Designing Discrete Choice Experiments to inform incentive-based schemes: lessons learned & challenges ahead

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Leading the way in Agriculture and Rural Research, Education and Consulting

Overview

- Discrete choice approaches
  - Best Worst Scaling (BWS)
  - Discrete Choice Experiments (DCE)

- Less focus on specific methodological details

- More focus on
  - application of techniques to inform policy decisions
  - general lessons learned
  - selected concerns
  - outlook for research

Discrete choice approaches

Context:

Land use and management decisions of farmers and land managers

Aim:

Obtain preference information for existing and/or novel ‘products’ (practices; policy options; interventions) and/or their characteristics

- Information most useful relatively **early** in the policy/ planning process - *ex-ante* evaluation

Two main applications

1. Prioritization of potentially large amount of farm management practices/options

2. Understanding preferences for characteristics of typically one or few farm management practices and/or associated policy options (e.g. Ag-env contracts)

- Environmentally beneficial farm management
- Disease risk mitigation
- Genetics/breed choice
- Rural development

Best-Worst Scaling

Prioritizing among many options

- Example: Choice between many (agri-environmental) practices for policy support
- Aim: Arrive at reduced set of menu options for adoption by farmers

  - Rating: how do you see practice A on a scale from 1-10?
  - Ranking: how do you rank practices A to E giving best a 1 and worst a 5
  - Best-Worst-Scaling: Select ‘best’ and ‘worst’ out of a list of practices shown, then determine relative importance of each practice based on choices made

BWS example: GHG mitigation in dairy

- Identification of promising GHG mitigation practices for policy support on dairy farms in Scotland

  GLENK ET AL. 2014

- Identification based on
  - Moderate to high levels of non-adoption (“potential”)
  - Ranked highly among non-adopters

