Societal perspectives on gene technologies and animals in agriculture. Is gene editing different?

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Overview

- Risk communication in the risk analysis process
- The importance of consumer risk perceptions
- AN overview of public attitudes to GM technologies
- Is gene editing of animals different?
- Conclusions

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Risk Communication in the Risk Analysis Process

Risk assessment is the process that is used to quantitatively or qualitatively estimate and characterize risk.

Risk management is the weighing and selecting of options and implementing controls as appropriate to assure an appropriate level of protection.

Risk communication is the exchange of information and opinions concerning risk and risk-related factors among risk assessors, risk managers, consumers and other interested parties.

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Differences between expert and citizen perceptions of risk

Risk = Toxicity X Exposure

- **Experts**
  - Rely on technical risk assessments
  - Use scientific argumentation which does not take account of socio-economic impacts
  - In theory, balance risk against benefits (but it is not always clear how socio-economic benefits, or even technical benefits, are assessed).
- **Public**
  - Use their risk perceptions to make judgements about risk
  - Require risk communication to take
  - account of their concerns as well as
  - technical risk estimates
  - Emotional (or affective) responses
  - Moral and ethical assessments
  - Trust in regulators and information

Frewer et al, 2066, Critical reviews in food science and nutrition. doi.org/10.1080/10408398.2013.801337

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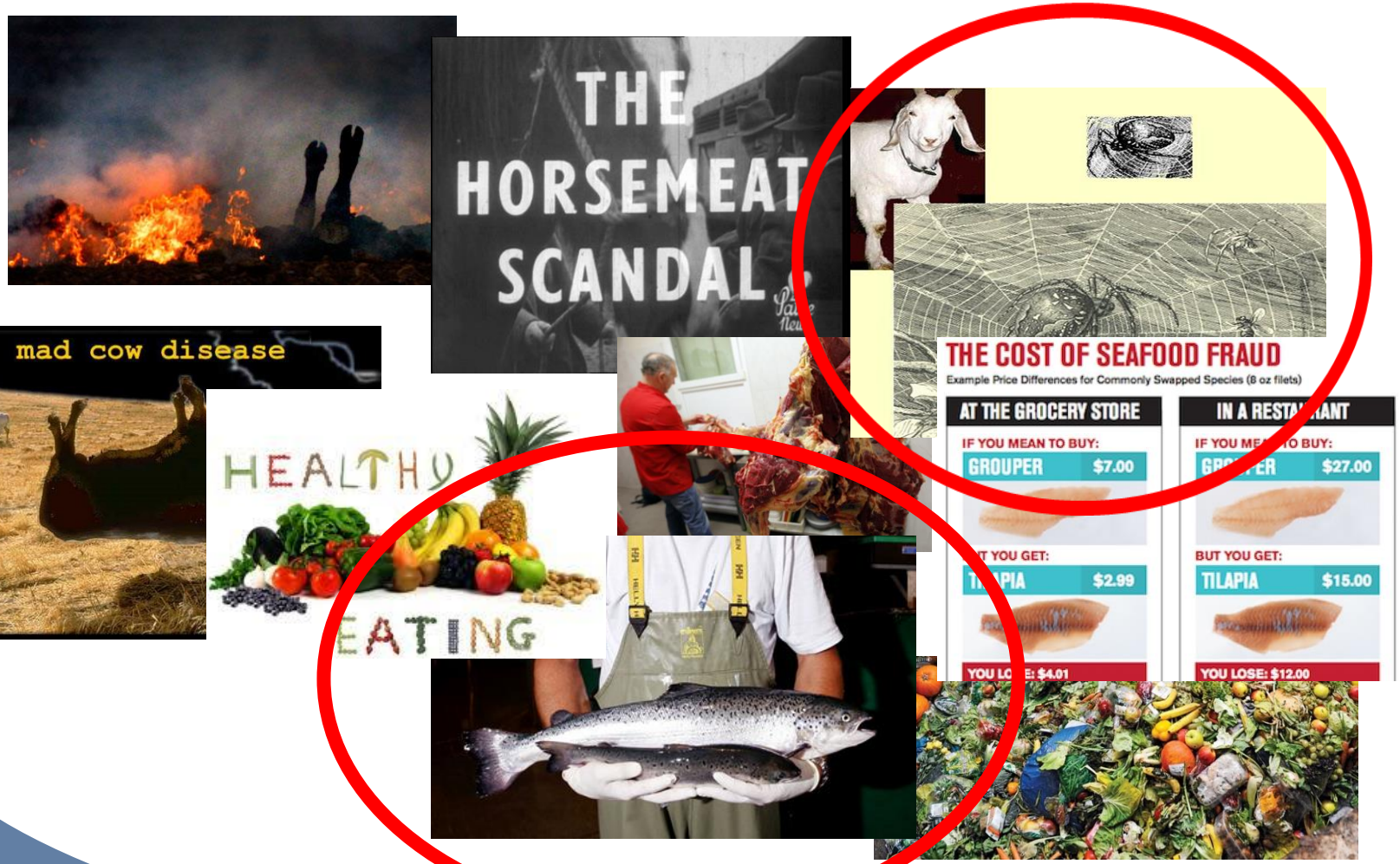
Food risks and food security



