ENDOGENEITY OF SELF-REPORTED CONSEQUENTIALITY IN STATED PREFERENCE STUDIES

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Stated preference methods

- Widely used to measure the value of non-market goods, especially public goods

- In transportation, marketing, health, culture, environmental economics, ...

- Based on surveys

- Many advantages:
  - Capture use and passive-use values
  - Go beyond the scope of the existing data

- But also important disadvantages:
  - Not based on market behavior
  - Might be viewed as not related to direct consequences
  - Incentive properties insufficiently understood

Conditions for truthful preference disclosure
(Carson and Groves 2007; Carson et al. 2014; Vossler et al. 2012)

One of the conditions requires the survey consequentiality

A necessary condition for truthful preference disclosure:

Consequentiality

- "a survey's results are seen by the agent as <u>potentially influencing</u> an agency's actions and the agent cares about the outcomes of those actions"
(Carson and Groves 2007)

- "an individual faces or perceives a nonzero probability that their responses will <u>influence decisions</u> related to the outcome in question and they will be <u>required to pay</u> for that outcome"
(*Contemporary Guidance for Stated Preference Studies*, Johnston et al. 2017)

policy consequentiality

payment consequentiality

Other dimensions of consequentiality?
E.g., pivotality?

Challenges with consequentiality

- **Consequentiality communicated** via survey scripts does not necessarily affect consequentiality perceptions (Czajkowski et al. 2017; Lloyd-Smith et al. 2019)

→ - How to **elicit consequentiality perceptions**?
  - A single general question: To what extent do you believe that the survey outcome will affect the decision of public authorities?
  - Questions differentiating between policy and payment consequentiality
  - More indicator (measurement) questions

→ - How to include data on consequentiality perceptions in **preference modelling**?
  - Endogeneity concerns: Self-reports on perceived consequentiality are likely driven by similar (unobservable) factors as stated preferences

Our study addresses these questions

Endogeneity of consequentiality perceptions
explored in previous studies

- Herriges et al. (2010) – an exogenous information treatment and a Bayesian treatment-effect model; <u>importance of controlling for endogeneity</u>

- <u>No significant problem of endogeneity</u> especially in studies using socio-demographics as instruments:
  - Vossler et al. (2012) – a generalized method of moments over-identification test
  - Interis and Petrolia (2014) – a two-step instrumental variable probit model

- Groothuis et al. (2017) – a bivariate probit approach; <u>perceived consequentiality found to be endogenous</u>; unobserved factors strengthen the consequentiality and decrease the likelihood of voting for the program

- Lloyd-Smith et al. (2019) – a special multi-step estimator for a scaled probit model; <u>importance of controlling for endogeneity</u>; with no endogeneity control, perceived consequentiality affects voting behavior, but the effect disappears with the special regressor

Endogeneity of consequentiality perceptions
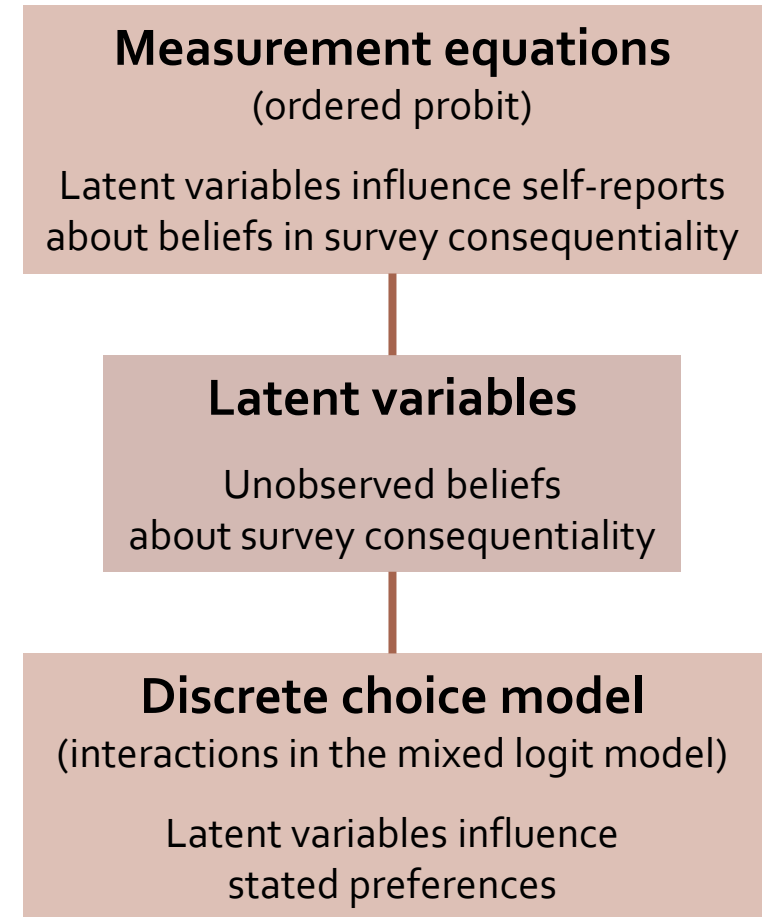explored in previous studies