GHG mitigation practices: dairy

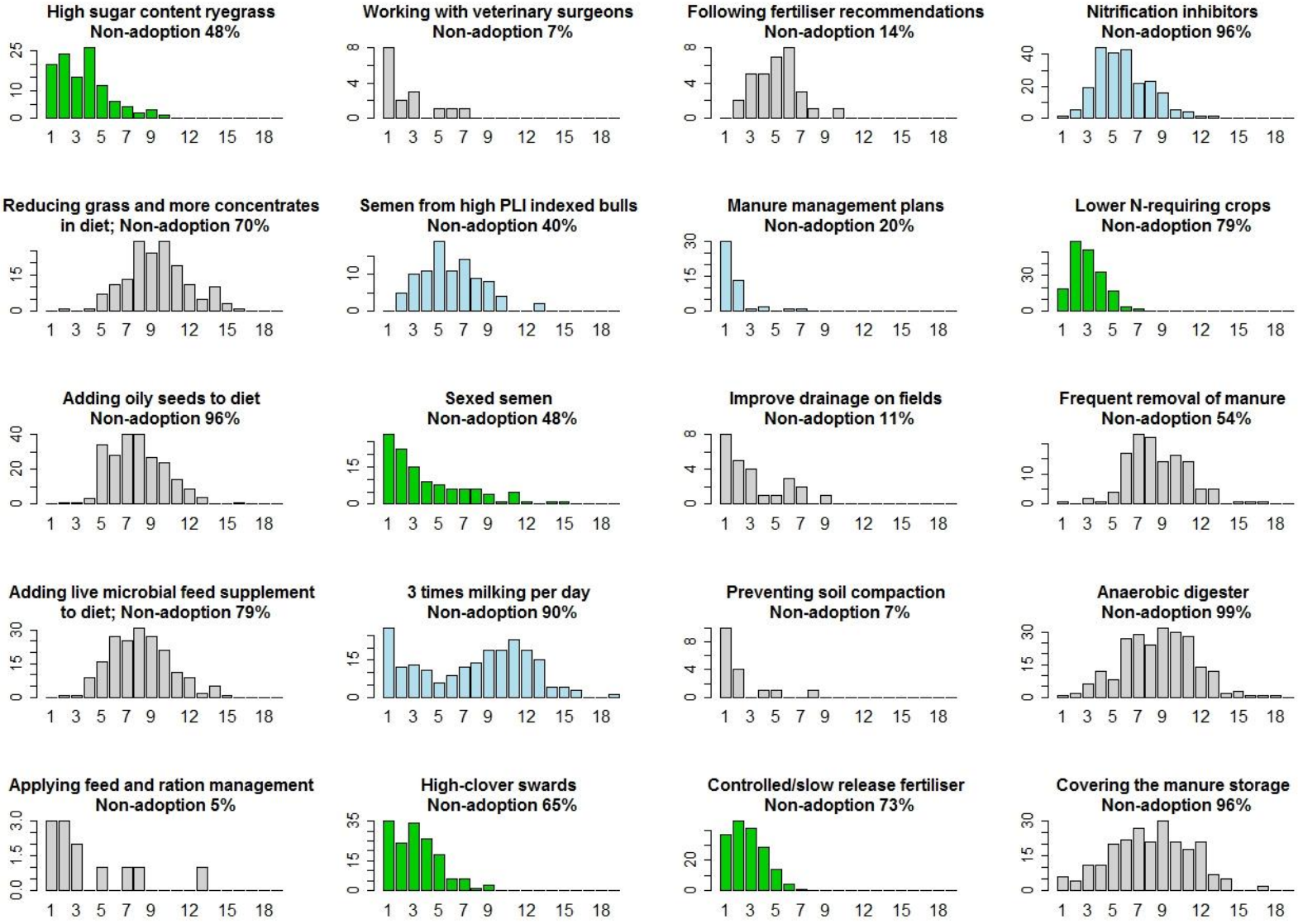
Animal nutrition	
P1	Planting high sugar content (high WSC) ryegrass (e.g. Aber HSG)
P2	Reducing grass in the diet and feeding more concentrates/grains/total mixed rations
P3	Adding oily seeds (e.g. canola, sunflower) at 10% to the diet
P4	Adding a live microbial feed supplement (e.g. Lactobacillus sp.) to the complete diet directly
P5	Applying feed and ration management (including forage/fodder analysis) with a feed company or advisor involved to optimise nutrient use of animals
Animal productivity	
P6	Working with veterinary surgeons to optimise biosecurity, vaccination and herd health
P7	Using bull semen from high PLI indexed bulls
P8	Using sexed semen to increase proportion of females born
P9	Moving from 2 to 3 times milking per day
Soil and fertiliser management	
P10	Using high-clover swards (20% of dry matter)
P11	Applying fertiliser according to fertiliser recommendations
P12	Make manure management plans taking full account of nutrients available in the manure
P13	Maintaining old drainage system (or installing a new one if needed) to improve drainage on fields
P14	Preventing soil compaction (e.g. avoiding heavy machinery and livestock poaching when soils are wet or saturated)
P15	Using the type of fertiliser that breaks down and releases nutrients slowly (controlled or slow release fertiliser)
P16	Using chemicals to prevent loss of N due to nitrification (nitrification inhibitors)
P17	Changing to crops which require less nitrogen fertilisation
Manure storage	
P18	Frequently (twice-a-week) removing manure from the cattle shed to outside storage (e.g. to manure heap; slurry tank)
P19	Installing and using an anaerobic digester to treat animal waste
P20	Covering the manure storage (e.g. straw, plastic film, tent, or lid in case of slurry and plastic film for farm yard manure)

BWS choice card example

Best for your farm's performance	Set 4	**Worst** for your farm's performance
☐	Adding oily seeds (e.g. canola, sunflower) at 10% to the diet	☐
☐	Installing and using an anaerobic digester to treat animal waste	☐
☐	Applying fertiliser according to fertiliser recommendations	☐
☐	Using the type of fertiliser that breaks down and releases nutrients slowly (controlled or slow release fertiliser)	☐

- Experimental design:
  - Balanced Incomplete Block Design
  - 9-10 choice cards per respondent
  - 4-5 management practices per choice card

BWS results: ranks of non-adopters



Other examples (with farmer samples)

- Food safety in UK ERDEM ET AL. 2012
- GHG mitigation in Welsh sheep JONES ET AL. 2013
- Carbon farming practices Australia KRAGT ET AL. 2016
- …

Other examples

- Effectiveness and practicality of interventions in the farm and rural environment to reduce human exposure to Escherichia coli CROSS ET AL. 2011
  - Two ‘best-worst’ scaling dimensions: practicality and effectiveness
  - Sample are ‘experts’

BWS: several ‘dimensions’

