

Ethics of quantification

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Where to find this talk: www.andreasaltelli.eu







= more material on my web site

From the lesson of Thursday: the Cartesian dream; the critique of technology; the crisis of science; implication for democratic representation…

How are we taught our science?

Karl Pearson (a social Darwinist) suggests not wasting resources on social programs as:

"No degenerate and feeble stock will ever be converted into healthy and sound stock by the accumulated effects of education, good laws, and sanitary surroundings"

Karl Pearson



Pearson, K., 1892, The Grammar of Science, Walter Scott Publisher, London, p.32.



American Philosophical Society. Noncommercial, educational use only.

Francis Galton and Karl Pearson (the one of chi-squared); laboratory of biometrics; distinguishing army officers from private soldiers from criminals convicted of murder from non-violent felons from Jews …





The Jewish type …



University College, London. Noncommercial, educational use only.



The first R&D Statistics ever, by Francis Galton (1822–1911)

Measuring the numbers of sons and daughters of 'great men of science' will tell us whether a society degenerates toward stupidity (Benoît Godin, 2010)

Godin, B., From Science to Innovation, INRS, Montreal, Canada, Communication presented to the Government-University-Industry Research Roundtable (GUIRR) US National Academy of Sciences, Washington, May 21, 2010. Kuhn said that the "educational initiation that prepares and licenses the student for professional practice… is both rigorous and rigid"

and "It is a narrow and rigid education [in physics/science], probably more so than any other except perhaps in orthodox theology"



Thomas Kuhn, The structure of scientific revolution, 192, Chapters I and XIII

and "the member of a mature scientific community is, like the typical character of Orwell's 1984, the victim of a history rewritten by the powers that be."



Thomas Kuhn, The structure of scientific revolution, 192, Chapter XIII Thus disciplinary advancements are presented in textbooks as the "perception of the obvious" made by one-eyed men in the kingdom of the blinds (Ravetz, 1971).

Can statisticians ignore their role in Eugenics, can chemists ignore what is phlogiston, or geologists how Alfred Lothar Wegener 1915 theory of Continental Drift was met with skepticism …



SIGNIFICANCE

ROYAL STATISTICAL SOCIETY ASA'I

More here

https://rss.onlinelibrary.wiley.com/doi/10. 1111/j.1740-9713.2016.00983.x Evidence based policy

PETRUCHIO: I say it is the moon. **KATHERINE:** I know it is the moon. **PETRUCHIO:** Nay, then you lie. It is the blessèd sun. KATHERINE: Then God be blessed, it is the blessèd sun.

But sun it is not, when you say it is not,

And the moon changes even as your mind.



W. Shakespeare, the Taming of the Shrew, Act IV. 'Policy based evidence' has entered the public discourse

Warring parties accuse one another of the sin

"Greenpeace […] wants is policy based evidence making not evidence based policy making" (Sanderson, 2015) …

Wilkes, G., 2015, Free Lunch: Policy-based evidence-making, Financial Times, July 3. Sanderson, A.B., 3 Feb 2015, Breitbart, see <u>http://www.breitbart.com/london/2015/02/03/academic-attacks-greenpeace-for-ignoring-the-evidence-on-gm-crops/</u>; the politician is UKIP Energy Spokesman Roger Helmer MEP.

VIDENCE. ARGUMENT.& PERSUASION IN THE POLICY

The pretended distinction between facts and value is used instrumentally

In the policy process fact and values cannot be separated in the making of an argument

VIDENCE ARGUMENT & FRSUASION I THE POLICY

"When science, technology, and public policy intersect, different attitudes, perspectives, and rules of argument come into sharp conflict. Scientific criteria of truth clash with legal standards of evidence and with political notions of what constitutes sufficient ground for action"

IDENCE. ARGUMENT.& PERSUASION THE POLICY ROCESS

Me: "the technique is never neutral" https://arxiv.org/ftp/arxiv/papers/1712/1712.06457.pdf