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Limitations:
- Little evidence – very few studies
- Mixed evidence
- Mostly for binary choice data (not discrete choice experiments)
- Step-wise procedures
- Single indicator (measurement) questions for consequentiality

Our approach: Hybrid choice model

- Hybrid choice models incorporate 'soft' (not objectively measureable) variables, such as perceptions and attitudes, into the choice model

- Here, the 'soft' variables: beliefs about survey consequentiality

- Directly including indicator variables (e.g., self-reports about perceived consequentiality) into a choice model may lead to biased estimates due to endogeneity and measurement problems

- All equations are estimated simultaneously

Measurement equations
(ordered probit)

Latent variables influence self-reports about beliefs in survey consequentiality

Latent variables

Unobserved beliefs about survey consequentiality

Discrete choice model
(interactions in the mixed logit model)

Latent variables influence stated preferences

Endogeneity control in hybrid choice models

Budziński and Czajkowski (2018)

Model 1

- Standard hybrid choice models do not resolve endogeneity

- Two types of endogeneity:
  1) Latent variables are endogenous
  2) Indicator variables are endogenous, but latent variables are not

- Solutions:

Model 2

  – Directly modeling the correlation between latent variables and random parameters – help (1)
  – Adding a latent variable to capture the correlation caused by missing covariates – help (1) and (2)

Model 3

Here, we present the first application of these approaches

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Empirical data

- We use the hybrid choice model to examine the role of consequentiality and of endogeneity control for value estimates

- Data from three large-scale discrete choice experiments

- Samples from 801 to 2,863 respondents

- Various valuation contexts: public theater offer, renewable energy

- Various ways of eliciting consequentiality perceptions: from one to several indicator questions

- This presentation focuses on one application only

Discrete choice experiment

- Public-good scenario: Extension of public theater offer in Poland (a number of shows)
- 4 choice tasks per person; CAWI; a representative sample of 2,863 residents of Poland

		Variant A	Variant B No changes	Attribute levels
	Entertainment theaters	+ 25%	no change	
	Drama theaters	+ 50%	no change	
	Children's theaters	no change	no change	+ 25%, + 50%, no change
	Experimental theaters	+ 50%	no change	
	Annual cost for you (tax)	50 PLN	0 PLN	5, 10, 20, 50 PLN
	Your choice	☐	☐	

Consequentiality elicitation

- Randomized statements assessed on a Likert scale with seven levels:
  from 'definitely disagree' to 'definitely agree' + don't know

- Used in the measurement → 9 ordered probit models as measurement equations

I think that …

[1] … by participating in this survey, I will have influence on the future theater offer.

[2] … the results of this survey will determine if to change the theater offer.

[3] … the results of this survey will be used to decide if to change the theater offer.

[4] … if the theater offer is decided to be changed, the results of this survey will be used to decide which type of shows will be played more and less.

[5] … the increase of the theater offer as described in this survey is possible to be implemented.

[6] … a decision to expand the theater offer will indeed result in more shows and premiers, as described in this survey.

[7] … a decision to expand the theater offer will indeed result in higher (tax) fees, which will increase my household expenditures, as described in this survey.

[8] … I am one of many people participating in this survey, so my responses do not have a chance to affect the survey final results.

[9] … a decision whether to change the theater offer will be taken independently of the survey results.

Results

Measurement equations (ordered probit) Latent variables influence self-reports about beliefs in survey consequentiality		

	Model 1	Model 2	Model 3
	Standard	Corr. LVs and random parameters	+ 1 LV

Latent variables — Unobserved beliefs about survey consequentiality

How many latent variables to include?

Discrete choice model (interactions in the mixed logit model) — Latent variables influence stated preferences

Results

Measurement equations
(ordered probit)

