Institution:
University of Cambridge

Unit of Assessment:
UoA10

Title of case study:
Communication of Risk and Uncertainty

1. Summary of the impact (indicative maximum 100 words)

This case study concerns the work of Professor David Spiegelhalter as Winton Professor for the Public Understanding of Risk at the University of Cambridge. Based on his research on risk communication, he has made numerous contributions to public service, influencing the way health screening information is given to the public, and public policy on breast implants and plain packaging of cigarettes. In addition, through lectures, Twitter, radio and TV appearances he has become a popular commentator on risk issues and reached a substantial segment of the UK public. He has had a continuing impact on the way that statistics, risk and uncertainty are discussed in the UK today.

2. Underpinning research (indicative maximum 500 words)

Following his appointment as Winton Professor of the Public Understanding of Risk at the Cambridge University Department of Pure Mathematics and Mathematical Statistics (DPMMS) in 2007, Professor David Spiegelhalter has researched the communication of risk and uncertainty and engaged in extensive collaborations. These fall under three main headings, although with considerable overlap:

- ***Communication and visualisation of risk:*** There is increasing demand for attractive and informative visualisations of quantified uncertainty, whether it concerns health outcomes, future weather, or financial forecasts, and this has become an active area of research within medicine and psychology. From 2007 with Mike Pearson (Computer Associate throughout the period) and Ian Short (Research Associate until his departure in 2010) in the Millennium Mathematics project in the Department of Applied Mathematics and Theoretical Physics (DAMTP) in Cambridge, Professor Spiegelhalter experimented with a variety of different representations, specialising in both static and animated icon arrays, as described in Spiegelhalter, Short and Pearson (2011) [1]. This work focussed explicitly on the need to communicate the magnitudes of risk and benefits to those with low numeracy, in which research has shown that multiple representations, and in particular icon arrays, can be of benefit in aiding comprehension and developing a degree of 'immunity to misleading anecdotes'. He also introduced the concept of 'microlives' – 30 minutes change in life-expectancy associated with a daily habit [2].

- ***Communication of uncertainty***: Not all uncertainties can be quantified by a probability distribution based on data. From 2009, in collaboration with Hauke Riesch (Research Associate on the Winton programme in DPMMS from 2007 to 2009, then Research Associate in the Judge Business School, Cambridge until 2011) Professor Spiegelhalter analysed the way that deeper scientific uncertainties were communicated, in particular the limitations in quantified risk analysis. A basic scale was developed while Riesch was in DPMMS and published in Spiegelhalter and Riesch (2011) [3], and the argument made for the necessity of explicit judgment in handling non-modelled uncertainty, and the need to clearly identify the level of scientific confidence in formal analyses. These ideas are particularly relevant when communicating public policy decisions in which there is a substantial degree of scientific uncertainty.

- Professor Spiegelhalter is a Principal Investigator in the University of Cambridge Behaviour and Health Research Unit (BHRU). Using his research on judgement about uncertainty, with Professor Theresa Marteau (Director, BHRU) and Rachel Pechey (Research Associate, BHRU) an elicitation exercise was carried out in 2012 on expert opinion about the possible impact of plain packaging of cigarettes [4].

- ***Media presentation of risk and statistics:*** There is considerable criticism of the way that the popular media deal with stories concerning risk and statistics. Research with Riesch from 2008

[5] analysed the process by which a scientific study is translated into media stories, and showed the vital importance of the press release in the final presentation by journalists. Based on this work, Professor Spiegelhalter has been active in promoting good practice in media reporting to both journalists and press officers.

3. References to the research (indicative maximum of six references)

*[1] DJ Spiegelhalter, I Short, M Pearson. Visualizing uncertainty about the future. *Science*, **333**: 1393-1400, 2011 DOI: 10.1126/science.1191181

*[2] DJ Spiegelhalter, Using speed of ageing and "microlives" to communicate the effects of lifetime habits and environment. *British Medical Journal*, **345**:e8223. 2012. DOI: 10.1136/bmj.e8223

*[3] DJ Spiegelhalter, H Riesch. Don't know, can't know: embracing deeper uncertainties when analysing risks. *Phil Trans Roy Soc A*, **369** 4730-4750, 2011. DOI: 10.1098/rsta.2011.0163

[4] R Pechey, D Spiegelhalter and TM Marteau. (2013) Impact of plain packaging of tobacco products on smoking in adults and children: an elicitation of international experts' estimates *BMC Public Health*, **13**:18. DOI: 10.1186/1471-2458-13-18

[5] H Riesch DJ Spiegelhalter. 'Careless pork costs lives': risk stories from science to press release to media. *Health, Risk & Society* , **13**: 47-64, 2011 DOI: 10.1080/13698575.2010.540645

(* papers best indicating the quality of the underpinning research)

4. Details of the impact (indicative maximum 750 words)

***Communication and visualisation of risk*:** Professor Spiegelhalter has worked with numerous collaborators in establishing good practice in risk communication, in particular the promotion of visualisations such as icon arrays. These include:

Spiegelhalter and Pearson's animation research [1] was used to help *Breakthrough Breast Cancer*, the largest UK breast cancer charity, Senior Information Officer [6], said "*Thank you so much for the advice of yourself and Mike Pearson for the development of Breakthrough Breast Cancer's online guide to breast screening. The icon array animations were a new venture for us and your advice and guidance was extremely helpful and has improved the end product. They are a pivotal part of the tool and feedback so far from laypersons and colleagues indicates that the animations help people to understand the complex issue of the risk of over diagnosis with breast screening very well".*

In 2012 Professor Spiegelhalter was asked to lead the statistical analysis for the Expert Advisory Group on Breast Implants that was charged with setting government policy following the Poly Implant Prothese (PIP) breast implants scandal [7]. This complex analysis required careful communication of the deeper uncertainties due to limited evidence, and led to the government decision not to undertake removal of the implants unless clinically justified.

