Interpreting dominance tests in DCEs

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Background and objectives

- How should dominance tests (DT) be used for supporting choice validity assessment in DCEs?

- Previous reviews: Frequency of the use of DT

- Our contribution:
  - How have authors used DT?
  - Implications of the Random Utility Model (RUM) for interpreting DT

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How are we currently using of DTs?

Data: DCE in health published in 2015 identified by Vass et al (2017)

→ 28 of 112 Studies included a dominance test (25%)

Vass, C., Rigby, D., & Payne, K. (2017). The Role of Qualitative Research Methods in Discrete Choice Experiments. Medical Decision Making, 37(3), 298–313. https://doi.org/10.1177/0272989X16683934
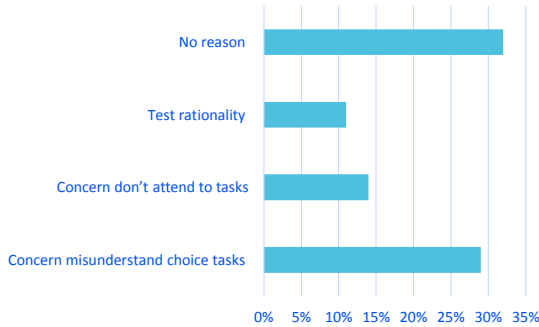
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How are we currently using of DTs?

Data: DCE in health published in 2015 identified by Vass et al (2017)

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1. Why did authors undertake DT?

Vass, C., Rigby, D., & Payne, K. (2017). The Role of Qualitative Research Methods in Discrete Choice Experiments. Medical Decision Making, 37(3), 298–313. https://doi.org/10.1177/0272989X16683934
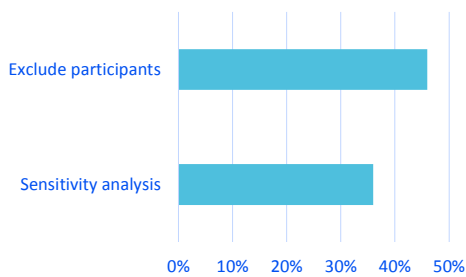
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How are we currently using of DTs?

Data: DCE in health published in 2015 identified by Vass et al (2017)

→28 of 112 Studies included a dominance test (25%)

2. How did authors use of DT results?

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Does 'failure' of DT violate the theory underlying the DCE?

Theory			Failure of DT
Expected utility theory	Axioms of coherent choice underlying of utility theory - completeness, transitivity, and independence		Violate axioms e.g. • Inattention • Simplifying heuristics e.g. straight-lining.
Random utility theory	Probabilistic choices Utility observed with a degree of error	Unobserved variables attributes	• Attributes that affect preferences may not be known / controlled for • Infer information beyond that presented in the DCE (e.g. high cost implies higher quality)
		Measurement error – rational, understand, attend, but still make a mistake	• Ambiguities in attribute definitions • Complexity of choice questions. • Design of the DT • Number of choice questions. • Fatigue

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Poorly designed DT: Illustration

	Treatment A	Treatment B
Cost	$100	$200
Location	Home	GP
CV risk	2%	3%
Choice	☐	☐

Dominant choice?

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Poorly designed DT: Illustration

Unobserved variables: lower cost might be perceived as implying lower quality

Ambiguous preference ordering: some people prefer the reassurance of receiving treatment at the GP

	Treatment A	Treatment B
Cost	$100	$200
Location	Home	GP
CV risk	2%	3%
Choice	☐	☐

Risk perception: Do / can patients distinguish between 2% and 3% risk?