Latent variables influence self-reports about beliefs in survey consequentiality

Latent variables

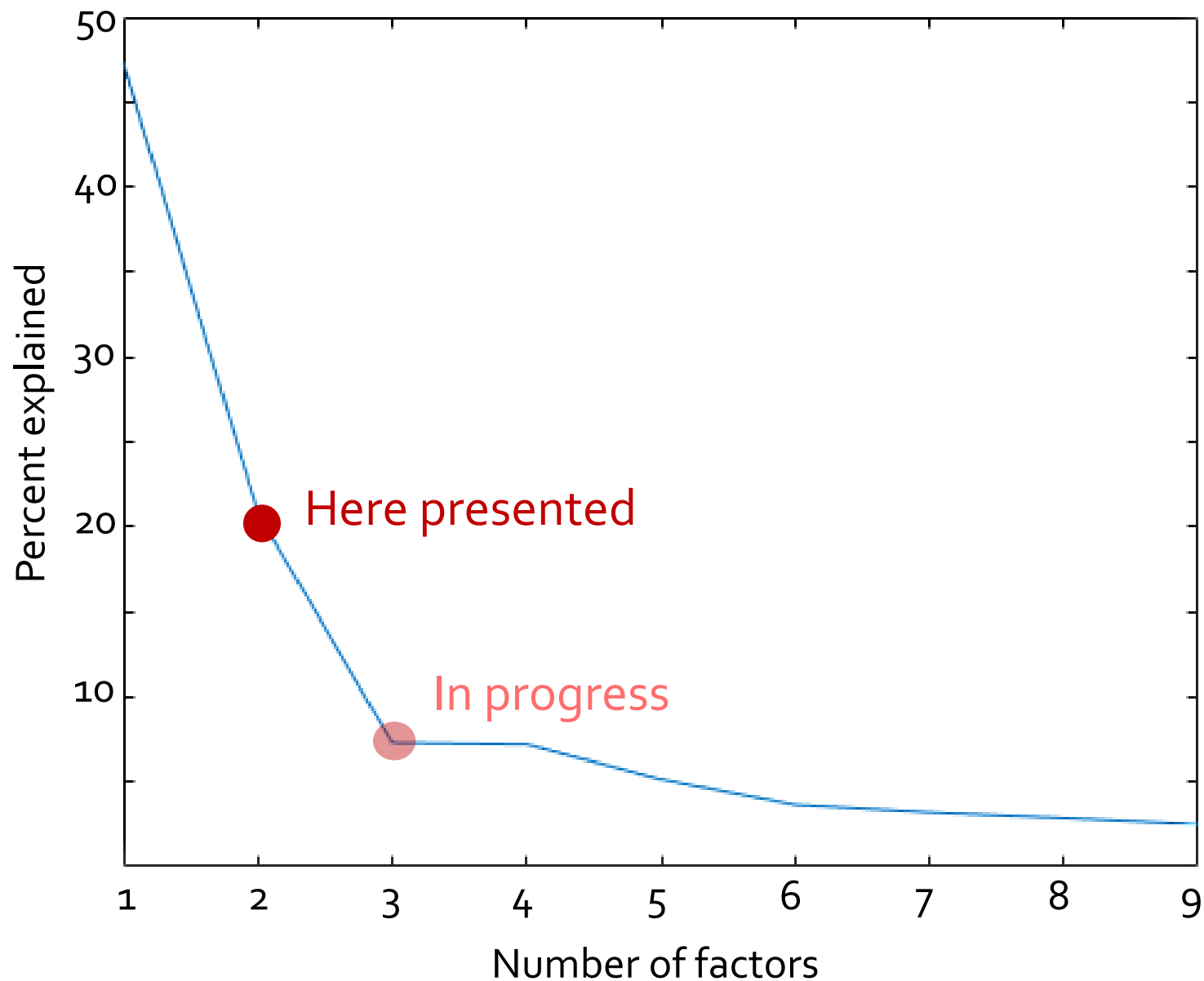Unobserved beliefs about survey consequentiality

Discrete choice model
(interactions in the mixed logit model)

Latent variables influence stated preferences

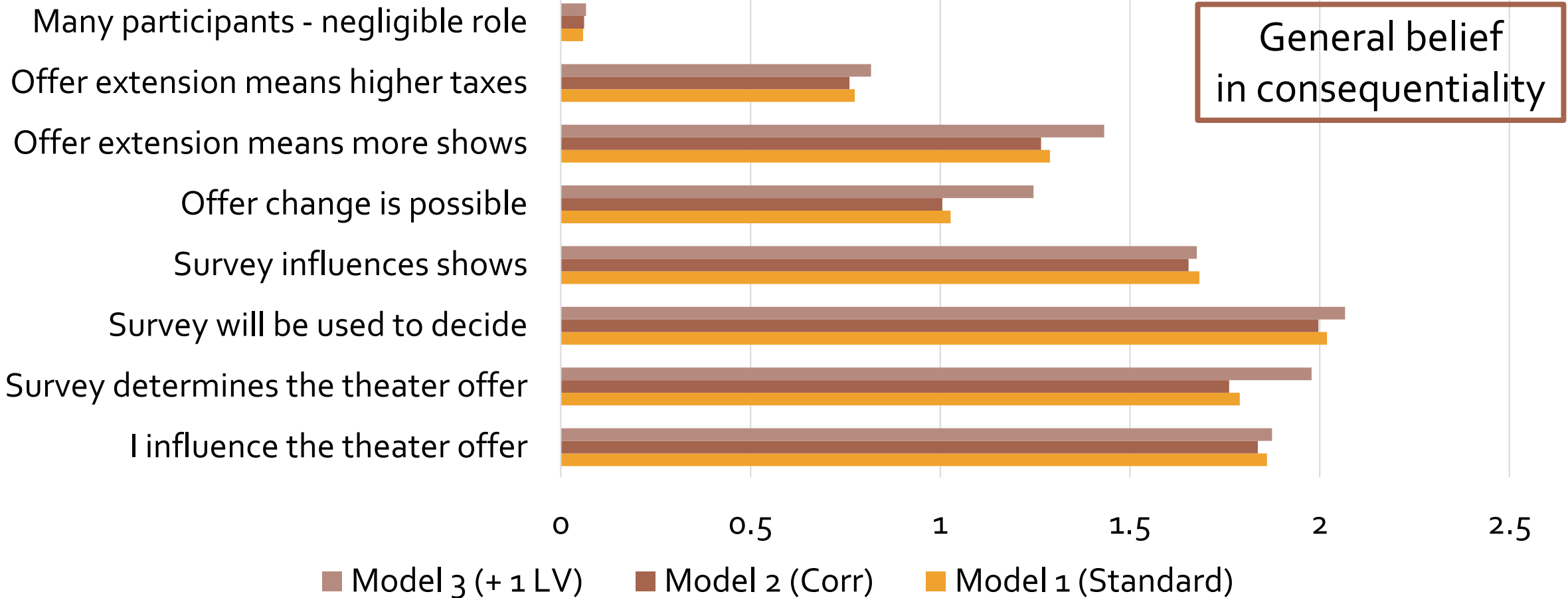|	Model 1 Standard	Model 2 Corr. LVs and random parameters	Model 3 + 1 LV
LL	-38,620.1	-38,564.6	-38,465.4
BIC/n	6.834	6.835	6.819