Majone: "In any area of public policy the choice of instruments, far from being a technical exercise that can be safely delegated to the experts, reflects as in a microcosm all the political, moral, and cultural dimensions of policy-making"

VIDENCE. ARGUMENT.& FRSUASION HE POLICY OCESS

"[my suggestion is to view a] policy analyst as a producer of arguments, capable of distinguishing between good and bad rhetoric, rather than as a "number cruncher" ... Power asymmetries in the framing of issues: those who have the deepest pockets marshal the best evidence → Instrumental use of quantification to obfuscate

A. Saltelli and M. Giampietro, "What is wrong with evidence based policy, and how can it be improved?," Futures, vol. 91, pp. 62–71, Feb. 2017.

A. Saltelli and S. Funtowicz, "What is science's crisis really about?," Futures, vol. 91, pp. 5–11, 2017.

JAMA Internal Medicine

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September 12, 2016

Special Communication | September 12, 2016

Sugar Industry and Coronary Heart Disease Research

A Historical Analysis of Internal Industry Documents

ONLINE FIRST

Cristin E, Kearns, DDS, MBA^{1,2}; Laura A, Schmidt, PhD, MSW, MPH^{1,3,4}; Stanton A, Glantz, PhD^{1,5,6,7,8}

[+] Author Affiliations

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JAMA Intern Med. Published online September 12, 2016. doi:10.1001/jamainternmed.2016.5394
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See also https://www.theguardian.com/society/2016/apr/07/the-sugar-conspiracyrobert-lustig-john-yudkin, and the story of US President Dwight Eisenhower heart attack,…

"our findings suggest the industry sponsored a research program in the 1960s and 1970s that successfully cast doubt about the hazards of sucrose while promoting fat as the dietary culprit in CHD [coronary hearth disease]"

http://archinte.jamanetwork.com/ article.aspx?articleid=2548255

Online First > Special Communication | September 12, 2016 Sugar Industry and Coronary Heart Disease Research A Historical Analysis of Internal Industry Documents Internal

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JAMA Internal Medicine

JAMA Intern Med. Published online September 12, 2016. doi 10.1001/jamainternmed.2016.5394

"One of the most important books of the year . . . What it has to say needs to be heard." ---The Christian Science Monitor

> The book that inspired the film MERCHANTS OF DOUBT.



Tobacco Smoke to Global Warming

NAOMI ORESKES & ERIK M. CONWAY





Naomi Oreskes Beware: transparency rule is a Trojan Horse



Like tobacco lobbyists and climate-change deniers, the US Environmental Protection Agency is co-opting scientific trappings to sow doubt, warns Naomi Oreskes.

Science and lobbying

(US) corporate interest can spend on lobbying \$34 for each dollar spent by diffuse interest and unions combined



Lee Drutman



(EU) the Brussels concentration effect



Sylvain Laurens



LOBBYISTS AND BUREAUCRATS IN BRUSSELS

CAPITALISM'S BROKERS



For both scholars a salient aspect of this power is lobbyists' access to more and better disseminated science

→ Urgent a remedial action to give citizens and political staffers Some structured mechanism of access to independent scientific evidence (L. Drutman)

See discussion on OTA in Adam Keiper, 2004, Science and Congress, The New Atlantis, https://www.thenewatlantis.com/publications/science-and-congress

"HIS MASTER'S VOICE" REG. U.S. PAT. OFF.

"Regulatory policy is increasingly made with the participation of experts, especially academics. A regulated firm or industry should be prepared whenever possible to coopt these experts. This is most effectively done by identifying the leading expert in each relevant field and hiring them as consultants or advisors or giving them research grant or the like"

Owen, B. M., & Braeutigam, R., 1978 The regulation game, : Strategic Use of the Administrative Process, Ballinger Press "This activity requires a modicum of finesse; it must not be too blatant, for the experts themselves must not recognize that they have lost their objectivity and freedom of action"



Owen, B. M., & Braeutigam, R., 1978 The regulation game, : Strategic Use of the Administrative Process, Ballinger Press

Numbers and

trust



Theodor M. Porter



Theodore M. Porter, Trust in Numbers, The Pursuit of Objectivity in Science and Public Life, Princeton 1995
p. 8: "The appeal of numbers is especially compelling to bureaucratic officials who lack the mandate of a popular election, or divine right.