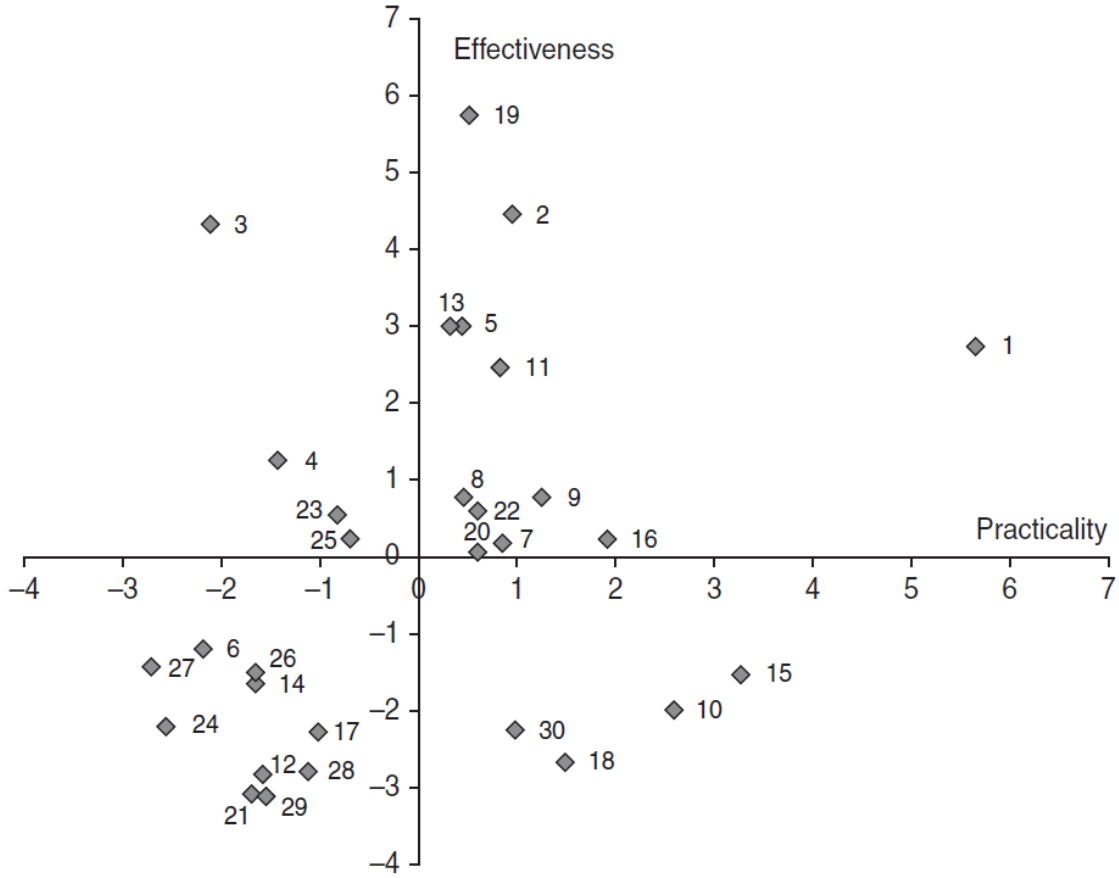


Fig. 1. Zero-centred scatterplot of mean effectiveness and practicality scores for the 30 control measures.

CROSS ET AL. 2011

BWS summary and outlook

- Provides useful early insights on trade-offs

- Simpler rating or ranking may(!) just do the job

BWS summary and outlook

- Use of several dimensions for ‘best-worst’ choices
  - Effectiveness
  - Practicability
  - Likelihood of adoption
  - Monitoring requirements
  - Potential to deliver co-benefits

- Dimensions should ideally be independent …

- Can also be across different samples
  - E.g. scientists, policy makers and farmers

Discrete Choice Experiments

Aim

- Understanding the supply side of public good (ecosystem service) provision
  - Participation in incentive-based schemes in agricultural landscapes
    - Agri-environmental schemes (AES)
    - Payments for ecosystem services (PES)

- Rapid increase in applications VILLANUEVA ET AL. 2017

Supply side DCEs

- Specific actions rather than broader policies/schemes

  Exception e.g. SCHULZ ET AL. 2014 (‘Greening’ in CAP)

- Action-based rather than outcome-based schemes
  - Implicit assumption that greater participation equals greater supply of ecosystem services in many studies

Information for decision makers

- How does participation in a scheme change as contract characteristics vary?

