# Learning the Value of Eco-Labels

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#### Motivation - Climate Action and Emissions



#### Global annual mean temperature relative to pre-industrial levels (1850–1900 average), 1850–2021 (degrees Celsius)



Source: The figure is drawn from the the World Meteorological Organization's State of the Global Climate 2021 report, which combines six international data sets for temperature: HadCRUT.SOL.01K Met Office), NOAAGlobalTemp v5 (USA), NASA GISTEMP v4 (USA), Berkeley Earth (USA), ERAS (ECMVF), JRA-55 (Japan).





Source: UN SDG Progress Report (2022)

#### Motivation - Climate Action and Emissions





Source: OECD Carbon Emission Report

### Motivation - Labels as source of information

- Labels and ratings are useful to inform consumers.
- Impact of *Information provision* (Allcott and Taubinsky, 2015):
  - Reduce biased beliefs
  - Reduce inattention (to energy costs)
  - Facilitate information acquisition
  - Forces reflection on the choice
- Consumers are experienced with making decisions with different ratings







### **Research Questions**

In this study:

1. How do consumers react to sustainability ratings compared to quality ratings?



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2. How do consumers update their behaviour when beliefs about ratings change?



#### Attention and the decision process

- Attention is an important mechanism in the decision process
- Process of selecting and filtering information relevant for the decision
- Multiple studies show links between importance of a stimulus and the attention paid to it (Review: Orquin and Mueller Loose, 2013)
- We expand on Engelmann et al. (2021) [WP] to incorporate attention to the estimations of the decision process.
- Attention allows to capture heterogeneity in the preferences of participants
- Also the role of contextual factors in the decision process.

### Experimental Design



- Participants choose between two products depending on Price, Quality and Sustainability
- Quality and Sustainability presented as ratings
- Participants do not know the underlying value of ratings (but know the range)

### Experimental Design



In the middle of the experiment:

- elicit their belief about the ratings
- Give them information about the ratings
- repeat decisions

#### Experimental Design

- Online Experiment (Prolific)
- Participants choose between 2 artificial products
- Products are not real, but benefits are.
- Participants get:
  - Participation fee
  - Bonus Payment
  - Planting trees (via OneTreePlanted.org)
- Three different attributes:
  - Price: Reduces Bonus Payment
  - Quality: Increases Bonus Payment
  - Sustainability: Increases amount of planted trees

- Participants observe Quality and Sustainability as ratings.
- Higher ratings (stars or leaves) represent a higher (but unkown) underlying value
- Information is hidden in 'boxes'
  - Participants mouse over the attributes to reveal info
  - Attributes revealed by rows

	Product 1	Product 2
Price	£2.5	£1
Quality	<mark>☆</mark> ☆☆	ፚ፞፞ፚ፞፞፞ፚ፞
Sustainability	999	<b>9</b> 99
	Product 1	Product 2

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Price		
Quality	<mark>ਨੇ</mark> ਨੇਨੇ	ኇ፟፟፟
Sustainability		
	Product 1	Product 2

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#### Main Task - some details



- Participants know the range for Quality and Sustainability, not values per level.
- Different attribute combinations (pseudo-randomized combinations)
- Demographics + Connectedness to Nature (CNS)

# Main Task - Additional Information



After eliciting beliefs, if assigned to Information treatments:

- We showed two graphs about the underlying value of the labels.
- Quality and Sustainability have a point system.
  - 10 Sustainability points = 1 tree
  - 10 Quality points = 0.5 pounds

# Main Task - Additional Information



- Depending on the treatment, one of the attributes had a convex distribution of values.
- A convex distribution: mid rating has a low value similar to low rating.
- 3 between-subject treatments:
  - S. Linear + Q. Linear
  - S. Convex + Q. Linear
  - S. Linear + Q. Convex

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#### **Experiment Overview**

- 295 participants in Prolific (139 female, 2 non-binary/not disclose)
- Most participants come from UK (68) or continental Europe (169)
- Avg. age =29.9
- 277 clicked to select where they wanted to plant the trees.
- 182 Selected a specific location
- Large differences in Connectedness to Nature (CNS) (histogram
  - mean (sd): 3.546 (.621)
  - min/max: 1.571/5

#### The green side of this project!

In total, 1153 trees where planted across the world.



Thanks to Diana Garcia for the beautiful Figure.

## Results - Before Information about ratings

Decision Stage (Before Information) Decision Stage (After Information)

## Results - Before Information about ratings

Decision Stage (Before Information) Information about ratings Decision Stage (After Information)

# Beliefs before information about ratings



## Decision Models - Before information about ratings

First stage: separate main factors affecting attention to attributes  $k \in \{P, S, Q\}$ 

- Individual factors  $\hat{\eta}_{k,i}$
- Contextual factors  $\hat{z}_{k,t}$

Second stage: Conditional Logits (i.e. Fixed Effects) for decisions with the following specifications:

$$V_{i,t} = \omega_{P,i,t} \Delta P_t + \omega_{S,i,t} \Delta v_{S,c_t} + \omega_{Q,i,t} \Delta v_{Q,c_t} + \eta_{i,t} \qquad (M1 - M3)$$

