

# Sequencing Anomalies in Choice Experiments

Brett Day & Jose-Luis Pinto

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# The rise & rise of the Choice Experiment

	CHOICE: 1		CHOICE: 2		
	Option 1	Option 2	Option 1	Option 2	
Attribute 1:	1	-3	-1	5	
Attribute 2:	4	9	6	4	... etc.
Price:	£W	£X	£Y	£Z	

✓                      ✓

- Rich data on each respondent's preferences
- Identify rates at which will trade off with every dimension of commodity space (various attributes)

# The discredited method of Contingent Valuation

Imagine a program that:

- increased attribute 1 from 4 to 8
- decreased attribute 2 from 3 to -2.

Would you pay £X to see that program implemented?

Would you pay £Z to see that program implemented?

- Only values a particular change in commodity space
- Little data on each respondent's preferences
- Well-documented 'anomalies' ... WTP/WTA disparity, insensitivity to scope, sequencing effects (SP bias/anchoring) etc.

# CV is a simple Choice Experiment

Imagine a program that:

- increased attribute 1 from 4 to 8
- decreased attribute 2 from 3 to -2.

Would you pay £X to see that program implemented?

Would you pay £Z to see that program implemented?

	CHOICE: 1		CHOICE: 2	
	Option 1	Option 2	Option 1	Option 2
Attribute 1:	4	8	4	8
Attribute 2:	3	-2	3	-2
Price:	£0	£X	£0	£Z

# Sequencing Anomalies in Contingent Valuation

- **Sub-sample 1:** £Med as first CV question  
? 50% of sample 'accept' £Med
- **Sub-sample 2:** £Low as first question; £Med as second question  
**WORSENING PRICE SEQUENCE:**  
? 25% of sample 'accept' £Med
- **Sub-sample 3:** £High as first question; £Med as second question  
**IMPROVING PRICE SEQUENCE:**  
? 50% of sample 'accept' £Med

Sequencing Anomalies in CV Acceptance Rates:

	Worsening	Improving
Price	-	None

# Sequencing Anomalies in Contingent Valuation

- **Sub-sample 1:** Offered commodity level Med at £X in first question  
? 60% of sample 'accept' Med
- **Sub-sample 2:** Offered Large for £X first, then Med for £X second  
**WORSENING COMMODITY SEQUENCE:**  
? 40% of sample 'accept' £X
- **Sub-sample 3:** Offered Small for £X first, then Med for £X second  
**IMPROVING COMMODITY SEQUENCE:**  
? 80% of sample 'accept' £X

Sequencing Anomalies in CV Acceptance Rates:

	Worsening	Improving
Price	-	None
Commodity	-	+

# Sequencing Anomalies in Choice Experiments?

## WORSENING PRICE SEQUENCE:

	CHOICE: 1		CHOICE: 2	
	Option 1	Option 2	Option 1	Option 2 <sup>-</sup>
Commodity:	Small	Large	Small	Large
Price:	£0	£5	£0	£10

## IMPROVING PRICE SEQUENCE:

	CHOICE: 1		CHOICE: 2	
	Option 1	Option 2	Option 1	Option 2 <sup>«</sup>
Commodity:	Small	Large	Small	Large
Price:	£0	£25	£0	£10

# Sequencing Anomalies in Choice Experiments?

## WORSENING COMMODITY SEQUENCE:

	CHOICE: 1		CHOICE: 2	
	Option 1	Option 2	Option 1	Option 2 <span style="color: red;">-</span>
Commodity:	None	Large	None	Medium
Price:	£0	£10	£0	£10

## IMPROVING COMMODITY SEQUENCE:

	CHOICE: 1		CHOICE: 2	
	Option 1	Option 2	Option 1	Option 2 <span style="color: red;">-</span>
Commodity:	None	Small	None	Medium
Price:	£0	£10	£0	£10

# Sequencing Anomalies in Choice Experiments?

## IMPROVING MIXED SEQUENCE:

	CHOICE: 1		CHOICE: 2	
	Option 1	Option 2	Option 1 <small>-</small>	Option 2 <small>«</small>
Commodity:	None	Large	Small	Large
Price:	£0	£25	£0	£10