Frewer, L. J., Fischer, A. R. H., Brennan, M., Bánáti, D., Lion, R., Mertens, R. M., ... & Vereijken, C. M. J. L. (2016). Risk/benefit communication about food—a systematic review of the literature. Critical reviews in food science and nutrition, 56(10), 1728-1745.

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Technology adoption

How does risk perception influence societal acceptance of novel and potentially beneficial emerging technologies?

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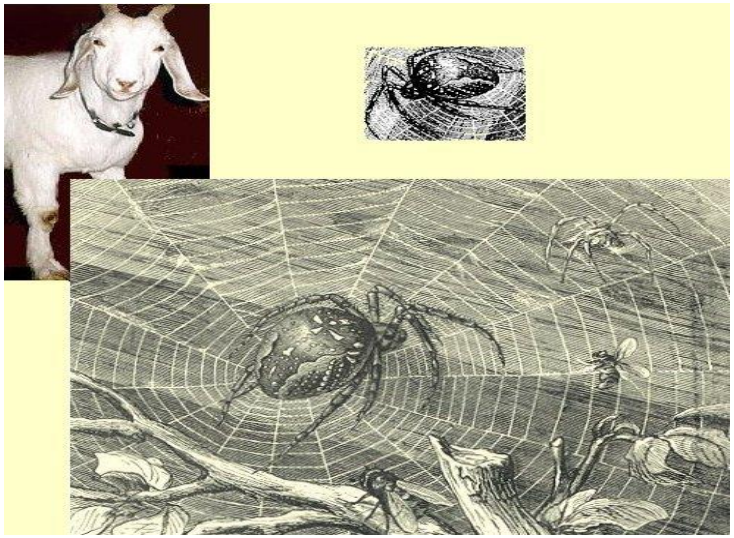
Novel applications GM animals and improved food security

Lactoferrin production
(Herman the Bull)

Aquabounty Salmon

The goat that produces spider silk in its milk (used for fabrics)



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The Observer
Medical research

This article is more than **3 years old**

Scientists deploy GM sheep in fight to treat Huntington's disease

Transgenic flock brought to UK for research into incurable brain condition, which affects more than 6,700 people in the country

Robin McKie *Observer science editor*

Sat 8 Jul 2017 22.00 BST

96 59

Jenny Morton, a professor of neurobiology at Cambridge University, with transgenic sheep imported from New

Results of meta-ananalysis – consumer attitudes to GM Foods

- ***Plant-related or "general" applications*** were more **acceptable than** *animal-related* applications.
- **Pharmaceutical production** more acceptable than **food applications**
- Risk perceptions (associated with both plants and animals) were greater in **Europe** than **North America** and **Asia.**
- Benefit perceptions were greater in **North America** and **Asia** than **Europe.**
- Moral concerns higher in **North America** and **Asia** compared to **Europe**
- ***Risk and benefit perceptions*** increased with time **everywhere**
- Potential to continue to ***map changes*** in perceptions and attitude of data added to the data base

Frewer, L. J., van der Lans, I. A., Fischer, A. R., Reinders, M. J., Menozzi, D., Zhang, X., & Zimmermann, K. L. (2013). Public perceptions of agri-food applications of genetic modification–a systematic review and meta-analysis. Trends in Food Science & Technology, 30(2), 142-152.