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The probability that the dominated alternative is chosen (p_e)

Inputs

1. Model extracted from the paper.

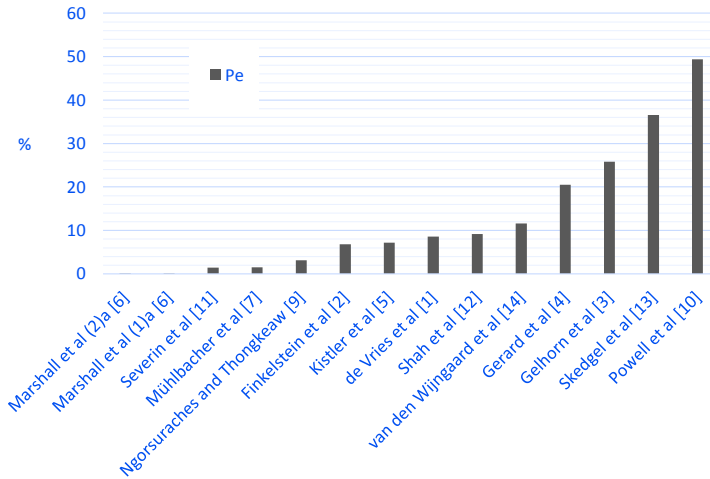2. Attribute levels used in the DT: 14 of 28 (50%) authors provided on request.

$$U_i = V(\beta, X_i) + \varepsilon_i.$$

$$P_e = \frac{\exp(V(\beta, X_{\text{dominated}}))}{\exp\big(V(\beta, X_{\text{dominated}})\big) + \exp(V(\beta, X_{\text{dominant}}))}$$
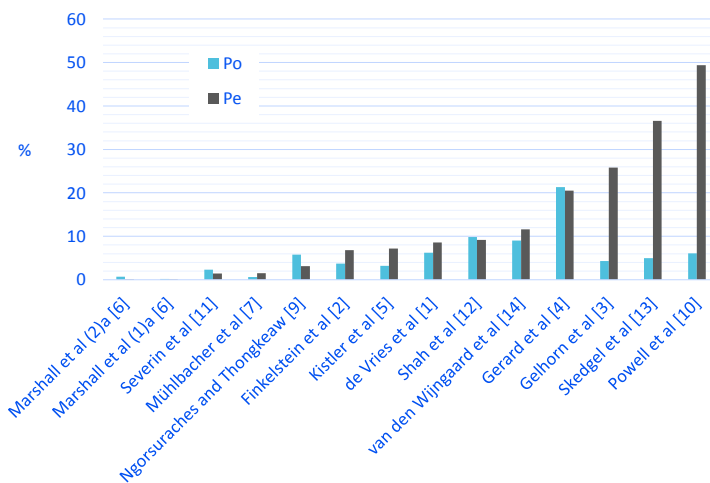
○Evidera | **PPD**

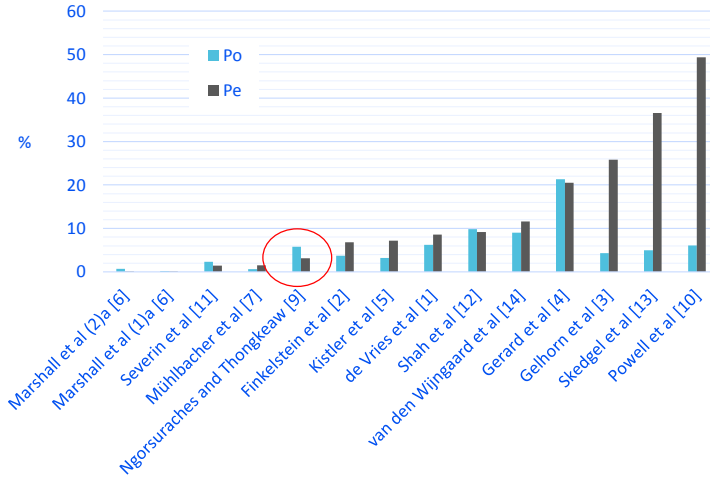## The probability that the dominated alternative is chosen (p_e)

