Introduction to Discrete Choice Experiments

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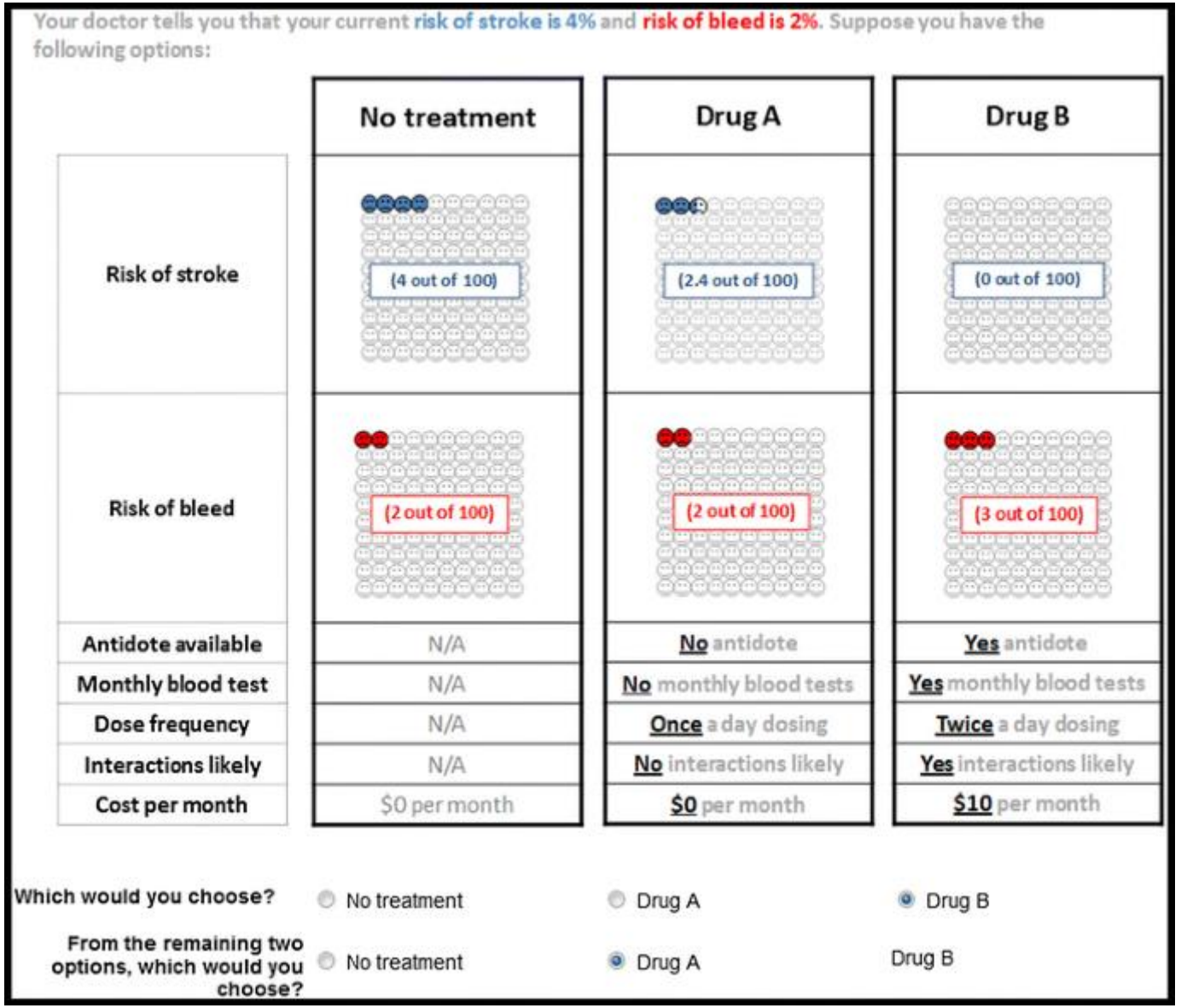
Including joint work with DARTH workgroup