## WORSENING MIXED SEQUENCE:


	CHOICE: 1		CHOICE: 2	
	Option 1	Option 2	Option 1 <small>-</small>	Option 2 <small>-</small>
Commodity:	Small	Large	None	Large
Price:	£0	£10	£0	£25

# Experimental Investigation

Application: **WTP to avoid episode of ill-health**

- Diagnosed with medical problem ... 1 yr of treatment will be completely cured
- State treatment ... free but 2 mths of ill-health (Severe or Mild)
- Private treatment ... costly (€Low, €Med, €High) but no ill-health

	State	Private	
Duration of Treatment:	12 mths	12 mths	
Symptoms:	Severe	None	
Duration of Symptoms:	2 mths	2 mths	
Price:	€0	€Med	

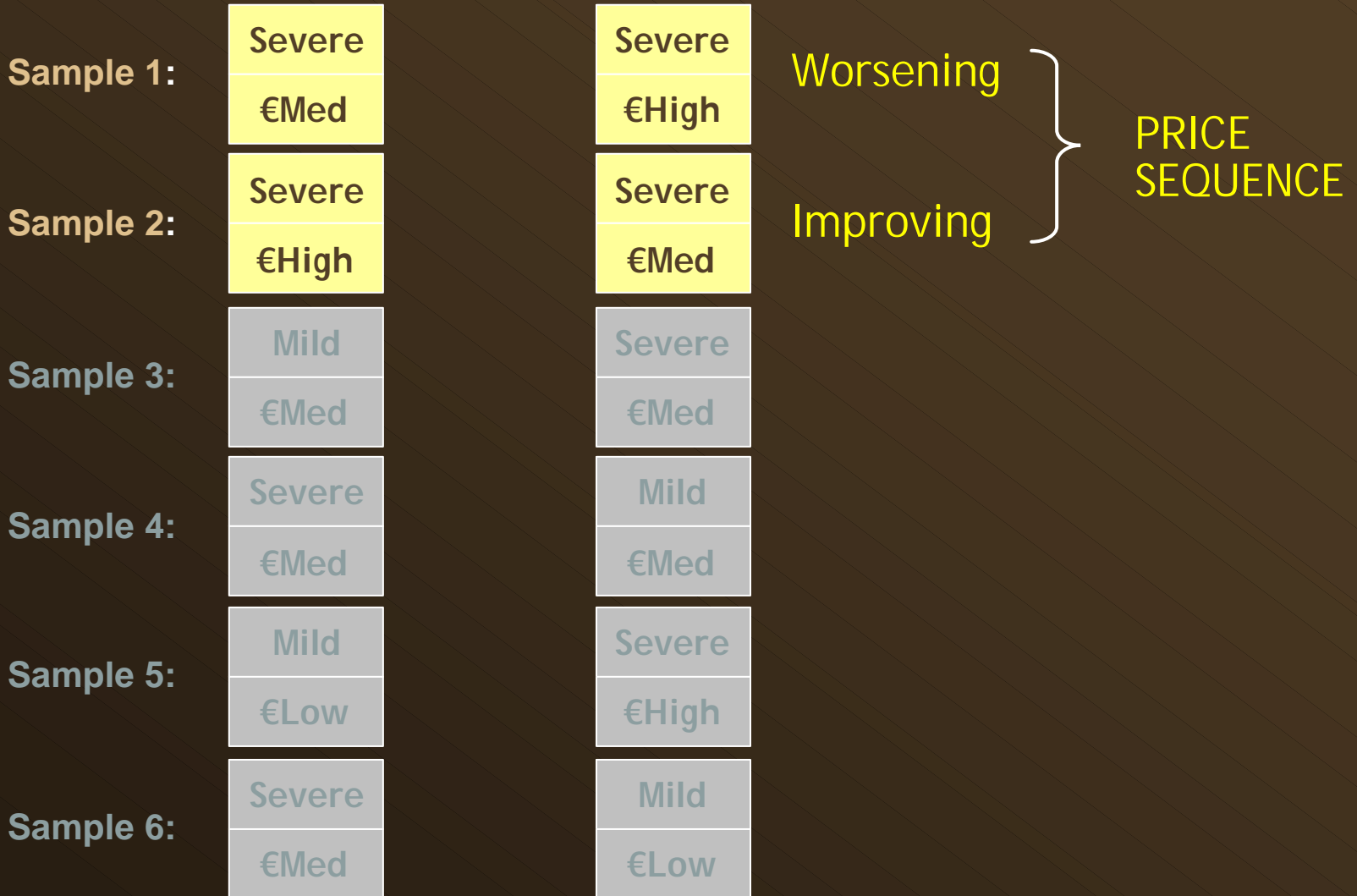


Option 1:	Severe
Option 2:	€Med

# Experimental Design

<b>Sample 1:</b>	Severe €Med	Severe €High	Mild €Med
<b>Sample 2:</b>	Severe €High	Severe €Med	Mild €Low
<b>Sample 3:</b>	Mild €Med	Severe €Med	Mild €Low
<b>Sample 4:</b>	Severe €Med	Mild €Med	Severe €High
<b>Sample 5:</b>	Mild €Low	Severe €High	Mild €Med
<b>Sample 6:</b>	Severe €Med	Mild €Low	Severe €High

# Experimental Design



# Experimental Design



# Experimental Design



# Results: Response Consistency

Sample 1:

Severe

€Med

Sample 2:

Severe

€High

Sample 3:

Mild

€Med

Sample 4:

Severe

€Med

Sample 5:

Mild

€Low

Sample 6:

Severe

€Med

- First Choices consistent across samples:

# Results: Response Consistency

Sample 1:

Severe

€Med

Sample 2:

Severe

€High

Sample 3:

Mild

€Med

Sample 4:

Severe

€Med

Sample 5:

Mild

€Low

Sample 6:

Severe

€Med

- First Choices consistent across samples:

# Results: Response Consistency

**Sample 1:**

Severe	25.3
€Med	74.4

**Sample 2:**

Severe	
€High	

**Sample 3:**

Mild	
€Med	

**Sample 4:**

Severe	25.9
€Med	74.1

**Sample 5:**

Mild	
