The Effects of the Number of Alternatives in Choice Experiment Questions

Weizhe Weng: Virginia Tech
Mark Morrison: Charles Sturt University
Kevin Boyle: Virginia Tech
Peter Boxall: University of Alberta
John Rose: The University of Sydney

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Motivation

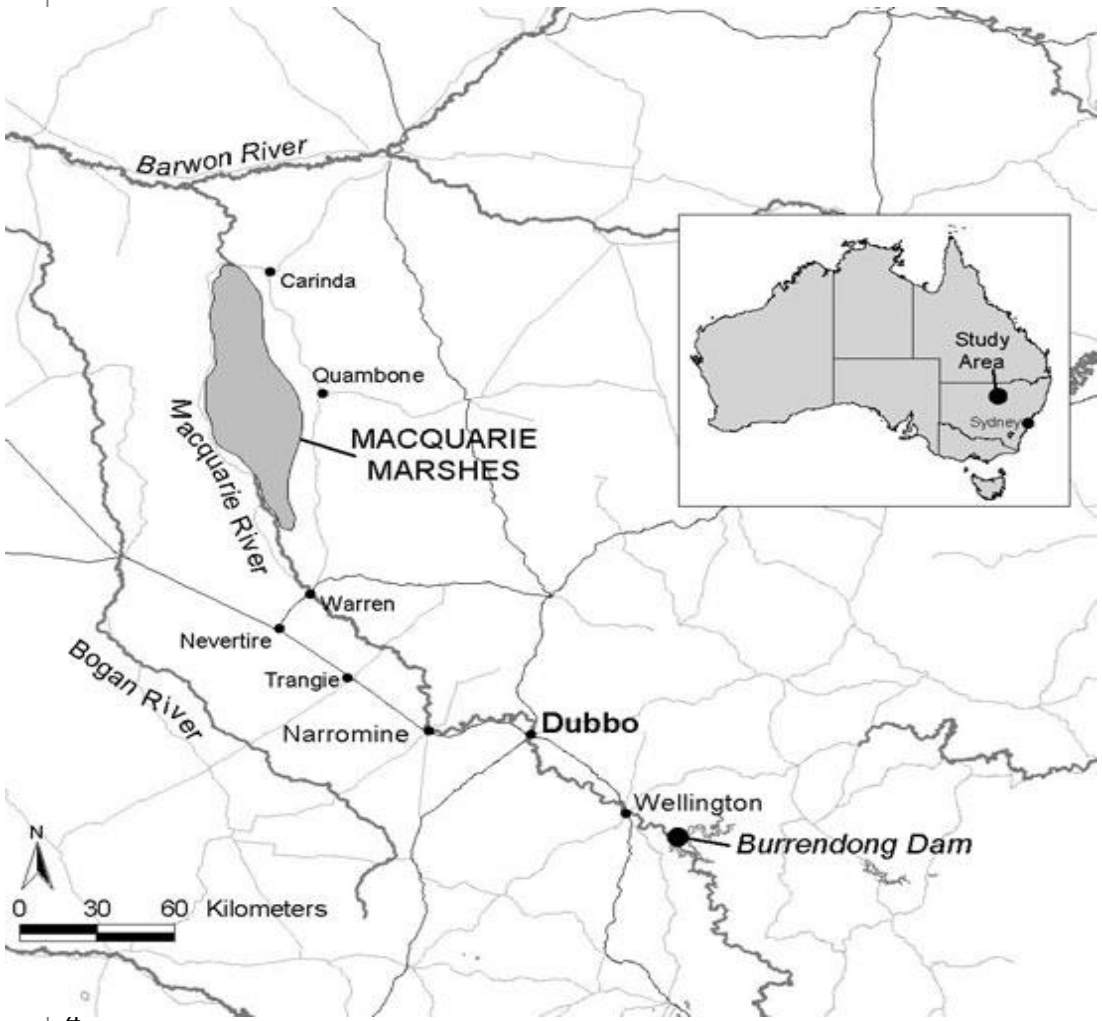
- Number of alternatives is a core element in the design of choice experiments
- Tradeoff exists when we increase the number of non-status quo (SQ) alternatives:
  - Matching (Rolfe and Bennett, 2009)
  - Task complexity (Boxall, 2009)
  - Incentive incompatibility (Carson and Groves,2007)

Research Questions

- Do preference estimates, scale heterogeneity, and estimates of willingness to pay change when we change the number of non-SQ alternatives?

- If yes, why?