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Attitudes of UK citizens to Gene editing applied to animals

- Five focus groups
  - 4 in the city of Newcastle (UK)
  - 1 in rural Northumberland
- Range of ages and SE classes
- Thematic analysis (nVivo) applied to the results

Francis Z. Naab, David Coles, Ellen Goddard, Lynn J. Frewer (in preparation). Public perceptions regarding the use of genomic technologies in breeding farm animals: a qualitive study.

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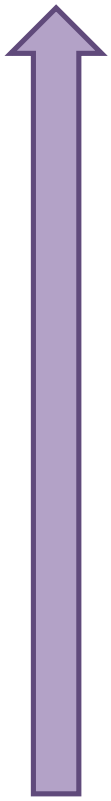
Ranking of different genomic technologies applied to animal production

Most negative



- Gene drives
- GM foods

- Gene editing
- Conservation genomics

- Accelerated breeding (no cisgenics or transgenics)
- Traditional breeding

Most positive

Naab et al (*ibid*)

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Priorities and Concerns expressed very similar when considering both GM and gene editing

- Very similar when considering all genomic technologies applied to animal production systems
- *Issue is the degree of concern…*
  - Perceived unnaturalness”
  - “Telos”
  - Alternative approaches?
  - Animal welfare
  - Ethical concern
    - Dis-enhancement
    - General disquiet
- Motivation for applying breeding technologies
  - **Financial gain**
  - **Improved animal health**
  - **Reduced negative environmental impacts**
  - **Human health**

Potentially a “tipping point” for acceptance of Gene Edited animals

Naab et al (*ibid*)