A decision made by the numbers (or by explicit rules of some other sort) has at least the appearance of being fair and impersonal." Theodore M. Porter TRUSTIN TRUSTIN TRUSTIN The Pursuit of Objectivity in Science and Public Life p. 8: "Scientific objectivity thusprovides an answer to a moraldemand for impartiality and fairness.

Quantification is a way of making decisions without seeming to decide.

Objectivity lends authority to officials who have very little of their own."

Trust, authority and styles of quantification: two different stories









Porter's story: Quantification needs judgment which in turn needs trust …without trust quantification becomes mechanical, a system, and 'systems can be played'.







Charles Goodhart

p. 44 "Any … measures necessarily involve a loss of information … [and distorts behavior]" (Porter, 1995)

This is what we normally call Goodhart's law, from Charles Goodhart. "When a measure becomes a target, it ceases to be a good measure."

http://cyberlibris.typepad.com/blog/files/Goodharts_Law.pdf

Methods for responsible quantification

See slides of a recent course: 'Numbers for Policy' http://www.andreasaltelli.eu/presentations/#Course

Problematic quantifications

Frames

Most analyses offered as input to policy are framed as cost benefit analysis or risk analyses.



Winner, L., 1986. The Whale and the Reactor: a Search for Limits in an Age of High Technology. The University of Chicago Press, 1989 edition.



Langdon Winner



Frames: The expression 'tax relief' is apparently innocuous but it suggests that tax is a burden, as opposed to what pays for road, hospitals, education and other infrastructures of modern life (Lakoff, 2004).



George Lakoff



Lakoff, G., 2010, Why it Matters How We Frame the Environment, Environmental Communication: A Journal of Nature and Culture, 4:1, 70-81.

Lakoff, G., 2004-2014, Don't think of an elephant: know your values and frame the debate, Chelsea Green Publishing.

Caeteris are never paribus

Sensitivity auditing

EC impact assessment guidelines: what do they say about sensitivity auditing ?



http://ec.europa.eu/smartregulation/guidelines/docs/br_toolbox_en.pdf

p. 392

... where there is a major disagreement among stakeholders about the nature of the problem, ... then sensitivity auditing is more suitable but sensitivity analysis is still advisable as one of the steps of sensitivity auditing. Sensitivity auditing, $[\cdots]$ is a wider consideration of the effect of all types of uncertainty, including structural assumptions embedded in the model, and subjective decisions taken in the framing of the problem.

[…]

The ultimate aim is to communicate openly and honestly the extent to which particular models can be used to support policy decisions and what their limitations are.

p. 393

"In general sensitivity auditing stresses the idea of honestly communicating the extent to which model results can be trusted, taking into account as much as possible all forms of potential uncertainty, and to anticipate criticism by third parties." The rules of sensitivity auditing

Rule 1: Check against rhetorical use of mathematical modelling;

Rule 2: Adopt an "assumption hunting" attitude; focus on unearthing possibly implicit assumptions;

Rule 3: Check if uncertainty been instrumentally inflated or deflated.

The rules of sensitivity auditing

Rule 4: Find sensitive assumptions before these find you; do your SA before publishing;

Rule 5: Aim for transparency; Show all the data;

Rule 6: Do the right sums, not just the sums right; the analysis should not solve the wrong problem;

Rule 7: Perform a proper global sensitivity analysis.