better   even better

- Responses to consequentiality statements are explained with latent variables

- Two latent variables (LVs) expressing perceived consequentiality:
  – General belief in consequentiality
  – Lack of belief in pivotality

Results: Measurement equations

Ordered probits

Results: Measurement equations

Ordered probits

Coefficients on how LV2 explains each statement

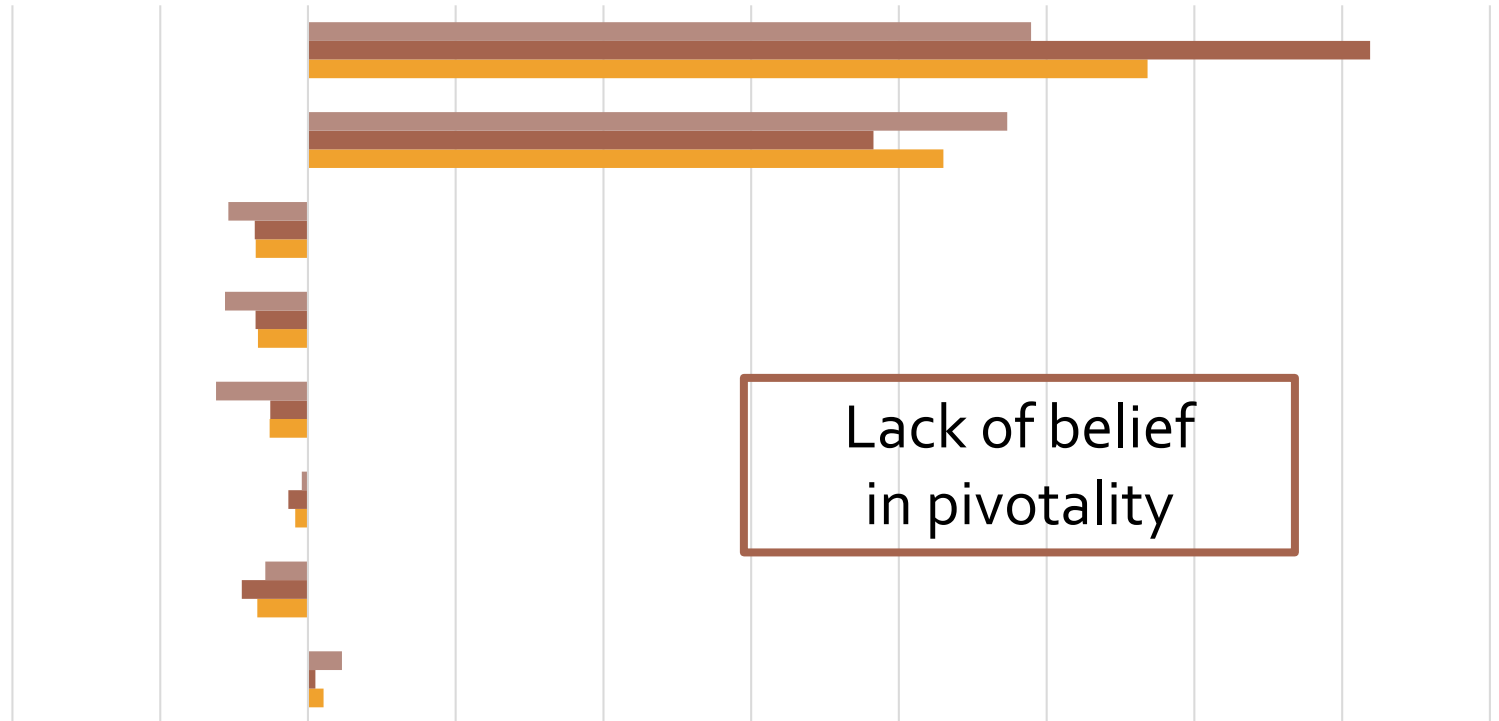|	
Decision independent of the survey	
Many participants - negligible role	
Offer extension means higher taxes	
Offer extension means more shows	
Offer change is possible	
Survey influences shows	Lack of belief in pivotality
Survey will be used to decide	
Survey determines the theater offer	