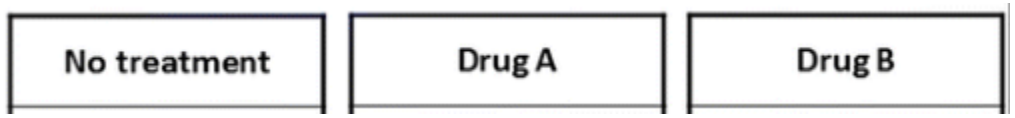
Discrete Choice Experiments

- Discrete choice experiments are a stated preference method where subjects must choose between two or more options that are defined through a set of *attributes.*
- Each attribute can take values from a pre-defined set of *levels.*



Discrete Choice Experiments

- Data from a DCE gives information about preferences.
- These data can be used to estimate utilities and willingness-to-pay

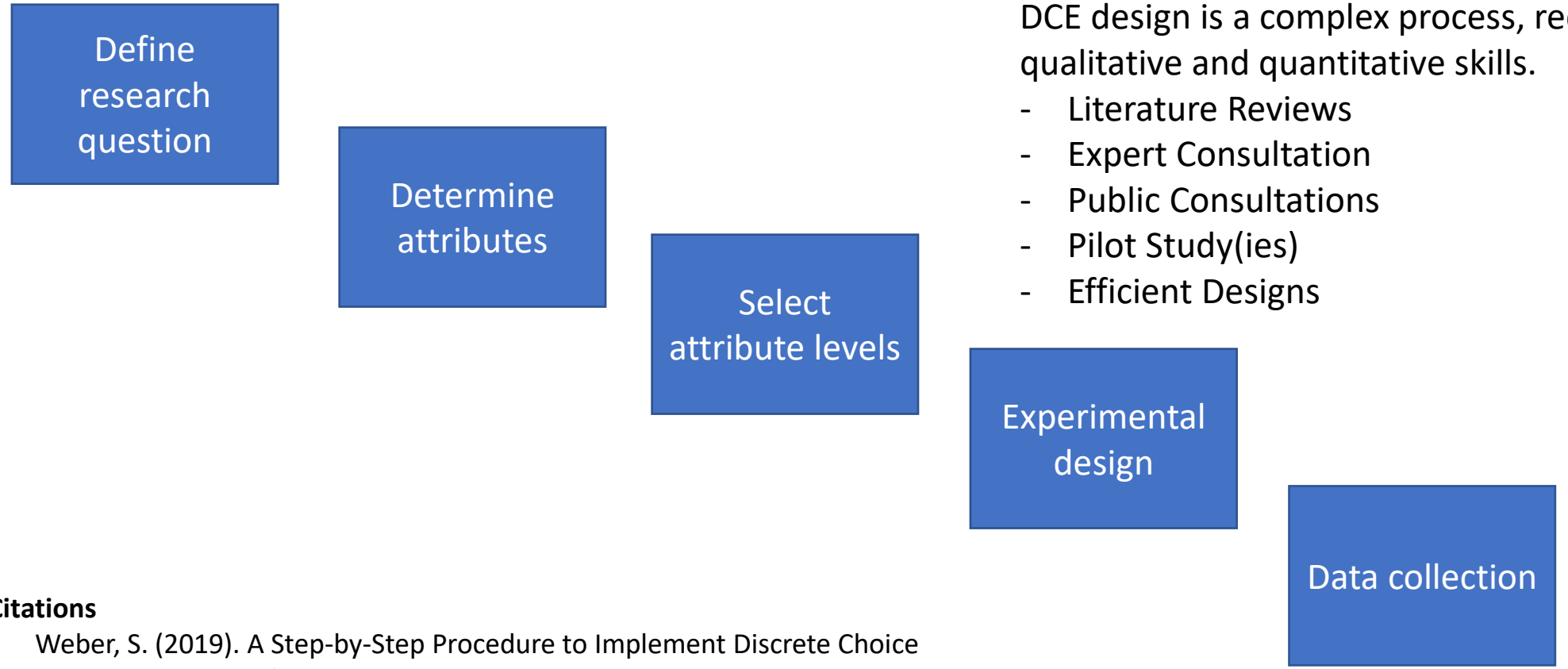


Underlying Utility	$U_{\text{No Treatment}}$	$U_{\text{Drug A}}$	$U_{\text{Drug B}}$
Revealed Ranking	3	1	2

$$U_{\text{Drug A}} \geq U_{\text{Drug B}} \geq U_{\text{No Treatment}}$$

- Analysing the DCE data can estimate the utility conditional the given attributes.