The rules of sensitivity auditing ca be used as columns for NUSAP pedigree matrix

					Universiteit Utrecht	
xar	nple P	edigree ı	matrix pa	rameter	strength	
Code	Proxy	Empirical	Theoretical basis	Method	Validation	and the second second
4	Exact measure	Large sample direct mmts	Well established theory	Best available practice	Compared with indep. mmts of same variable	
3	Good fit or measure	Small sample direct mmts	Accepted theory partial in nature	Reliable method commonly accepted	Compared with indep. mmts of closely related variable	
2	Well correlated	Modeled/derived data	Partial theory limited consensus on reliability	Acceptable method limited consensus on reliability	Compared with mmts not independent	
ľ	Weak correlation	Educated guesses / rule of thumb est	Preliminary theory	Preliminary methods unknown reliability	Weak / indirect validation	Jeroen van der Sluijs
0	Not clearly related	Crude speculation	Crude speculation	No discernible rigour	No validation	



Copernicus Institute

Uncertainty Assessment - Flood Risk Management, Nottingham, 6 Oct 2004

http://www.nusap.net/



Some examples: Sensitivity auditing: the OECD PISA study

Do PISA data justify PISA-based education policy?

PISA-based education policy



International Journal of Comparative Education and Development Vol. 19 No. 1, 2017 pp. 1-17 © Emerald Publishing Limited 2396-7404 DOI 10.1108/IJCED-12-2016-0023





Q. Search analysis: research, academics.

Arts + Culture Business + Economy Cities Education Environment + Energy FactCheck Health + Medicine Politics + Society Science + Technology







With PISA the OECD gained the centre-stage in the international arena on education policies, which led to important controversies

http://www.theguardian.com/e ducation/2014/may/06/oecdpisa-tests-damagingeducation-academics

theguardian

OECD and Pisa tests are damaging education worldwide - academics

In this letter to Dr Andreas Schleicher, director of the OECD's Programme for International Student Assessment, academics from around the world express deep concern about the impact of Pisa tests and call for a halt to the next round of testing



In School children in Sichuan province in China. Academics say the OECD should develop alternatives to league tables and find more meaningful ways of reporting assessment, taking account of different cultures. Photograph: James Zeng Huang/Corbis Sygma

Critical remarks by the 80 signatories of the letter:

- Flattening of curricula (exclusion of subjects)
- Short-termism (teaching to the test)
- Promoting "life skills to function in knowledge societies"
- Stressing the student
- \ldots \rightarrow Stop the test!
- A more participatory run of the study would be advisable

Figure 1

Present value of Scenario I (improve student performance in each country by 25 points on the PISA scale) in billion USD (PPP)



Note: Discounted value of future increases in GDP until 2090 due to reforms that improve student performance in each

http://www.oecd.org/edu/school/programmeforinternationalstudentassessmentpisa/thehighcostofloweduca tionalperformance.htm

PISA's daring quantifications:

"If every EU Member State achieved an improvement of 25 points in its PISA score (which is what for example Germany and Poland achieved over the last decade), the GDP of the whole EU would increase by between 4% and 6% by 2090; such an 6% increase would correspond to 35 trillion Euro"

Woessmann, L. (2014), "The economic case for education", EENEE Analytical Report 20, European Expert Network on Economics of Education (EENEE), Institute and University of Munich.

Our study identifies both technical and normative issues:

1) Non response bias (what students are excluded; PISA non-response for England: the bias turned out to be twice the size of the OECD declared standard error in 2003.

2) Non open data, which makes SA impossible

Our study identifies both technical and normative issues:

3) Flattening curricula (do all countries wish to prosper by becoming knowledge societies?)

4) Power implications: power in the use of evidence. OECD (unelected officers and scholars) becoming a global super-ministry of education Some examples: Sensitivity analysis: the case of the Stern review Global Environmental Change 20 (2010) 298-302



Sensitivity analysis didn't help. A practitioner's critique of the Stern review

Andrea Saltelli^{*}, Beatrice D'Hombres

Joint Research Centre, Institute for the Protection and Security of the Citizen, Ispra, Italy



The case of Stern's Review – Technical Annex to postscript



William Nordhaus, University of Yale



Nicholas Stern, London School of Economics

Stern, N., Stern Review on the Economics of Climate Change.
UK Government Economic Service, London,
www.sternreview.org.uk.
Nordhaus W., Critical Assumptions in the Stern Review on
Climate Change, SCIENCE, 317, 201-202, (2007).