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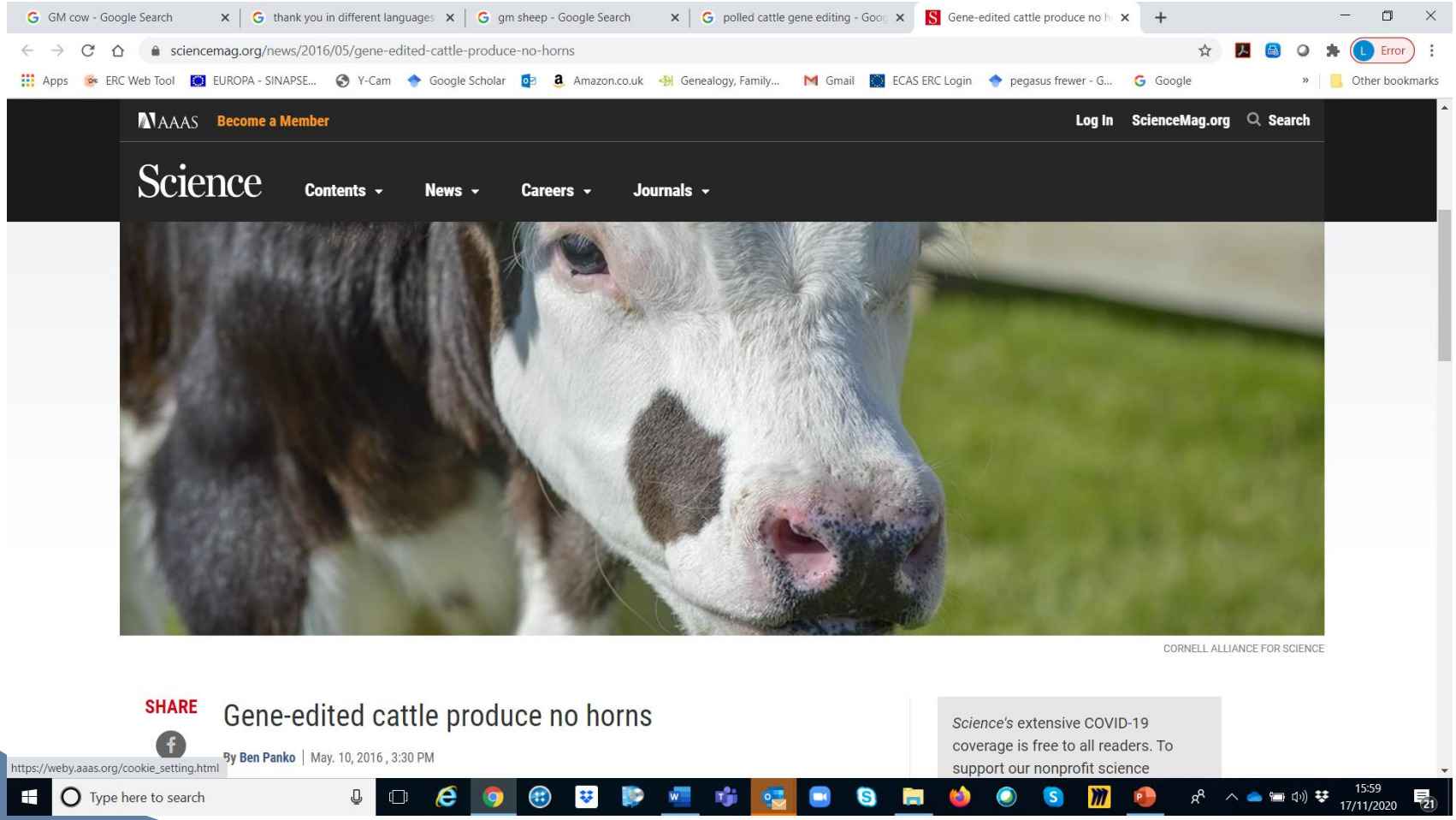
Improved welfare or unnatural application of gene editing?
Polled cattle



Naab et al (*ibid*)

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Genome Editing and Farmed Animals: Nuffield Council on Bioethics

- Identified as priority field of applications in 2016 report, *Genome Editing: an ethical review,* because:
  - Comparatively near-term application addressing significant societal challenges
  - Relatively little discussed in public sphere (despite significance of public in earlier genomic technologies)
  - Raises significant ethical issues (relating to: animal welfare, environment, human and animal health, traceability, labelling, food security, food culture, globalisation and technology transfer etc.)

www.nuffieldbioethics.org/topics/animals-food-and-environment/genome-editing-and-farmed-animals

In-depth inquiry

- Working group of 11 independent experts from variety of fields and backgrounds, convened in 2019
  - Site visits and fact-finding meetings with invited experts
  - Open call for evidence (June – September 2019)
  - Commissioned literature review on public attitudes to genome technologies and novel foods
  - Review of relevant ethics literature
- Evidence contributes to extended working group deliberation
- Report due in Spring 2021

www.nuffieldbioethics.org/topics/animals-food-and-environment/genome-editing-and-farmed-animals

Public dialogue

- Review of literature found
  - Exploration of public attitudes lags behind new technologies and applications
  - Attitudes relate to complex factors that are difficult to unpick
  - There is comparatively little existing quantitative research
- Questions
  - How much can be read across from fist generation rDNA technologies to Genome Editing?
  - How much can be read across to animals from attitudes to crops?
  - How can people with different perspectives engage with each other to address common societal challenges?
- **Policy needs to be informed by up-to-date public dialogue**

www.nuffieldbioethics.org/topics/animals-food-and-environment/genome-editing-and-farmed-animals

Conclusions

- Gene editing of animals
  - Generally not perceived as negatively as genetic modification
  - Attitudes nuanced by context
  - “Why is it being applied”
  - Ethical concerns
    - Animal welfare versus dis-enhancment
    - The case of polled cattle.

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