Designing a Discrete Choice Experiment



DCE design is a complex process, requiring both qualitative and quantitative skills.

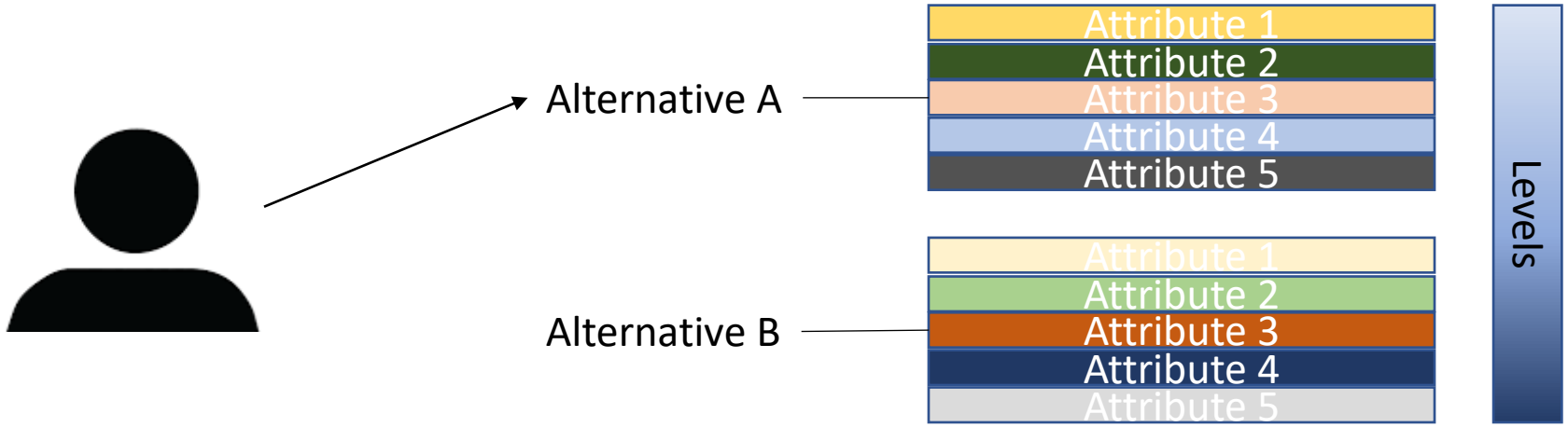
- Literature Reviews
- Expert Consultation
- Public Consultations
- Pilot Study(ies)
- Efficient Designs

Citations

- Weber, S. (2019). A Step-by-Step Procedure to Implement Discrete Choice Experiments in Qualtrics.
- Coast J, Horrocks S. (2007) Developing attributes and levels for discrete choice experiments using qualitative methods.
- Johnson FR, Lancsar E, Marshall D, Kilambi V, Muhlbacher A, Regier DA, et al. (2013) Constructing experimental designs for discrete choice experiments: report of the ISPOR conjoint analysis experimental design good research practices task force.

Discrete Choice Experiments

- A DCE consists of asking I individuals to choose between J alternatives across S scenarios.
- A scenario is a single choice that the individual is required to make, where each of the J alternatives are defined in terms of a given set of attribute levels $A_{i,j,s}$, for $i = 1, \dots, I, j = 1, \dots, J, s = 1, \dots, S$.



Estimating Utilities

- The utility U for individual i, alternative j and scenario s is $U_{i,j,s}$
- A DCE gives data $y_{i,s}$, the choice for individual i in scenario s.
- An individual will choose option j if it has the highest utility

$$P_{i,j,s} = Prob\left(U_{i,j,s} > U_{i,l,s}\right) = Prob(y_{i,s} = j)$$
$$\text{for all } l \neq j$$

- As we observe choices, the scale of the utility is unidentifiable.

$$Prob\left(U_{i,j,s} > U_{i,l,s}\right) = Prob\left(aU_{i,j,s} + b > aU_{i,l,s} + b\right)$$

Multinomial Logistic Regression

- The impact of the attributes on the utility can be estimated:

$$U_{i,j,s} = \alpha_j + \beta A_{i,j,s} + \gamma_j X_i + \epsilon_{i,j,s}$$

where X_i are individual-specific covariates and $\epsilon_{i,j,s}$ is an error term.