- Relative importance of contract characteristics
  - Enhancing factors
  - Factors detrimental to uptake
- Probability of uptake
- Compensation requirements in monetary terms (*willingness to accept*, WTA)

DCE: introduction

- Respondents (farmers) are offered a series of choices between contract options
- A ‘no contract’ option is typically available (no forced choice)
- Contracts offered differ in their characteristics or attributes, including a payment made to farmers
- Differences between contract options are based on an experimental design

Attributes

- Payments are often offered for a pre-defined fixed amount of land to be enrolled (e.g. the whole farm, largest plot)
- Alternatively, payments are specified on a per hectare (or length of feature) basis

- Other attributes can be grouped into
  - management actions to be taken
  - services provided e.g. training and extension services; assistance with administration
  - contractual terms such as contract length; possibility of contract cancellation; monitoring requirements; penalties for non-compliance; premium/bonus paid for collaboration

Examples

- AES (different environmental services) for farmers in Spain ESPINOSA ET AL. 2010

Example of a choice set (Aragón sample)

	Alternative A	Alternative B	Alternative C
Surface	50 % eligible surface	Free to choose	Neither Alternative A nor Alternative B. I would maintain my current farm management
Grazing in the enrolled surface	Free	Limited (not allowed between 01/08–30/09)	
Technical advisory service compulsory and free of charge	No	Yes	
Fixed Premium of 1,000 €	No	Yes	
Premium level (€.ha^{-1}.year^{-1})	60	80	

Examples

- Pesticide-free buffer zones in Denmark CHRISTENSEN ET AL. 2011

	Subsidy scheme A	Subsidy scheme B
Buffer zone width (between 6 and 24 m)	6 m	Flexible width
Contract length	1 year	5 years
Option to cancel contract (without costs)	Yes	No
Changed agricultural practice	Pesticide-free	Pesticide-free
Application method	Usual application procedure	Free assistance
Size of subsidy	336 DDK	228 DDK

Which of the subsidy schemes do you prefer?

Subsidy scheme A
Subsidy scheme B
None of these

Examples

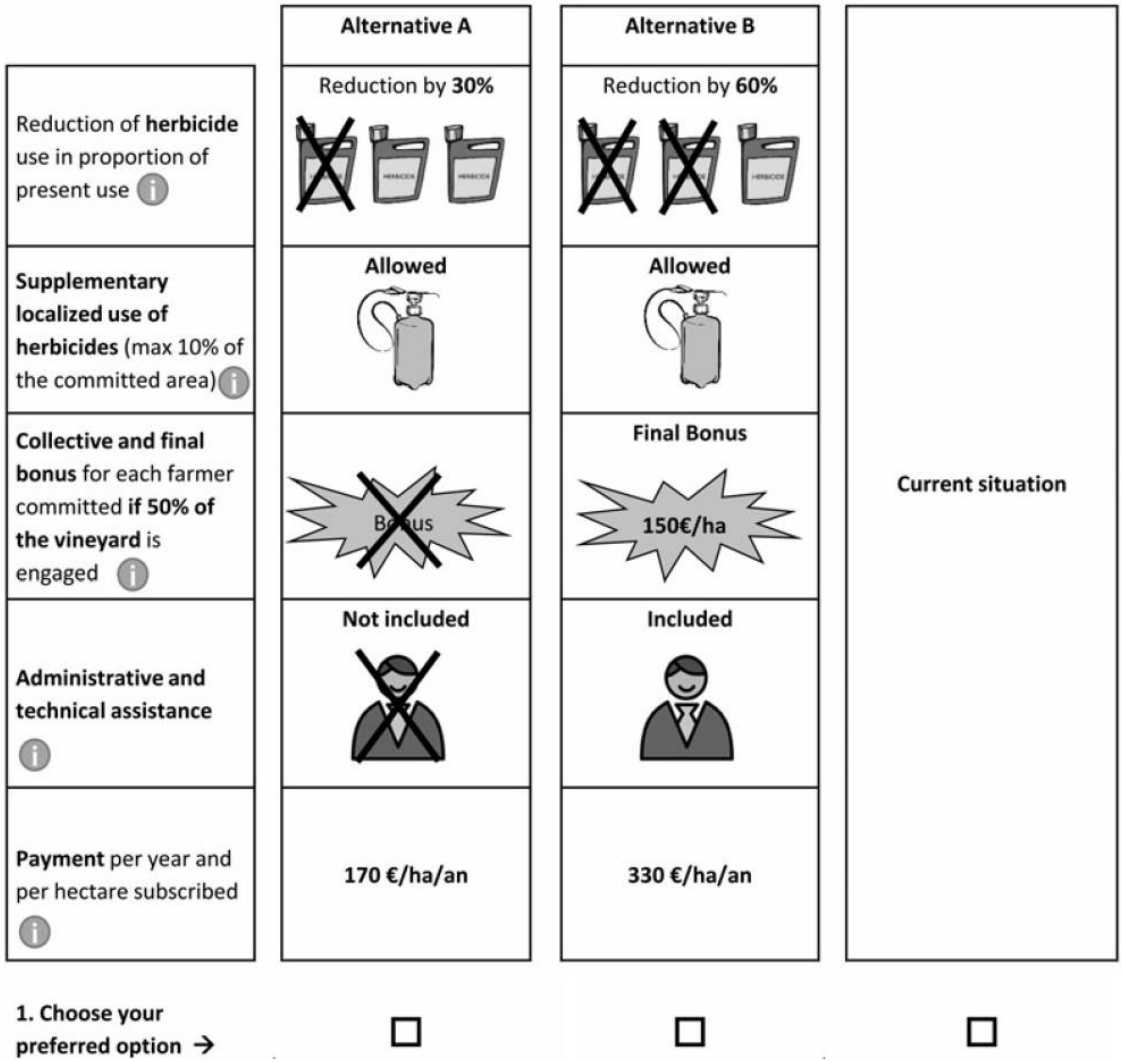
- Agri-environmental scheme for afforestation in Denmark BROCH & VEDEL 2012