Study Area



- Originally the largest wetlands in New South Wales, Australia
- A wetland of international importance under Ramsar Convention
- Important habitat for waterbirds

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Design of the Study

- One-time WTP to improve the quality of Macquire Marshes
- 3 Split Sample Treatments: SQ+1, SQ+2, SQ+3
- Each subject answered only one of these question formats
- 8 choice sets

Attribute Levels in Questionnaire

Attributes	Status Quo	Attribute Levels
cost-water rates (one-off increase in AUD)	no change	$20, $50, $75, $100, $125, $150, $200, $250
emp-irrigation related employment	4400	4200, 4000, 3800 jobs
wet-Wetlands area	500	700, 900, 1100 km^2
bird-waterbirds breeding	every 8 years	every 6, 4, 2 years
end-endangered and protected bird species present	6 species	12, 18, 25 species

Model Estimation

- Two mixed logit models
  - Uncorrelated model
  - Fully correlated model

- WTP estimates
  - Restoring environmental attributes to historical highest levels
  - no change in employment

Research Hypotheses

- *Hypothesis 1*:

  The three treatments are statistically indistinguishable in terms of preference estimates and scale heterogeneity.

- *Hypothesis 2*:

  WTP is the same across treatments.

Results: Tests of Hypotheses

	SQ+1 vs. SQ+2	SQ+1 vs. SQ+3	SQ+2 vs. SQ+3
		Hypothesis (1)	
Uncorrelated	108.50[a]***[b]	124.54***	31.85***
Correlated	94.19***	265.01***	129.03***
		Hypothesis (2)	
Uncorrelated	0.390 [c]	0.086*	0.380
Correlated	0.195	0.006***	0.112

[a] Likelihood ratio chi-square test statistic

[b] ***$p<0.01$

[c] p-value for convolution test

Mean-shift analysis

- Add the interaction of the ASC variable with respondent characteristics and treatment features ($\boldsymbol{Z}_t$)

- $\boldsymbol{Z}_t$ includes
  - Socio-demographic characteristics
  - Inferred complexity
    - An indicator based on three level of attribute changes (InfCom)
    - Choice set number in the sequence of total number of tasks (Task)
  - Attitudinal characteristics

Results: Mean-shift analysis

	Coefficient Estimates		
	SQ+1	SQ+2	SQ+3
ASC and attributes			
ASC_{SQ}	1.512**[a]	-2.441***	1.561
	(0.646)	(0.756)	(0.999)
cost	-0.038***	-0.053***	-0.038***
	(0.003)	(0.003)	(0.003)
emp	0.003***	0.002***	0.001***
	(0.0003)	(0.0002)	(0.0001)
wet	0.002***	0.002***	0.001***
	(0.000)	(0.000)	(0.0002)
bird	-0.109**	-0.126***	-0.160***
	(0.044)	(0.018)	(0.016)
end	0.073***	0.085***	0.086***
	(0.014)	(0.006)	(0.006)
Inferred complexity			
ASC*InfCom	-0.427***	0.045	-0.008
	(0.081)	(0.062)	(0.070)
ASC*Task	0.041	0.074***	0.139***
	(0.025)	(0.026)	(0.033)
Log likelihood	-2153.816	-3432.833	-3821.229

[a]***p<0.01, **p<0.05

Results: Latent Class analysis (SQ+2)

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	Coefficient Estimates	
	Class1	Class2
ASC and attributes		
ASC_{SQ}	-0.093	0.140
	(0.225)	(0.291)
cost	0.010***[a]	0.023***
	(0.0003)	(0.001)
emp	0.0008**[b]	0.0003*[c]
	(0.00007)	(0.0002)
wet	0.001***	0.0003**
	(0.000)	(0.0002)
bird	-0.106***	-0.075***
	(0.008)	(0.017)
end	0.061***	0.037***
	(0.002)	(0.006)
Inferred complexity		
ASC*Infcom	-0.070***	0.138***
	(0.014)	(0.017)
ASC*Task#	0.064***	0.030*
	(0.015)	(0.018)
Latent class share	0.572	0.428
Log likelihood	-10769.171	

[a]***p<0.01, **p<0.05, *p<0.1

Conclusions

- Significant differences across three treatments
  - Preference estimates are different across all three treatments
  - WTP estimates are different between SQ+1 and SQ+3

- SQ+1 is the recommended design because
  - Minimizes task complexity
  - Matching effect is dominated by task complexity
  - Incentive Compatible