- If $\epsilon_{i,j,s}$ is assumed to be i.i.d Gumbel distribution with shape parameter 1, then α_j, β and γ_j are estimated using *logistic regression*.
- Individual-specific slopes $\beta_{i,j}$ can be specified.
- Other distributions for the error functions require different models, i.e., normally distributed errors require probit regression.

Interpreting the Results

- The β coefficients estimate the utility weights for each attribute
- The willingness to pay is the ratio of two coefficients:

For two attributes *price* and *wait time,* $\frac{\beta_{wait}}{\beta_{price}}$ is the willingness to pay to be seen a minute sooner.

- The "true" utility is unidentifiable but external information can be used to *anchor* U to a given scale:

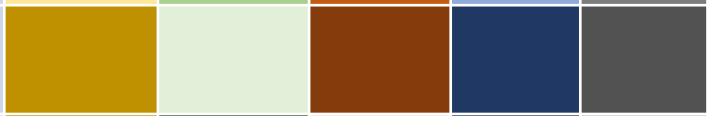
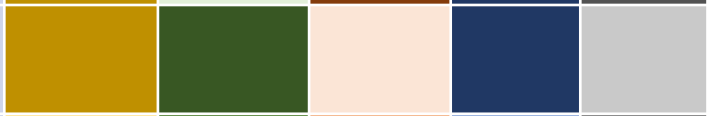
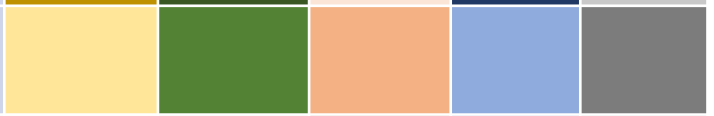
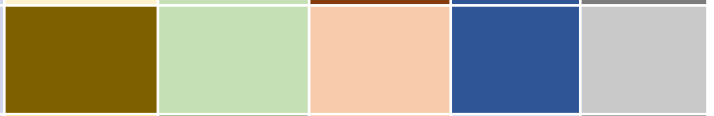
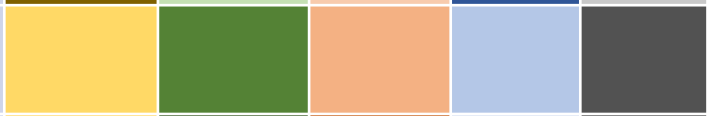
For EQ5D, the utility of state 11111 is set to 1 with another state estimated by Time Trade Off or Standard Gamble.

- A DCE that include price or time naturally gives an external anchor.

Data: Wide Form

ID	Choice	Attributes of A	Attributes of B
1	A		
1	B		
1	A		
2	A		
⋮	⋮	⋮	⋮

Data: Long Form

ID	Choice	Alternative	Attributes
1	TRUE	A	
1	FALSE	B	
1	FALSE	A	
1	TRUE	B	
1	TRUE	A	
1	FALSE	B	
2	TRUE	A	
2	FALSE	B	
⋮	⋮	⋮	⋮

Discrete Choice Experiment in R

- There are several packages to analyse DCEs in R.
- We will use the mlogit package which requires *long form* data
- The apollo package is more flexible but has its own data storage method - http://www.apollochoicemodelling.com/
- The Rchoice package is another alternative.
- Packages for generalised linear models are also suitable, e.g., glm, glmmTMB.

Citations

- Emily Lancsar, Denzil G. Fiebig, Arne Risa Hole (2017) Discrete Choice Experiments: A Guide to Model Specification, Estimation and Software, *PharmacoEconomics*, 35:697–716
- Ian Waudby-Smith, A. Simon Pickard, Feng Xie, Eleanor M. Pullenayegum (2020) Using Both Time Tradeoff and Discrete Choice Experiments in Valuing the EQ-5D: Impact of Model Misspecification on Value Sets, *Medical Decision Making*, 40(4):483-497