Expert Elicitation – Insights and Lessons Learned

CAsToR Symposium 2021 – Simulation Modeling in Tobacco Regulatory Science: Where are we and where should we go next?

June 8, 2021

What is Expert Elicitation (EE)?

- Structured method of systematically synthesizing the opinions of experts where there is uncertainty due to insufficient data/information
- Heuristic
- Scientific consensus method
- Quantitative or qualitative

Select Application Areas for Expert Elicitation

- Gathering data not accurately known or available
- Putting together the structure of a model
- Developing causal relationships in complex economic or social phenomena
- Prioritizing objectives

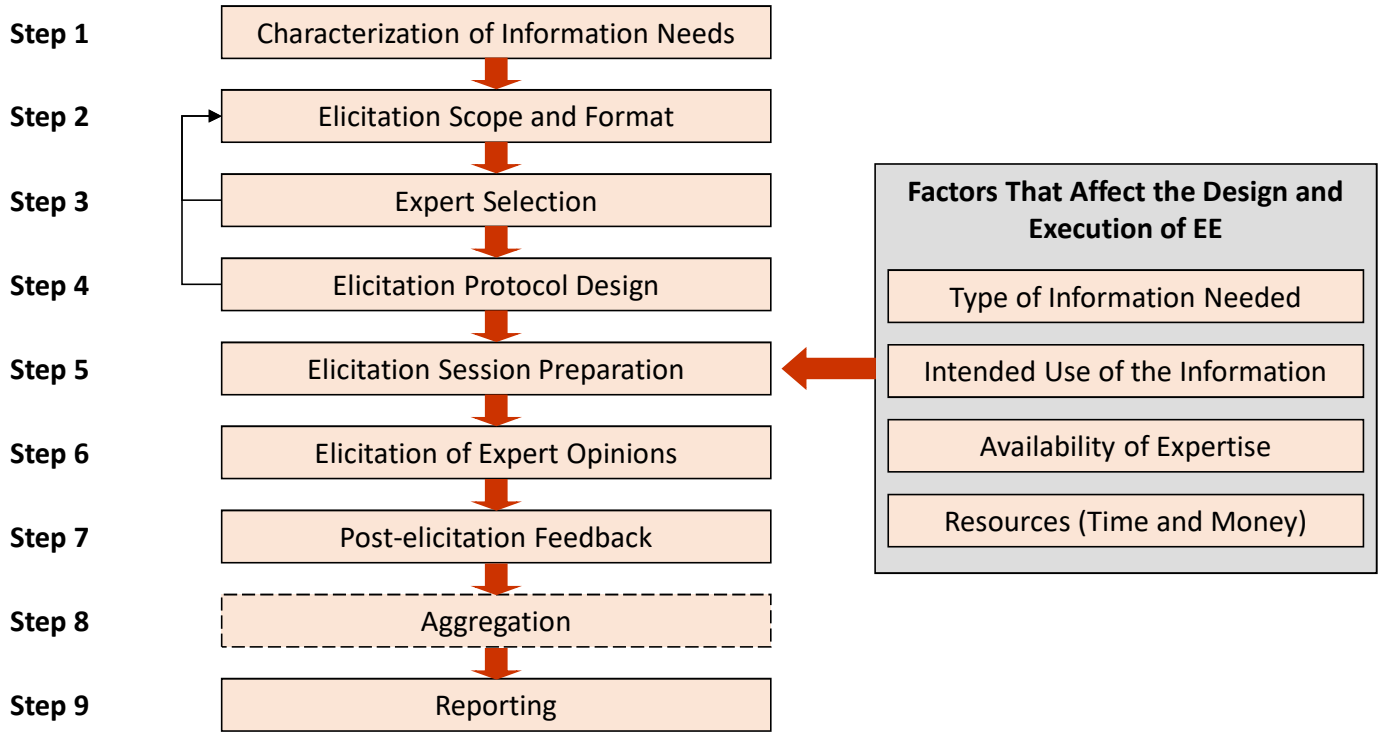
When is Expert Elicitation Desirable?

- Unavailable or unobtainable data of suitable quality
- Conflicting evidence and/or models
- Available experts
- Available financial resources

- Empirical data exists with a high degree of consensus
- Insufficient expertise
- Availability of other acceptable methods for obtaining the information that are less intensive and expensive

Source: U.S. Environmental Protection Agency, 2009

What does A Typical Expert Elicitation Process Look Like?