<u>The Stern - Nordhaus exchange on</u> <u>SCIENCE</u>

 Nordhaus falsifies Stern based on 'wrong' range of discount rate

2) Stern's complements its review with a postscript: a sensitivity analysis of the cost benefit analysis

3) Stern infers: My analysis shows robustness'



... but foremost Stern says:
 changing assumptions → important effect
 when instead he should admit that:
 changing assumptions → all changes a lot



How was it done? A reverse engineering of the analysis



% loss in GDP per capita


Same criticism applies to Nordhaus – both authors frame the debate around numbers which are …



____ ··· precisely wrong

From: Saltelli, A., D'Hombres, 2010, Sensitivity analysis didn't help. A practitioner's critique of the Stern review, *GLOBAL ENVIRONMENTAL CHANGE*, 20, 298–302. Frames as hypocognition & Socially constructed ignorance For Rayner (2012) "Sense-making is possible only through processes of exclusion. Storytelling is possible only because of the mass of detail that we leave out. Knowledge is possible only through the systematic 'social construction of ignorance'

(Ravetz, 1986)"



Steve Rayner

Jerry Ravetz

Ravetz, J., R., 1987, Usable Knowledge, Usable Ignorance, Incomplete Science with Policy Implications, Knowledge: Creation, Diffusion, Utilization, 9(1), 87– 116. Rayner, S., 2012, Uncomfortable knowledge: the social construction of ignorance in science and environmental policy discourses, Economy and Society, 41:1, 107–125. Rayner's (2012) strategies to deal with "uncomfortable knowledge".

1. Denial: "There isn't a problem"

2. Dismissal: "It's a minor problem"

Rayner, S., 2012, Uncomfortable knowledge: the social construction of ignorance in science and environmental policy discourses, Economy and Society, 41:1, 107–125.

Rayner's (2012) strategies to deal with "uncomfortable knowledge".

3. Diversion: "Yes I am working on it" (In fact I am working on something that is only apparently related to the problem)

Rayner, S., 2012, Uncomfortable knowledge: the social construction of ignorance in science and environmental policy discourses, Economy and Society, 41:1, 107–125.

Rayner's (2012) strategies to deal with "uncomfortable knowledge".

4. Displacement: "Yes and the model we have developed tells us that real progress is being achieved" (The focus in now the model not the problem).

Rayner, S., 2012, Uncomfortable knowledge: the social construction of ignorance in science and environmental policy discourses, Economy and Society, 41:1, 107–125.

"Uncomfortable knowledge" can be used as a gauge of an institution's health.

The larger the "uncomfortable knowledge" an institution needs to maintain, the closer it is to its ancient régime stage (Funtowicz and Ravetz, 1994).

Funtowicz, S.O. and Jerome R. Ravetz, 1994, Emergent complex systems, Futures, 26(6), 568–582.

Why frames 'stick'

"If is difficult to get a man to understand something when his salary depends upon his not understanding it."



Upton Sinclair

The End





Grade a set of questions using a Likert scale

Likert scale

5. Strongly agree
4. Agree
3. Neutral
2. Disagree
1. Strongly disagree

A. Our duty is to provide objective numbers to policy makers. A cost benefit analysis is useful to make sure that taxpayer money is well spent.

B. Given proper statistical tools it is always possible to arrive at a number quantifying our present state of knowledge.

C. Numbers should be objective and not the result of 'stealth advocacy'.

D. Numbers can convey a misleading impression of accuracy and precision.

E. The analyst should strive to highlight the difference between risk and uncertainty.