

**UK COVID-19 Inquiry: Module 2 - Rule 9 Request to Professor Karl Friston - Reference: M2/ISAGE/01/PKF**

**1. A brief overview of your qualifications, career history, professional expertise and major publications.**

Karl Friston is a theoretical neuroscientist and authority on brain imaging. He invented statistical parametric mapping (SPM), voxel-based morphometry (VBM) and dynamic causal modelling (DCM). These contributions were motivated by schizophrenia research and theoretical studies of value-learning, formulated as the dysconnection hypothesis of schizophrenia. Mathematical contributions include variational Laplacian procedures and generalized filtering for hierarchical Bayesian model inversion. Friston works on models of functional integration in the human brain and the principles that underlie neuronal interactions. His main contribution to theoretical biology is a free-energy principle for action and perception (active inference).

Friston received the first Young Investigators Award in Human Brain Mapping (1996) and was elected a Fellow of the Academy of Medical Sciences (1999). In 2000 he was President of the international Organization of Human Brain Mapping. In 2003 he was awarded the Minerva Golden Brain Award and was elected a Fellow of the Royal Society in 2006. In 2008 he received a Medal, Collège de France. He became of Fellow of the Royal Society of Biology in 2012, received the Weldon Memorial prize and Medal in 2013 for contributions to mathematical biology and was elected as a member of EMBO (excellence in the life sciences) in 2014 and the Academia Europaea in (2015). He was the 2016 recipient of the Charles Branch Award for unparalleled breakthroughs in Brain Research and the Glass Brain Award – a lifetime achievement award in the field of human brain mapping. He holds Honorary Doctorates from the universities of York, Zurich, Liège and Radboud University. He received the Donald O Hebb Award from the International. Neural Network Society in 2022.

Friston has published over 500 articles and is the most cited academic in behaviour and neurosciences. Specific publications pertaining to coronavirus include:

Peer-reviewed [1-6] and archival [7-12] papers

1. Friston KJ, Parr T, Zeidman P, et al. Second waves, social distancing, and the spread of COVID-19 across America. **Wellcome Open Research** 2020; 5(103): 103.
2. Friston KJ, Parr T, Zeidman P, et al. Dynamic causal modelling of COVID-19. **Wellcome Open Research** 2020; 5(89): 89.
3. Friston K, Costello A, Pillay D. 'Dark matter', second waves and epidemiological modelling. **BMJ Glob Health** 2020; 5(12): e003978.
4. Sarkar, Amar et al. "The gut microbiome as a biomarker of differential susceptibility to SARS-CoV-2." **Trends in molecular medicine** vol. 27,12 (2021): 1115-1134.
5. Friston KJ, Flandin G, Razi A. Dynamic causal modelling of COVID-19 and its mitigations. **Scientific Reports** 2022; 12(1): 12
6. Bottemanne, H. and K. J. Friston (2021). "An active inference account of protective behaviours during the COVID-19 pandemic." **Cogn Affect Behav Neurosci** 21(6): 1117-1129. 419.
7. Moran RJ, Billig AJ, Cullen M, et al. Using the LIST model to Estimate the Effects of Contact Tracing on COVID-19 Endemic Equilibria in England and its Regions. **medRxiv** 2020.

8. Daunizeau J, Moran RJ, Mattout J, Friston K. On the reliability of model-based predictions in the context of the current COVID epidemic event: impact of outbreak peak phase and data paucity. **medRxiv** 2020.
9. Daunizeau J, Moran R, Brochard J, Mattout J, Frackowiak R, Friston K. Modelling lockdown-induced secondary COVID waves in France. **medRxiv** 2020.
10. Moran RJ, Fagerholm ED, Cullen M, et al. Estimating required 'lockdown' cycles before immunity to SARS-CoV-2: Model-based analyses of susceptible population sizes, 'S0', in seven European countries including the UK and Ireland. **medRxiv** 2020: 2020.04.10.20060426.
11. Friston KJ, Costello A, Flandin G, Razi A. Viral mutation, contact rates and testing: a DCM study of fluctuations. **medRxiv** 2021: 2021.01.10.21249520.
12. Friston KJ, Parr T, Zeidman P, et al. Tracking and tracing in the UK: a dynamic causal modelling study. **arXiv** e-prints 2020: arXiv:2005.07994.

**2. An outline of when you participated in Independent SAGE, the role that you performed and any matters that you advised on.**

I participated in Independent SAGE from its inception until February 2022, when I stood down on sabbatical. I attended weekly meetings, *ad hoc* meetings and weekly briefings on YouTube. My specific expertise was in (i) epidemiological modelling and (ii) specific issues relating to the neuropsychiatry of COVID-19.