Source: Knol, A.B., Slottje, P., van der Sluijs, J.P. *et al.* 2010

Use of EE in Tobacco Control Research

Study	Objective	Type of EE	Expert Uncertainty	Number of Experts	Protocol	Mode	Aggregation
Trochim et al., 2003	To develop a conceptual framework that describes the tactics the tobacco industry uses to undermine tobacco control programs	Qualitative	Not assessed	34 (online); 13 (face-to-face)	Nominal Group Technique / Kaplan Method	Online & Face-to-face	Behavioral
Levy et al., 2004	Assess the relative risk of use of LN-SLT compared with cigarette smoking with respect to mortality, lung cancer, heart disease, and oral cancer	Quantitative	Self-assessed	9	Delphi (3 rounds)	Questionnaires	Mathematical (linear pool)
Pechey, Spiegelhalter and Marteau, 2013	To estimate the likely impact of plain packaging of tobacco products on smoking prevalence in adults and the percentage of children trying smoking	Quantitative	Self-assessed	33	Semi-structured Interviews	Telephone	Mathematical (linear pool)
Apelberg et al., 2018	To estimate the effect of reducing nicotine in cigarettes to minimally addictive levels on rates of cigarette-smoking cessation, switching from cigarette smoking to products excluded from the policy, dual use, cigarette-smoking initiation, and initiation of products excluded from the policy	Quantitative	Self-assessed	8	Delphi (1 round)	Questionnaires	Mathematical (linear pool)
Levy et al., 2021	To estimate the transitions from cigarette use to other combustible tobacco product, smokeless tobacco, novel nicotine delivery product use, or no tobacco use under a federal menthol cigarettes and cigar ban	Quantitative	Self-assessed	11	Delphi (2 rounds)	Questionnaires	Mathematical (linear pool)

Use of EE in Other Areas

Food and Drug Administration (FDA)

- To estimate the frequency of inappropriate food handling practices in households and retail establishments by type of food
- To 1) formulate a model of *Salmonella* transmission to tomatoes, and 2) estimate the relative effectiveness of a range of tomato pre- and postharvest practices in reducing the likelihood of *Salmonella* contamination

Environmental Protection Agency (EPA) Criteria Air Pollutant Program

- Determine particulate matter (PM) concentration response for mortality
- Regulatory impact analysis of final PM National Ambient Air Quality Standards

Intergovernmental Panel on Climate Change (IPCC)

- Address specific components of the climate change issue, e.g., biomass, temperature gradient, etc.

Lesson 1: Select Experts Carefully

Types of experts

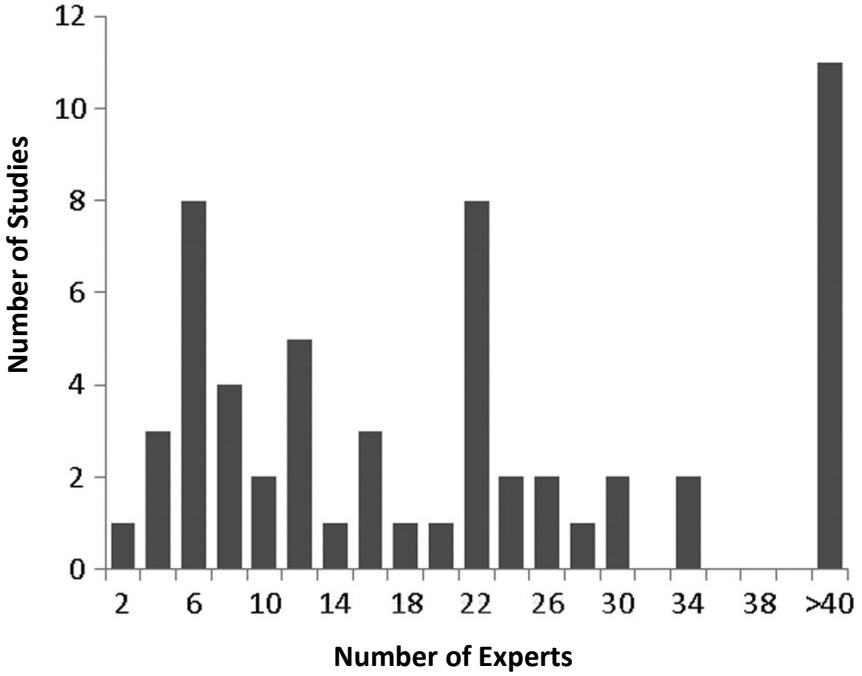
- Professionals (generalists, subject-matter experts, and normative experts)
- Non-professionals