€Low	

**Sample 6:**

Severe	28.9
€Med	71.1

- First Choices consistent across samples:  
(p-value > .600)



# Results: Response Consistency

**Sample 1:**

Severe	25.3
€Med	74.4

**Sample 2:**

Severe	32.5
€High	67.5

**Sample 3:**

Mild	
€Med	

**Sample 4:**

Severe	25.9
€Med	74.1

**Sample 5:**

Mild	
€Low	

**Sample 6:**


Severe	28.9
€Med	71.1

- First Choices consistent across samples:  
(p-value > .600)
- Standard Economic Assumptions:
  - Cheaper is better



# Results: Response Consistency

Sample 1:	Severe	
	€Med	
Sample 2:	Severe	
	€High	
Sample 3:	Mild	37.3
	€Med	62.7
Sample 4:	Severe	
	€Med	
Sample 5:	Mild	22.9
	€Low	77.1
Sample 6:	Severe	
	€Med	



- First Choices consistent across samples:  
(p-value > .600)
- Standard Economic Assumptions:
  - Cheaper is better  
(p-values: .106, .021)

# Results: Response Consistency

**Sample 1:**

Severe	25.3
€Med	74.4

**Sample 2:**

Severe	
€High	

**Sample 3:**

Mild	37.3
€Med	62.7

**Sample 4:**

Severe	25.9
€Med	74.1

**Sample 5:**

Mild	
€Low	

**Sample 6:**

Severe	28.9
€Med	71.1

- First Choices consistent across samples:  
(p-value > .600)
- Standard Economic Assumptions:
  - Cheaper is better  
(p-values: .106, .021)
  - More is better  
(p-value: .019)



# Results: Response Consistency

Sample 1:	Severe €Med	✓	⇒	Severe €High	✓
Sample 2:	Severe €High	✓	⇒	Severe €Med	✓
Sample 3:	Mild €Med	✓	⇒	Severe €Med	✓
Sample 4:	Severe €Med	✓	⇒	Mild €Med	✓
Sample 5:	Mild €Low			Severe €High	
Sample 6:	Severe €Med			Mild €Low	

- First Choices consistent across samples:

(p-value > .600)

- Standard Economic Assumptions:

- Cheaper is better

(p-values: .106, .021)

- More is better

(p-value: .019)

- Respondents internally consistent

Looking good for  
CEs!!!