The elicitation exercise on the effect of plain packaging of cigarettes is a 'highly accessed' paper on Biomed Central (over 3000 in the first 3 months) [8]. The Department of Health is using this study [9] as a major part of the impact assessment for deciding a policy on plain packaging. The importance of this research is reflected in the tobacco industry sponsoring full-page advertisements in national newspapers criticising the study.

Professor Spiegelhalter has explained the techniques for communication and visualization set out in his research in numerous schools and public talks to around 40,000 people since 2008 including around 16,000 school students. A teacher in a comprehensive school [10]reported *"As a result of David Spiegelhalter's visit, several of my year 13 students have openly said they are very much more interested in pursuing a career in Statistics as they could see how useful and interesting it could be."*

***Media presentation of risk and statistics*:** Based on his research on the presentation of risk stories in the news, good practice in media reporting has been promoted by Professor Spiegelhalter through, for example,

Working closely with the Science Media Centre from 2008, resulting in numerous quotes provided in leading news outlets concerning risk stories. This led to Professor Spiegelhalter being awarded the 2011 Science Communication Award for Established Researchers from the Society of Biology. In addition, he was a member of the group that produced guidance for science reporting that had been requested by the Leveson Inquiry [11]. The Chief Executive of the Science Media Centre [14], said: *"From mobile phones and cancer to vaccination and heart disease, he has answered countless calls from journalists to help them understand complex pieces of scientific research. Without his involvement, these public health stories would be prone to inaccuracy. David's patience and willingness to engage, as well as a flair for pithy soundbites and clever analogies, means the public are well informed about health and science through the popular media."*

Engagement with newspapers leading to the adoption of improved practices, for example meetings with sub-editors at The Times and groups of reporters from the Guardian, Daily Mail, Daily Telegraph and ITN, and lecturing to trainee journalists and press officers. The Chief Science Reporter, The Times [14], said: *"David makes the subjects of risk and statistics not only easy to understand, but also entertaining and intriguing. He's helped us at The Times on all kinds of stories. He's also come in to give our sub-editors a talk on the importance of being rigorous in reporting statistics, which certainly had an impact on the way they went about their jobs."*.

Numerous public talks on media portrayal of statistics: including to over 500 at the Cambridge Science Festival "*100% of people who filled in an evaluation card said 'How to spot a shabby statistic' was good or very good (85% very good!)"*[13].

Professor Spiegelhalter comments on risk and statistics in the media on Twitter as @undunc (>6000 followers, top 0.01% of Twitter users) and in 2012 was among 'top 6 scientists on Twitter' in Observer magazine.

Professor Spiegelhalter's YouTube video on risk communication has had over 85,000 views.

In 2012 Professor Spiegelhalter fronted a one-hour BBC4 documentary 'Tails You Win, the Science of Chance' that featured visualisations based on the research of Spiegelhalter and Mike Pearson into icon arrays for 'possible futures', and included contributions from the Bank of England on handling deeper uncertainties. The YouTube clip has received over 17,000 [15] views. Viewing figures for the first showing were around 750,000 [12], extremely high for a BBC4 science programme. "*Understandably, much of human endeavour has amounted to an effort to quantify, regulate and eventually overcome chance. Spiegelhalter is an immensely engaging guide to this struggle, meeting seismologists, gamblers, statisticians and others who study the throw of the dice, metaphorical or literal"* [16]

Professor Spiegelhalter was the subject of an episode in the Radio 4 series '*A Life Scientific'* in June 2013, discussing his work on Microlives and reaching an audience of over 2 million.

5. Sources to corroborate the impact (indicative maximum of 10 references)

[6] Screening *Breakthrough Breast Cancer,* Senior Information Officer

[7] Breast Implants https://www.gov.uk/government/publications/poly-implant-prothese-pip-breast-implants-final-report-of-the-expert-group

[8] Email from Biomed Central confirming number of downloads

[9] Email from Department of Health confirming use of study in policy assessment

[10] Email from Teacher at Meridian School, Royston

[11] Proposed guidelines to Leveson
http://www.levesoninquiry.org.uk/wp-content/uploads/2012/07/Second-submission-to-Inquiry-from-Guidelines-for-science-and-health-reporting-31.05.12.pdf

[12] E-mail from BBC about viewing figures for 'Tails you win, the Science of chance'

[13] Public talks on media presentation – Evaluation Compendium and Cambridge Science Festival feed back

[14] Submission for Society of Biology Award:
http://www.jonathanpegg.com/pages/content/index.asp?PageID=255

[15] Link to YouTube video Maximise your chances of living to 100 - Tails You Win:
http://www.youtube.com/watch?v=vApS8EkopTI

[16] The Guardian TV Listings and Previews 15th-19th October:
http://www.theguardian.com/tv-and-radio/2012/oct/15/tv-listings-previews-15-19- October