Thanks

- Contact: weizhe11@vt.edu
- Questions and Comments are warmly welcome

Results: Model Estimates (Uncorrelated coefficients)

	Coefficient Estimates		
	SQ+1	SQ+2	SQ+3
ASC_{SQ}	-2.039***[a]	-2.863***	-3.233***
	(0.220)	(0.181)	(0.262)
cost	-0.039***	-0.057***	-0.062***
	(0.003)	(0.005)	(0.005)
emp	0.003***	0.001***	0.0008***
	(0.0003)	(0.0004)	(0.0001)
wet	0.002***	0.002***	0.001***
	(0.0003)	(0.0002)	(0.0002)
bird	-0.233***	-0.104***	-0.132***
	(0.033)	(0.014)	(0.014)
end	0.103***	0.067***	0.079***
	(0.012)	(0.005)	(0.006)
Log likelihood	-2246.232	-3539.111	-3943.304

[a] ***p<0.01

[b] sd denotes standard deviations of normal distributed coefficients

Results: Model Estimates (correlated coefficients)

	Coefficient Estimates		
	SQ+1	SQ+2	SQ+3
ASC_{SQ}	-1.993***[a]	-3.352***	-5.151***
	(0.237)	(0.255)	(0.371)
cost	-0.049***	-0.057***	-0.046***
	(0.004)	(0.005)	(0.004)
emp	0.003***	0.001***	0.0009***
	(0.0004)	(0.0001)	(0.0001)
wet	0.003***	0.002***	0.001***
	(0.0004)	(0.0002)	(0.0002)
bird	-0.302***	-0.108***	-0.136***
	(0.043)	(0.016)	(0.016)
end	0.134***	0.071***	0.086***
	(0.013)	(0.005)	(0.006)
Log likelihood	-2207.186	-3486.403	-3875.815

[a] ***p<0.01

[b] sd denotes standard deviations of normal distributed coefficients

Results: Willingness to pay

	Uncorrelated	Correlated
SQ+1	\$198***[a]	\$231***
	(\$111 , \$285)[b]	(\$161 , \$301)
SQ+2	\$109*	\$118***
	(\$17 , \$201)	(\$62 , \$174)
SQ+3	\$115**	\$103***
	(\$31 , \$199)	(\$65 , \$141)

[a]***p<0.01 **p<0.05 *p<0.1

[b]90% confidence interval in parentheses

Attribute Levels in Questionnaire

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Example Choice Set for SQ+2

Outcome	Option 1: Continue current situation	Option 2: Increase water to Macquarie Marshes	Option 3: Increase water to Macquarie Marshes
Your water rates (one-off increase)	no change	$20 increase	$50 increase
Irrigation related employment	4400 jobs	4350 jobs	4350 jobs
Wetlands area	500 km^2	650 km^2	1000 km^2
Waterbirds breeding	every 8 years	every 3 years	every year
Endangered and protected bird species present	6 species	25 species	15 species
I would choose	❒	❒	❒

Socio-demographic characteristics of respondents and attitudinal characteristics of the samples

	SQ+1	SQ+2	SQ+3
Socio-demographic characteristics			
Farm	15%$^{SQ+2}$	12%$^{SQ+1}$	13%
Memb	7%	6%	6%
Age	39^{SQ+2}	41$^{SQ+1,SQ+3}$	39^{SQ+2}
Edu	39%	40%	37%
Inc	67444	67669	66175
Attitudinal characteristics			
OpPurch	57%	58%	56%
OpBias	31%$^{SQ+2}$	37%$^{SQ+1}$	32%
OpPay	57%	55%$^{SQ+3}$	60%$^{SQ+2}$
OpWork	55%	57%	56%
OpTrust	6%	6%	7%
Stated complexity			
InfoUnd	1%	2%	2%
InfoMore	18%	19%	21%
InfoConf	11%$^{SQ+2,SQ+3}$	15%$^{SQ+1}$	16%$^{SQ+1}$
AnswDiff	12%$^{SQ+2,SQ+3}$	17%$^{SQ+1}$	16%$^{SQ+1}$

[a]. Superscripts denote statistically significant differences at the 10% level, e.g., the SQ+2 superscript on the SQ+1 age statistics indicates that the statistics for these two treatments are significantly different at 10% level.

Historical and Current attribute level

Attribute	Historical High Level	Current Level
Wetlands Area (square kilometers)	2200	500
Waterbird breeding (frequency)	every 1 year	every 8 years
Endangered and protected bird species	31	6
Irrigation related employment	0	4,400