# Results: Price Sequencing

<b>Sample 1:</b>	Severe	Severe	42.2
	€Med	€High	57.8

• Worsening Price Seq.:

<b>Sample 2:</b>	Severe	Severe
	€High	€Med

<b>Sample 3:</b>	Mild	Severe
	€Med	€Med

<b>Sample 4:</b>	Severe	Mild
	€Med	€Med

<b>Sample 5:</b>	Mild	Severe
	€Low	€High

<b>Sample 6:</b>	Severe	Mild
	€Med	€Low

# Results: Price Sequencing

Sample 1:	Severe		Severe	42.2
	€Med		€High	57.8
Sample 2:	Severe	32.5	Severe	
	€High	67.5	€Med	
Sample 3:	Mild		Severe	
	€Med		€Med	
Sample 4:	Severe		Mild	
	€Med		€Med	
Sample 5:	Mild		Severe	
	€Low		€High	
Sample 6:	Severe		Mild	
	€Med		€Low	

- Worsening Price Seq.: **-ve**  
(p-value = .099)



# Results: Price Sequencing

Sample 1:	Severe €Med	Severe €High	
Sample 2:	Severe €High	Severe €Med	24.1 75.9
Sample 3:	Mild €Med	Severe €Med	
Sample 4:	Severe €Med	Mild €Med	
Sample 5:	Mild €Low	Severe €High	
Sample 6:	Severe €Med	Mild €Low	

- Worsening Price Seq.: **-ve**  
(p-value = .099)
- Improving Price Seq.:

# Results: Price Sequencing

Sample 1:	Severe	25.3	Severe	
	€Med	74.4		€High
Sample 2:	Severe		Severe	24.1
	€High		€Med	75.9
Sample 3:	Mild		Severe	
	€Med		€Med	
Sample 4:	Severe		Mild	
	€Med		€Med	
Sample 5:	Mild		Severe	
	€Low		€High	
Sample 6:	Severe		Mild	
	€Med		€Low	



- Worsening Price Seq.: **-ve**  
(p-value = .099)
- Improving Price Seq.: **No**  
(p-value = .790)


# Results: Commodity Sequencing

Sample 1:	Severe €Med	Severe €High	
Sample 2:	Severe €High	Severe €Med	
Sample 3:	Mild €Med	Severe €Med	8.4 91.6
Sample 4:	Severe €Med	Mild €Med	
Sample 5:	Mild €Low	Severe €High	
Sample 6:	Severe €Med	Mild €Low	

- Worsening Price Seq.: **-ve**  
(p-value = .099)
- Improving Price Seq.: **No**  
(p-value = .790)
- Worsening Com. Seq.:

# Results: Commodity Sequencing

Sample 1:	Severe		Severe	
	€Med		€High	
Sample 2:	Severe		Severe	
	€High		€Med	
Sample 3:	Mild		Severe	8.4
	€Med		€Med	91.6
Sample 4:	Severe	25.9	Mild	
	€Med	74.1	€Med	
Sample 5:	Mild		Severe	
	€Low		€High	
Sample 6:	Severe		Mild	
	€Med		€Low	



- Worsening Price Seq.: **-ve**  
(p-value = .099)
- Improving Price Seq.: **No**  
(p-value = .790)
- Worsening Com. Seq.: **-ve**  
(p-value < .001)

# Results: Commodity Sequencing

Sample 1:	Severe €Med	Severe €High
Sample 2:	Severe €High	Severe €Med
Sample 3:	Mild €Med	Severe €Med
Sample 4:	Severe €Med	Mild 64.7 €Med 35.3
Sample 5:	Mild €Low	Severe €High
Sample 6:	Severe €Med	Mild €Low

- Worsening Price Seq.: **-ve**  
(p-value = .099)
- Improving Price Seq.: **No**  
(p-value = .790)
- Worsening Com. Seq.: **-ve**  
(p-value < .001)
- Improving Com. Seq.:

# Results: Commodity Sequencing

Sample 1:	Severe €Med		Severe €High
Sample 2:	Severe €High		Severe €Med
Sample 3:	Mild 37.3 €Med 62.7		Severe €Med
Sample 4:	Severe €Med		Mild 64.7 €Med 35.3
Sample 5:	Mild €Low		Severe €High
Sample 6:	Severe €Med		Mild €Low



- Worsening Price Seq.: **-ve**  
(p-value = .099)
- Improving Price Seq.: **No**  
(p-value = .790)
- Worsening Com. Seq.: **-ve**  
(p-value < .001)
- Improving Com. Seq.: **+ve**  
(p-value < .001)