-0.4   -0.2   0   0.2   0.4   0.6   0.8   1   1.2   1.4   1.6

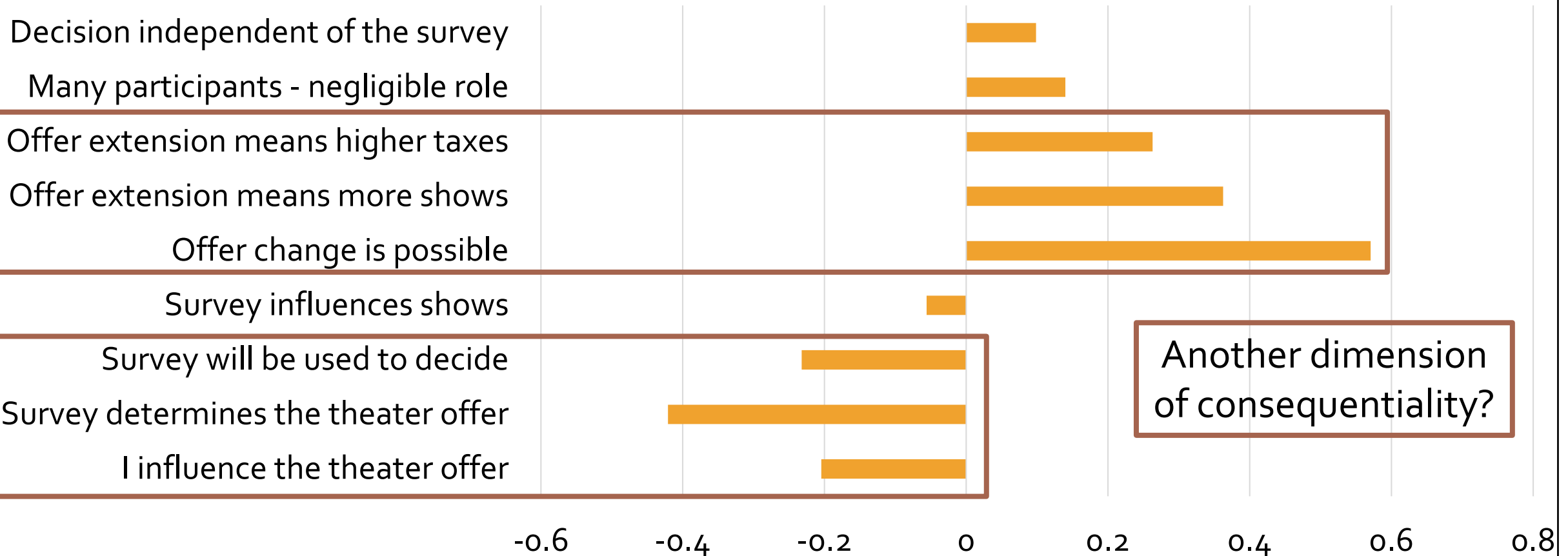■ Model 3 (+ 1 LV)   ■ Model 2 (Corr)   ■ Model 1 (Standard)
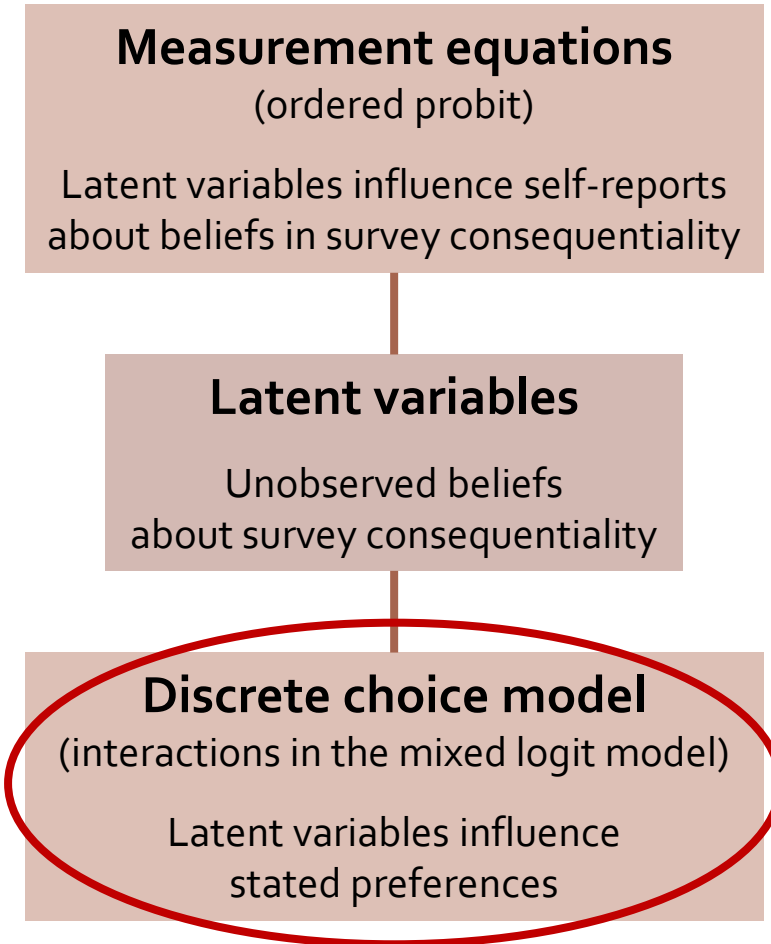
Results: Measurement equations