Balance

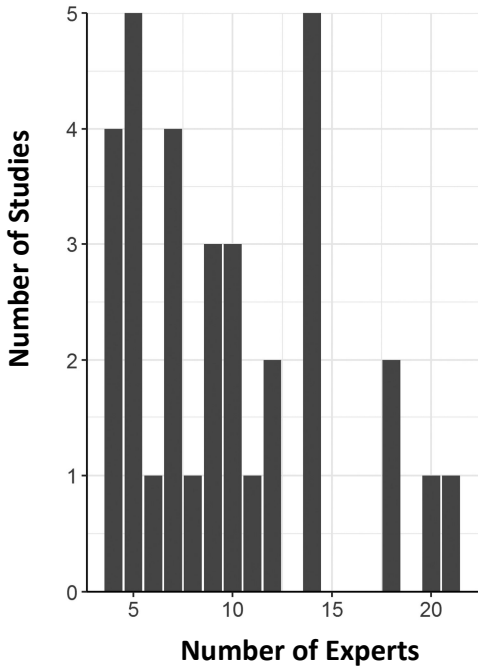
- High degree of value uncertainty
- High stakes
- Need for wide peer-community acceptance

- Agency recommendations
- Recommendation by other experts
- Participation on scientific committees (e.g., NAS or SAB)
- Literature review
- Citation analysis

Lesson 2: Optimum Number of Experts Ranges from 6 to 22



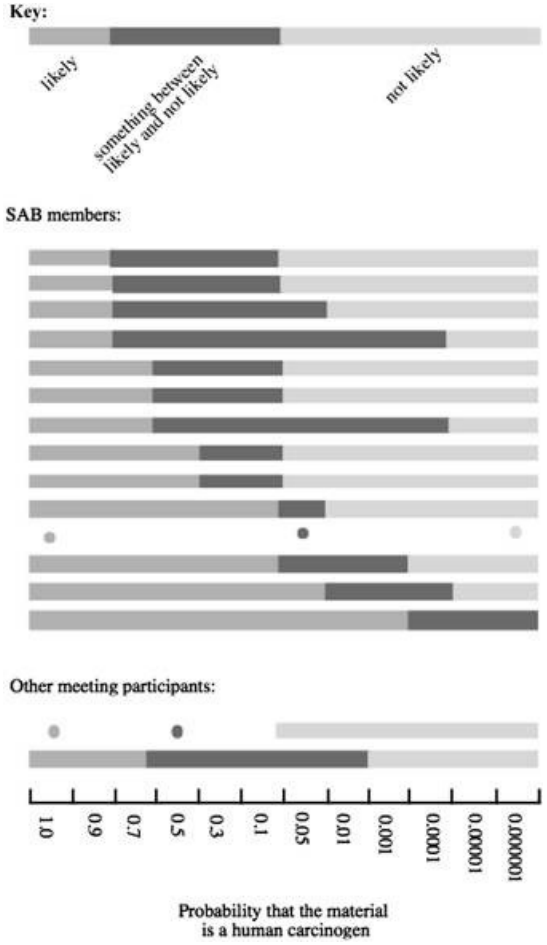
Source: Butler, Thomas, and Pintar, 2015



Source: Colson and Cooke, 2018

Lesson 3: Avoid Use of Qualitative Terms

- Results obtained when members of the Executive Committee of the EPA Science Advisory Board were asked to assign numerical probabilities to uncertainty words that had been proposed for use with EPA cancer guidelines



Source: Morgan, 2014

Lesson 4: Beware of Heuristics and Biases

- Availability
- Anchoring and adjustment
- Representativeness
- Overconfidence
- Hindsight bias
- Motivational bias

Lesson 4 (cont.): Mitigate or Minimize Heuristics and Biases

- Familiarize the expert with the elicitation process
- Use familiar measurements and ask questions within area of expertise
- Decompose elicitation into small distinct parts; perform combinatorial exercises using a computer
- Be specific with wording – use a graphical representation if possible
- Do not provide example numbers for expert to anchor to
- Ask the expert to discuss estimates and give evidence for and against
- Provide feedback and allow expert to re-consider

Source: Kynn, 2008

Lesson 5: Prepare Experts for the Elicitation

- Introduce the scope and purpose of the study
- Provide training on:
  - How to think about probabilities
  - How to avoid biases
- Provide post-elicitation feedback

Additional Insights

- Performance weighting of expert responses (aka classical model) performs better than equal weighting but only slightly
- Jury is still out on different elicitation methods (Delphi vs. nominal group technique vs. decision conferencing, etc.)
- EE is well-suited for complex technical problems, unobtainable data, conflicting conceptual models
- EE is not a substitute for rigorous empirical methods
- Understanding the source of differences between experts can lead to insights, consensus, and/or revision of the elicitation protocol → May be more valuable than any aggregate finding

Questions?