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The probability that the dominated alternative is chosen (p_e) vs observed choice of the dominated option (p_o)
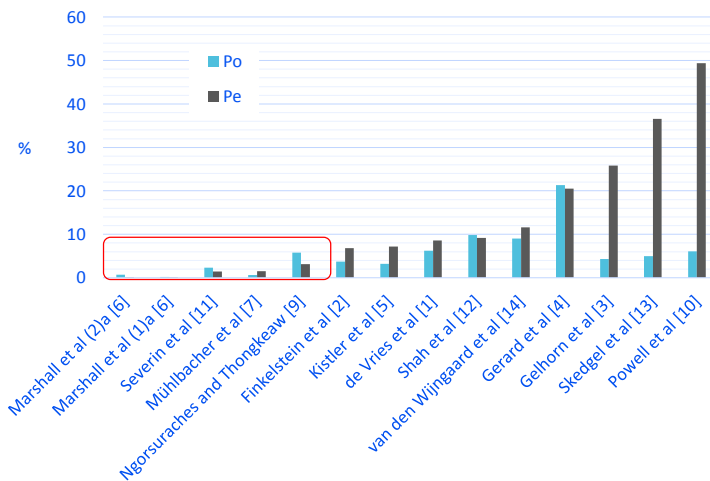
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Should we exclude 'fails' if $p_o > p_e$?

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Should we exclude 'fails' if $p_o > p_e$?
1. Low p_e

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Should we exclude 'fails' if $p_o > p_e$?
1. Low p_e

		β	Dominant	Dominated
Efficacy 1	H	1.2	✔	
	M	0.6		
	L	0		✔
Efficacy 2	H	1.0	✔	
	M	0.5		
	L	0		✔
Safety	L	0.8	✔	
	M	0.4		
	H	0		✔
Utility			3	0
Probability choose dominated				0.05

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Should we exclude 'fails' if $p_o > p_e$?
1. Low p_e

		β	Dominant	Dominated
Efficacy 1	H	1.2	✔	
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	L	0		✔
Efficacy 2	H	1.0	✔	
	M	0.5		
	L	0		✔
Safety	L	0.8	✔	
	M	0.4		
	H	0		✔
Utility			3	0
Probability choose dominated				0.05

1. Clear – 'failure' not due to choice ambiguity

2. Possibly lack of attendance

3. But large differences in β suggest answering other questions 'well'

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Should we exclude 'fails' if $p_o > p_e$?
2. High p_e

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	M	0.6		
	L	0		
Efficacy 2	H	1.0	✓	✓
	M	0.5		
	L	0		
Safety	L	0.8	✓	
	M	0.7		✓
	H	0		
Utility			3	2.9
Probability choose dominated				0.48

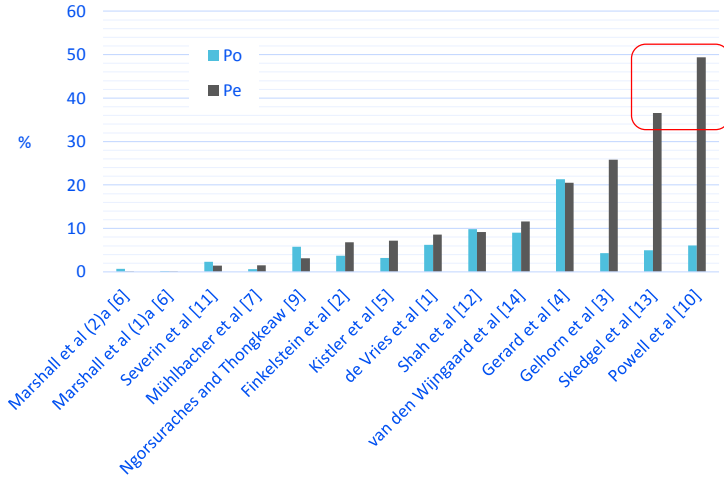## Should we exclude 'fails' if $p_o > p_e$?
2. High p_e

		β	Dominant	Dominated
Efficacy 1	H	1.2	✓	✓
	M	0.6		
	L	0		
Efficacy 2	H	1.0	✓	✓
	M	0.5		
	L	0		
Safety	L	0.8	✓	
	M	0.7		✓
	H	0		
Utility			3	2.9
Probability choose dominated				0.48

1. Very high p_e requires very small utility differences

2. 'Failure' due to preference ambiguity or non-differentiation of levels?