Ordered probits

Additional latent variable in Model 3 (+ 1 LV) to control endogeneity

Coefficients on how LV3 explains each statement

Results

Measurement equations

(ordered probit)

Latent variables influence self-reports
about beliefs in survey consequentiality

Latent variables

Unobserved beliefs
about survey consequentiality

Discrete choice model

(interactions in the mixed logit model)

Latent variables influence
stated preferences

	Model 1	**Model 2**	**Model 3**
	Standard	**Corr. LVs and random parameters**	**+ 1 LV**
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- Two latent variables (LVs) expressing perceived consequentiality:
  – General belief in consequentiality
  – Lack of belief in pivotality

Results: Discrete choice component

Mixed logits with means interacted with LVs

Mean coefficient estimates

	Model 1	Model 2	Model 3
	Standard	Corr. LVs and random parameters	+ 1 LV
Status quo	0.4719***	0.4459***	0.4711***
Entertainment	0.8926***	0.999***	0.9151***
Drama	0.5769**	0.464*	0.4259
Children's	0.1364	0.1099	0.0443
Experimental	-0.4336	-0.502*	-0.409
– Cost (10 EUR)	3.7752***	3.8161***	3.6282***

- Preference parameters are random

- For all, standard deviations are (highly) significant

- Mean coefficient estimates are similar across models

Results: Discrete choice component

Mixed logits with means interacted with LVs

## Coefficients of interactions of means with LV1 (general consequentiality)
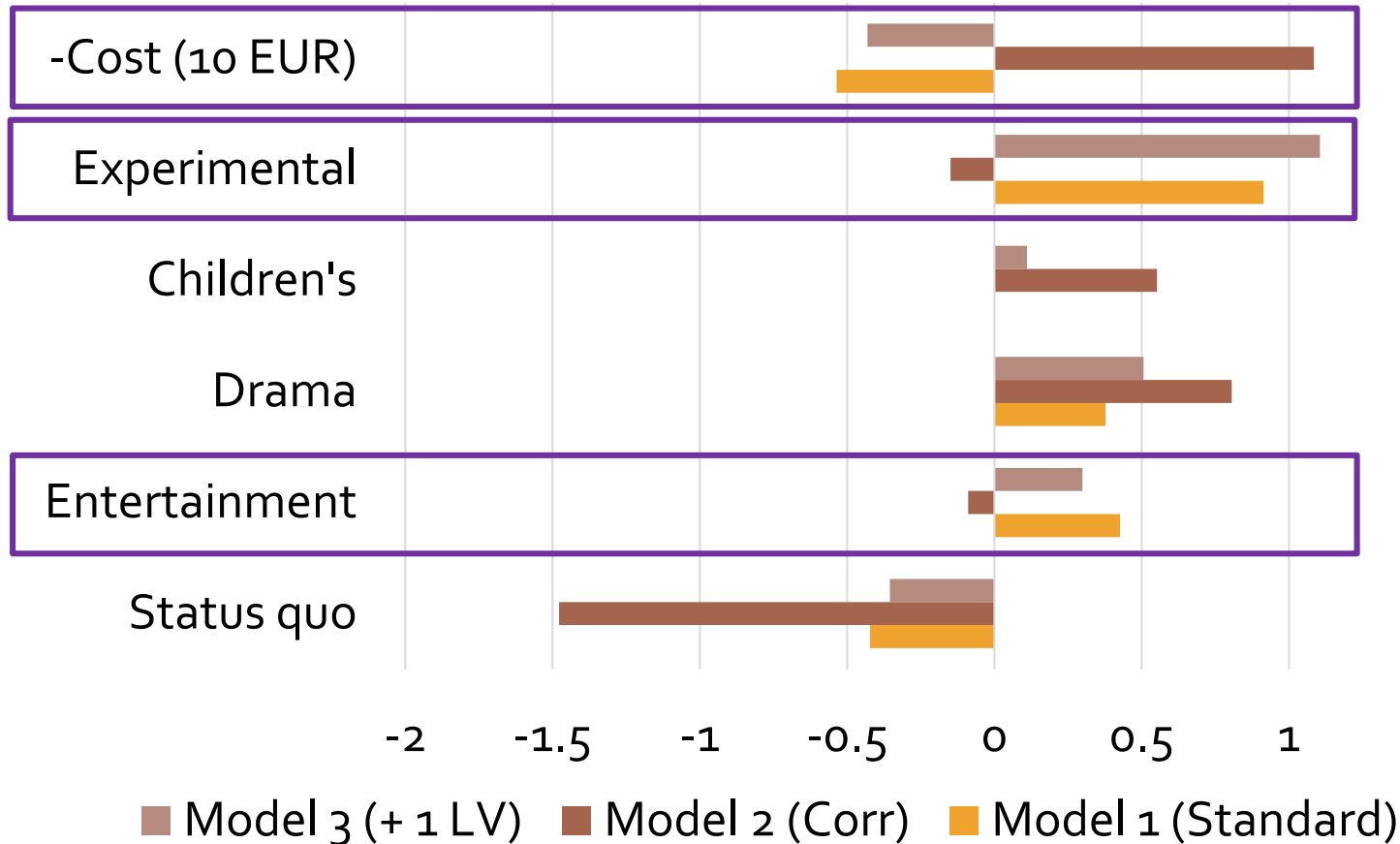
- Model 2 (Corr) accounts for one endogeneity type: endogeneity of the latent variable