# Results: Mixed Sequencing

Sample 1:	Severe €Med	Severe €High
Sample 2:	Severe €High	Severe €Med
Sample 3:	Mild €Med	Severe €Med
Sample 4:	Severe €Med	Mild €Med
Sample 5:	Mild €Low	Severe 32.5 €High 67.5
Sample 6:	Severe €Med	Mild €Low

- Worsening Price Seq.: **-ve**  
(p-value = .099)
- Improving Price Seq.: **No**  
(p-value = .790)
- Worsening Com. Seq.: **-ve**  
(p-value < .001)
- Improving Com. Seq.: **+ve**  
(p-value < .001)
- Worsening Mixed Seq.:

# Results: Mixed Sequencing

Sample 1:	Severe		Severe	
	€Med		€High	
Sample 2:	Severe	32.5	Severe	
	€High	67.5	€Med	
Sample 3:	Mild		Severe	
	€Med		€Med	
Sample 4:	Severe		Mild	
	€Med		€Med	
Sample 5:	Mild		Severe	32.5
	€Low		€High	67.5
Sample 6:	Severe		Mild	
	€Med		€Low	



- Worsening Price Seq.: **-ve**  
(p-value = .099)
- Improving Price Seq.: **No**  
(p-value = .790)
- Worsening Com. Seq.: **-ve**  
(p-value < .001)
- Improving Com. Seq.: **+ve**  
(p-value < .001)
- Worsening Mixed Seq.: **No**  
(p-value = .500)

# Results: Mixed Sequencing

Sample 1:	Severe €Med	Severe €High	
Sample 2:	Severe €High	Severe €Med	
Sample 3:	Mild €Med	Severe €Med	
Sample 4:	Severe €Med	Mild €Med	
Sample 5:	Mild €Low	Severe €High	
Sample 6:	Severe €Med	Mild €Low	41.0 59.0

- Worsening Price Seq.: **-ve**  
(p-value = .099)
- Improving Price Seq.: **No**  
(p-value = .790)
- Worsening Com. Seq.: **-ve**  
(p-value < .001)
- Improving Com. Seq.: **+ve**  
(p-value < .001)
- Worsening Mixed Seq.: **No**  
(p-value = .500)
- Improving Mixed Seq.:

# Results: Mixed Sequencing

Sample 1:	Severe		Severe
	€Med		€High
Sample 2:	Severe		Severe
	€High		€Med
Sample 3:	Mild		Severe
	€Med		€Med
Sample 4:	Severe		Mild
	€Med		€Med
Sample 5:	Mild	22.9	Severe
	€Low	77.1	€High
Sample 6:	Severe		Mild
	€Med		€Low



- Worsening Price Seq.: **-ve**  
(p-value = .099)
- Improving Price Seq.: **No**  
(p-value = .790)
- Worsening Com. Seq.: **-ve**  
(p-value < .001)
- Improving Com. Seq.: **+ve**  
(p-value < .001)
- Worsening Mixed Seq.: **No**  
(p-value = .500)
- Improving Mixed Seq.: **+ve**  
(p-value < .001)

# Results: Mixed Sequencing

Sample 1:	Severe €Med	Severe €High
Sample 2:	Severe €High	Severe €Med
Sample 3:	Mild €Med	Severe €Med
Sample 4:	Severe €Med	Mild €Med
Sample 5:	Mild €Low	Severe €High
Sample 6:	Severe €Med	Mild €Low

- Worsening Price Seq.: **-ve**  
(p-value = .099)
- Improving Price Seq.: **No**  
(p-value = .790)
- Worsening Com. Seq.: **-ve**  
(p-value < .001)
- Improving Com. Seq.: **+ve**  
(p-value < .001)
- Worsening Mixed Seq.: **No**  
(p-value = .500)
- Improving Mixed Seq.: **+ve**  
(p-value < .001)

# Conclusions

- CEs are complicated DC CV questions ... if we observe anomalous responses to the simple questions, then why not to the complex ones?
- Split-sample experiment shows a simple CE to exhibit same sequencing anomalies as CV
- Recommend caution in accepting claims that CE is the “solution”
- More research on why observe anomalies & under what circumstances they disappear.