi: 10.12688/f1000research.124627.1)
- NIHR Guidance on co-producing a research project, April 2024. Accessed on: 13/11/2024
    - Key principles:
        - sharing of power – the research is jointly owned and people work together to achieve a joint understanding
        - including all perspectives and skills – make sure the research team includes all those who can make a contribution
        - respecting and valuing knowledge of all those working together on the research – everyone is of equal importance
        - reciprocity – everybody benefits from working together
        - building and maintaining relationships – an emphasis on relationships is key to sharing power
- Vaughn LM and Jacquez F, Participatory research methods: choice points in the research process. Journal of Participatory Research Methods, 2020. 1:1.https://doi.org/10.35844/001c.13244
- Staniszewska, S., Hill, E.M., Grant, R. et al. Developing a Framework for Public Involvement in Mathematical and Economic Modelling: Bringing New Dynamism to

Vaccination Policy Recommendations. *Patient* 14, 435–445 (2021). https://doi.org/10.1007/s40271-020-00476-x

Lightning talk: How information changes behaviour – Krishane Patel (Financial Conduct Authority)

- Context/timing - Gilmore, M., Karapetyan, D., Murphy, G., Ng, C., & Spang, J. (2023). Testing what gets consumers engaged with their pension and why. Financial Conduct Authority. [https://www.fca.org.uk/publications/research/testing-what-gets-consumers-engaged-their-pension-and-why]
- Risk warning - Hayes, L., Thakrar, A., & Lee, W. (2018). Now you see it: drawing attention to charges in the asset management industry. *FCA Occasional Paper*, (32). [https://www.fca.org.uk/publications/occasional-papers/occasional-paper-no-32-now-you-see-it-drawing-attention-charges-asset-management-industry]
- Framing - Fesenfeld, L., Sun, Y., Wicki, M., Beiser-McGrath, L., & Bernauer, T. (2021). Systematic review raises doubts about the effectiveness of framing in climate change communication [https://www.researchsquare.com/article/rs-445613/v1]
- Ownership - Milkman, K. L., et al. (2022). A 680,000-person megastudy of nudges to encourage vaccination in pharmacies. *Proceedings of the National Academy of Sciences*, 119(6), e2115126119. [https://www.pnas.org/doi/10.1073/pnas.2115126119]
- Costs/fines - Gneezy, U., & Rustichini, A. (2000). A fine is a price. *The journal of legal studies*, 29(1), 1-17. [https://www.jstor.org/stable/10.1086/468061
- Distributions - Maltby, J., Wood, A. M., Vlaev, I., Taylor, M. J., & Brown, G. D. (2012). Contextual effects on the perceived health benefits of exercise: The exercise rank hypothesis. *Journal of Sport and Exercise Psychology*, 34(6), 828-841. [https://pubmed.ncbi.nlm.nih.gov/23204361/]

Other resources suggested by participants and speakers

- ONS data visualisation and content guidance manual – ONS in-house guidance for data vis, interaction design, content design, writing for the web and creating content for different types of users.
- From plus.maths.org writing guide:
    - Uncertainty
        - Guidance on writing about and presenting statistics from the Office for National Statistics
        - Uncertainty Toolkit for Analysts in UK Government (and one page summary)

        - Guidance on communicating quality, uncertainty and change from the Government Analysis Function
        - How to communicate uncertainty from FullFact
    - Accessibility and visualisations (all from from the Government Analysis Function)
        - Guidance on charts, tables and the use of colour
        - Guidance on infographics
        - Guidance on communicating uncertainty
    - Trustworthiness
        - Five rules for evidence communication by Michael Blastland et. al, Nature, November 2020
        - Transparent communication of evidence does not undermine public trust in evidence by John R. Kerr et al, PNAS Nexus, December 2022
        - Communicating the coronavirus crisis, plus.maths.org, March 2020 – Our interview with David Spiegelhalter where he explained trustworthiness and intelligent transparency.
    - Other resources
        - How to write numbers – a free online course aimed at journalists from the Royal Statistical Society
        - Resources for journalists from the Winton Centre for Risk and Evidence Communication

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