- Endogeneity control matters largely for cost

- And so it changes willingness-to-pay values

- In Model 3 (+1 LV), maybe another consequentiality dimension?

Results: Discrete choice component

Mixed logits with means interacted with LVs

Coefficients of interactions of means with LV2 (pivotality)
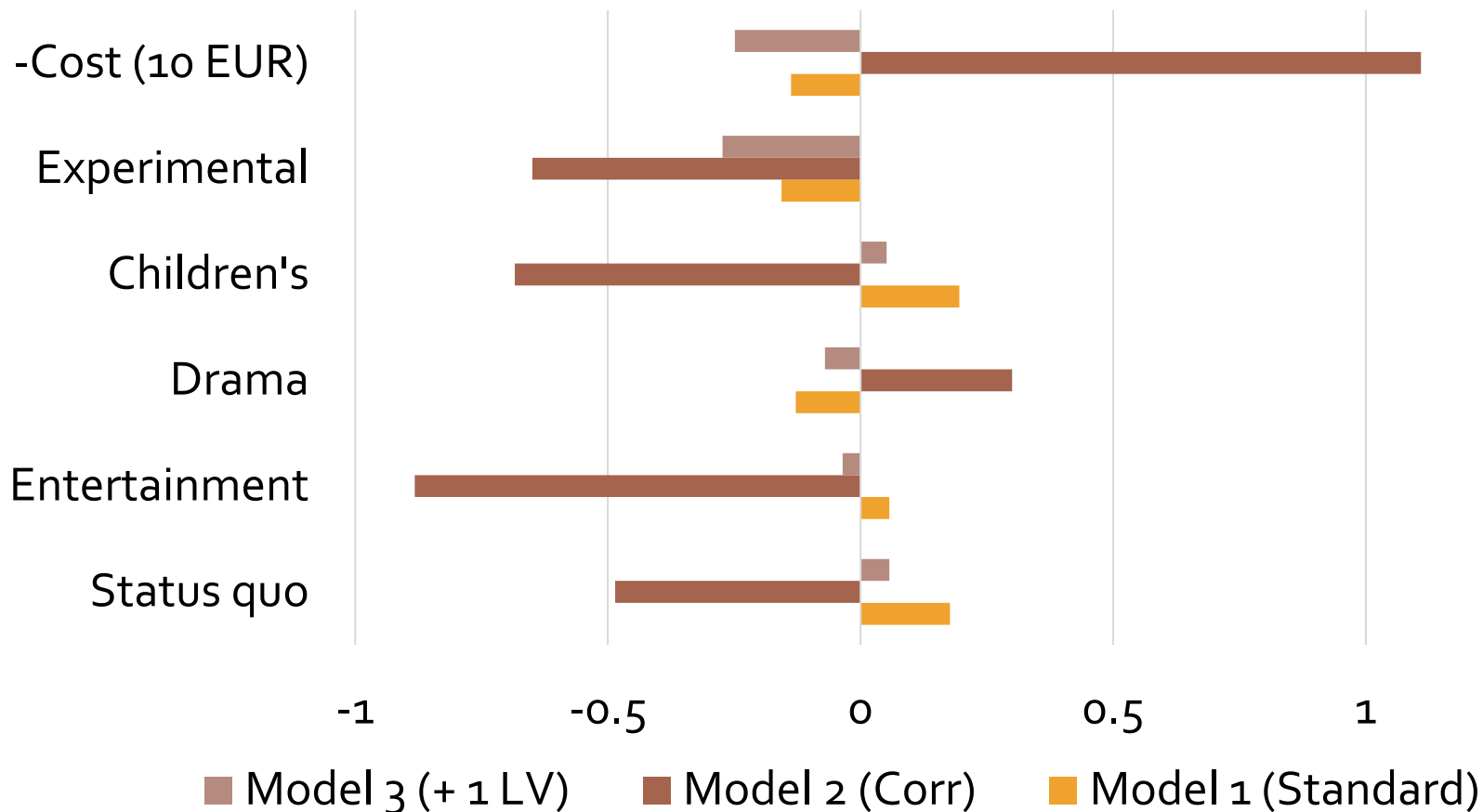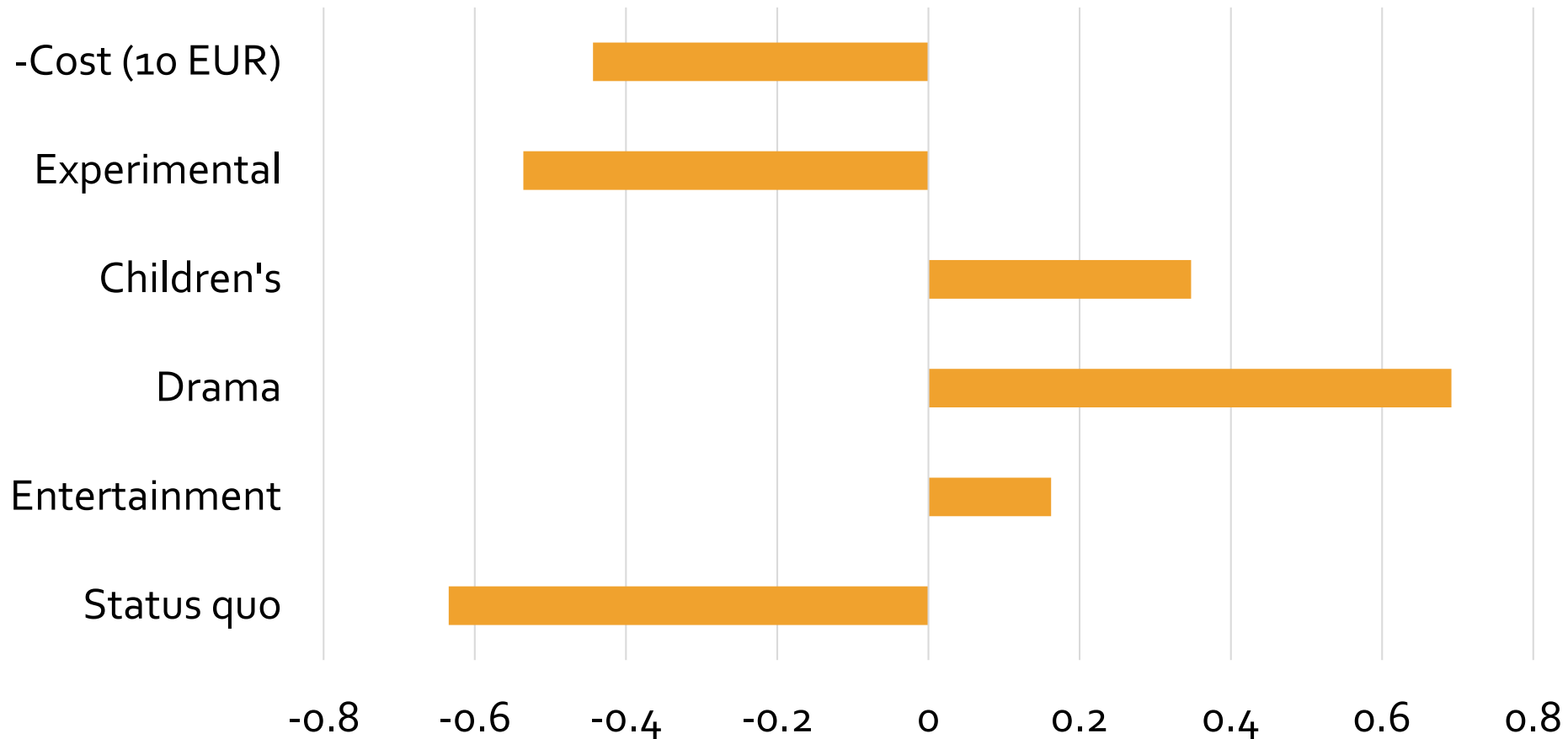

- Similar findings

- Endogeneity control in Model 2 matters for many attributes

- In Model 3, maybe another dimension of consequentiality, rather than endogeneity control?

Closing thoughts

- More research:
  - Model specifications with more latent variables to control for more dimensions of consequentiality (or for other aspects captured by the nine Likert-scale responses)
  - Other datasets with several indicators of consequentiality
  - The need to (theoretically) identify dimensions of perceived consequentiality and to design ways (indicator questions) of eliciting these perceptions

- For now:
  - Some evidence of endogeneity issues
  - Accounting for endogeneity of perceived consequentiality appears to matter for value estimates
  - Similar findings from other datasets we have considered

- **The first application of a hybrid choice model in theory correcting for endogeneity**

THANK YOU!

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