3. As you approach p_e= 50%, DT provides little information
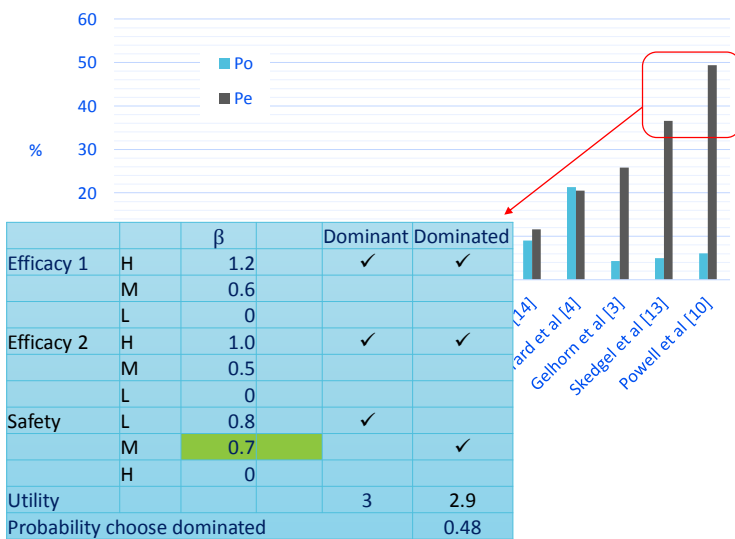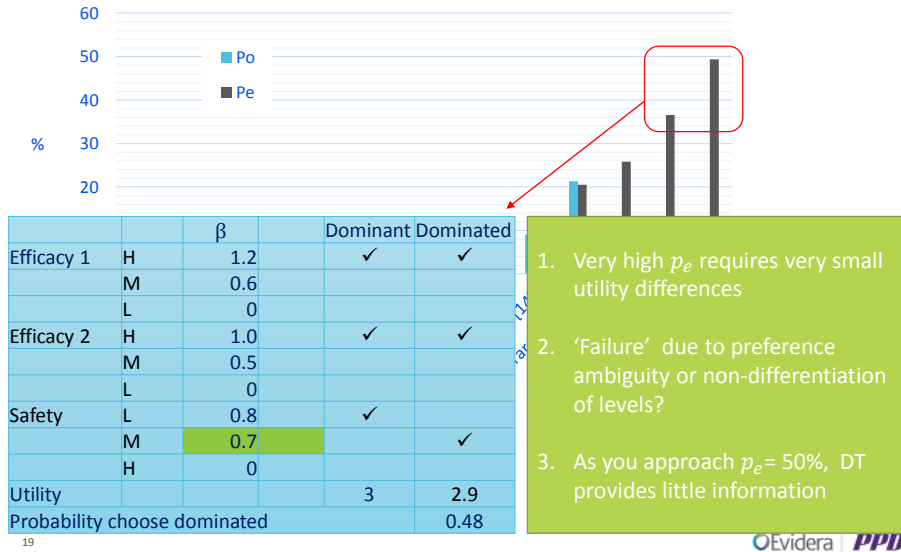
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SUMMARY

- 'Failure' of a DT not necessarily an indication of a lack of attention or irrationality. RUT - we'd expect some participants to 'fail' the DT
  - Test with very high p_e provides little information.
  - Test with very low p_e suggest the DCE has been designed and answered well
    - Average 'failure' rate (6%) - would require a very low p_e before we'd conclude this was a problem
- Poorly designed DCE's / DT may contribute to high 'failure' rates e.g.
  - Small / uncertain part-worths point to problems with the overall design
  - Attributes with ambiguous preference orders – avoid cost, mode of admin
  - Conclusion: problem with the study, rather than the respondents' attention / rationality!
  - Qualitative research and pilot tests can help identify
    - Ambiguities in preference ordering.
    - Levels that can (i) differentiate, and (ii) will trade.
- Other data can help inform the interpretation of DT
  - Time to complete choice tasks
  - Straight-lining

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