With:

$$\omega_{k,i,t} = \pi_{k,0} + \pi_{k,\eta} \hat{\eta}_{k,i} + \hat{z}_{k,t} \beta_k \qquad (M1)$$

$$\omega_{k,i,t} = \pi_{k,0} + \pi_{k,\eta} \hat{\eta}_{k,i} \qquad (M2)$$

$$\omega_{k,i,t} = \pi_{k,0} \tag{M3}$$

Where:

- $\Delta P_t$  is difference in price
- $\Delta v_{S,c_t}, \Delta v_{Q,c_t}$ : diff. in S and Q ratings with  $c_t \in \{2vs1, 3vs2, 3vs1\}$

# Willingness to Pay (WTP) - Before information

Marginal WTP for increasing each rating.

$$WTP_{c}^{k}(\bar{a}_{i}) = rac{\omega_{k,i,t}\Delta v_{k,c}}{\omega_{P,i,t}}$$

#### Concavity and Transitivity



Lighter colors (green/orange): Participants with lowest avg. attention to attribute (10th percentile)

Darker colors (green/orange): Participants with highest avg. attention to attribute (90th percentile)

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#### Attention to Sustainability



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Marginal WTP for increasing each rating.

$$WTP_{c}^{k}(\bar{a}_{i}) = rac{\omega_{k,i,t}\Delta v_{k,c}}{\omega_{P,i,t}}$$

#### Attention to Quality



Lighter colors (green/orange): Participants with lowest avg. attention to attribute (10th percentile)

Darker colors (green/orange): Participants with highest avg. attention to attribute (90th percentile)

# Results - After Information about ratings

Decision Stage Information (Before Information) about ratings

Decision Stage (After Information)

# Results - After Information about ratings



# Sustainability



# Sustainability



Quality



Quality



### Results after Information

- $\bullet\,$  Treatments have different effects on Q and S
  - $\downarrow S_2 \Longrightarrow \downarrow v^{S}(2,1), \uparrow v^{S}(3,2)$
  - $\downarrow Q_2 \Longrightarrow \uparrow v^Q(3,2)$
- Shifts in attention linked to shifts in preferences
  - $\downarrow$  Individual in attention to S  $\Longrightarrow \downarrow v^{S}(2,1)$
  - $\uparrow$  Individual in attention to Q  $\implies \uparrow v^Q(3,2)$
- Treatment effects are stronger on participants with initial higher attention to attribute.

# Summary of results

#### **Before Information:**

- Beliefs about Sustainability and Quality ratings are linear.
- Preferences for Q and S are concave
- Individual and contextual factors of attention capture heterogeneity in preferences for all attributes.

#### After Information:

- Changes in beliefs are in line with treatments
- WTP changes asymmetrically for Q and S
- Changes in Attention partially moderate the changes in WTP



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#### Pseudo-randomization

- For each pair (1,2),(3,2),(3,1) (number of leaves of each product), we combine them with:
  - Non-Sustainable product with higher quality and higher price
  - Non-Sustainable product with higher quality and lower price
  - Non-Sustainable product with lower quality and lower price
  - Non-Sustainable product with higher quality and equal price
- Additionally, 2 trials have equal sustainability but one has higher price and quality.
- All pairs have the same combination for each participant. (e.g. same higher Q and P for the three pairs of S)
- The participants observe the same blocks before and after and in the same order.

Back

#### Attitude - Sustainability

How do you see yourself: are you generally a person who is prepared to behave sustainably, even when this is inconvenient or costly to you?



# Connectedness to Nature



### Before Information - Results

	(1)		(2)		(3)	
$\Delta P$	-1.026***	(0.000)	-1.026***	(0.000)	-1.073***	(0.000)
$\Delta P  imes ar{a}_P$	-0.911***	(0.000)	-0.925***	(0.000)		
$\Delta P  imes  ilde{a}_P$	-0.041	(0.549)				
$\Delta Q(3vs2)$	1.266***	(0.000)	1.226***	(0.000)	1.206***	(0.000)
$\Delta Q(2vs1)$	1.791***	(0.000)	1.798***	(0.000)	1.749***	(0.000)
$\Delta Q(3vs2) \times \bar{a}_Q$	0.513***	(0.001)	0.398**	(0.006)		
$\Delta Q(3vs2) \times \tilde{a}_Q$	-0.284**	(0.007)				
$\Delta Q(2vs1)  imes ar{a}_Q$	0.551***	(0.000)	0.589***	(0.000)		
$\Delta Q(2vs1)  imes  ilde{a}_Q$	0.091	(0.378)				
$\Delta S(3vs2)$	0.992***	(0.000)	0.975***	(0.000)	0.981***	(0.000)
$\Delta S(2vs1)$	1.182***	(0.000)	1.209***	(0.000)	1.236***	(0.000)
$\Delta S(3vs2)  imes ar{a}_S$	0.697***	(0.000)	0.614***	(0.000)		
$\Delta S(3vs2)  imes  ilde{a}_S$	-0.158	(0.093)				
$\Delta S(2vs1)  imes ar{a}_S$	0.790***	(0.000)	0.872***	(0.000)		
$\Delta S(2vs1)  imes  ilde{a}_S$	0.179	(0.110)				
Observations	4981		4981		4981	
AIC	3640.001		3640.350		3836.793	
BIC	3737.702		3705.484		3869.360	

*p*-values in parentheses

$$^{*}$$
  $p < 0.05$ ,  $^{**}$   $p < 0.01$ ,  $^{***}$   $p < 0.001$