*3. A summary of any reports and/or articles you have written, interviews and/or evidence you have given regarding the work of SAGE and/or its subcommittees and/or the UK's response to the Covid-19 pandemic. Please include links to those documents where possible.*

Please see the Independent SAGE website for archived reports.

I maintained and updated the DCM COVID website that contains links to various scientific reports and dashboards.

I was asked to prepare a number of reports for (and was interviewed on) various media outlets (including BBC Newsnight, Channel 4 News, UnHerd, i-news, et cetera). In addition, I served on a Scientific Advisory Board convened by Dr Raghbir Ali—Special Adviser to the Cabinet Office. This entailed weekly meetings and occasional scenario modelling reports that were forwarded to the Cabinet Office. These reports are archived on the following site:

[Scenario Modelling - Dynamic Causal Modelling, UCL, UK](#)

Finally, I co-authored several BMJ op-eds. For example:

Karl Friston: How should we respond to an upsurge in covid-19 cases?  
September 24, 2020

Karl Friston: New covid-19 restrictions can only work as a prelude to a restructured find, test, trace, isolate and support system

October 15, 2020

Modelling the pandemic—time is of the essence

November 9, 2020

Karl Friston and Anthony Costello: What we have learned from the second covid-19 surge?  
December 8, 2020

We should shift our focus from covid-19 mortality to morbidity, particularly in children  
July 6, 2021

Karl Friston and Anthony Costello: A measured approach to zero covid  
February 25, 2021

**4. Your views as to whether the work of SAGE and/or its subcommittees in responding to the Covid-19 pandemic (or the UK's response more generally) succeeded in its aims. We have previously invited independent members of SAGE and its subcommittees to address this issue by reference to the matters set out below. You may find them of assistance, although we recognise that some are likely to be beyond your knowledge. Please address this issue as you see fit.**

**a. The composition of the groups and/or their diversity of expertise;**

- My understanding of the general consensus (within and beyond Independent SAGE) was that there was a perceived **lack of public health expertise** among the members of SAGE.
- Within SPI-M there was a little evidence of expertise in complex system modelling; in particular, formal approaches to **comparing epidemiological and agent-based behavioural models**.
- The groups had a perceived lack of expertise in **control theory**, which might have been relevant for scenario modelling.

**b. The way in which the groups were commissioned to work on the relevant issues;**

**c. The resources and support that were available;**

**d. The advice given and/or recommendations that were made;**

**e. The extent to which the groups worked effectively together;**

**f. The extent to which applicable structures and policies were utilised and/or complied with and their effectiveness.**

No informed comment

**5. Your views as to any lessons that can be learned from the UK's response to the Covid-19 pandemic, in particular relating to the work of SAGE and/or its subcommittees. Please describe any changes that have already been made, and set out any recommendations for further changes that you think the Inquiry should consider making.**

From my perspective (as an expert in complex systems modelling and clinical timeseries analysis) there were missed opportunities, particularly in relation to (Bayesian) model comparison. In other words, instead of basing recommendations on a basket of different modelling initiatives, it would have been, in principle, possible to assess the evidence for different models and weight their predictions in proportion to model evidence (a.k.a., marginal likelihood). However, to realise this (standard) approach to real time estimation (nowcasting) and forecasting, it would have been

necessary to discuss the implementation of (variational) Bayesian model comparison procedures with members of the SPI-M.

One obvious mechanism—that would have enabled these discussions—would be to adopt the standard procedure in communicating scientific reports; namely, **peer review**. Practically, this could involve **regular (online) peer-review sessions under the auspices of the Royal Society**. These would provide an opportunity for members of SAGE to present their assumptions and procedures to a broader church of expertise, to ensure best practice and underwrite scientific consensus.

This could be gracefully implemented by re-purposing the RAMP initiative: instead of reviewing scientific papers as a triage exercise for the members of SPI-M, the contributors to RAMP could be invited to review and comment upon the work of SAGE *per se*.

**6. A brief description of documentation relating to these matters that you hold (including soft copy material held electronically). Please retain all such material. I am not asking for you to provide us with this material at this stage, but I may request that you do so in due course.**

- An example of peer-review and critique of SPI-M modelling: this brief report was prepared for the Cabinet Office.
- Background documentation could include peer-reviewed scientific papers (please see above) and other public domain material; e.g., a BMJ Op-Ed: [Modelling the pandemic—time is of the essence - The BMJ](#)

Yours faithfully,

**Personal Data**

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