	Contract 1	Contract 2
Purpose of afforestation	Ground water	Recreation
Possibility of cancelling the contract	Can be cancelled until year 10	Cannot be cancelled
Visits by authorities[a]	10 % are visited	25 % are visited
Compensation (DKK/ha)	4,840€/ha	5,650€/ha
	Contract 1 ❑	Contract 2 ❑

I do not want any of the contracts ❑

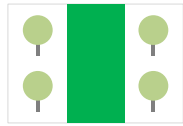
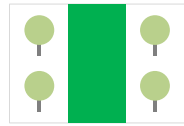
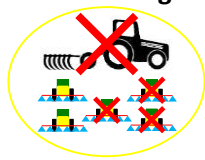
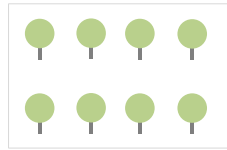
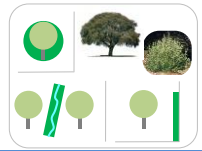
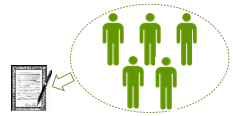
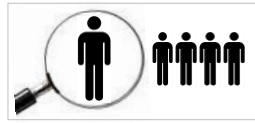
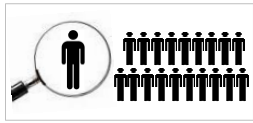
Examples

- AES (herbicide use) for winegrowers in France
  KUHFUSS ET AL. 2016



Examples

- AES (biodiversity and soil conservation) for olive growing in Southern Spain
  VILLANUEVA ET AL. 2015

	Alternative A	Alternative B	Alternative C
Yearly payment	**€200/ha** 	**€300/ha** 	**Neither Alternative A, nor Alternative B. I would maintain my current farm management**
Cover crops area	**50% of olive tree area** 	**50% of olive tree area** 	
Cover crops management	**Restrictive mgmt.** 	**Free mgmt.** 	
Ecological focus areas	**0% of EFA in olive tree area** 	**2% of EFA in olive tree area** 	
Participation	**Individual** 	**Collective** 	
Monitoring	**Monitoring at 20%** 	**Monitoring at 5%** 	
	I choose A ☐	**I choose B** ☐	**I choose C** ☐

Lessons so far I

- Contract characteristics affect uptake

- Probability of uptake increases/compensation needs decrease if …

  - management practices are less restrictive
  - Contract duration is shorter
  - contracts involve individual participation rather than collaboration
  - enforcement is less strict (e.g. lower penalty for non-compliance)
  - additional advice is available
  - more flexibility on elements above is offered

- **Scheme design can considerably influence its "success"**

Lessons so far II

- Farmers differ in their supply response to different contract characteristics

- Preference heterogeneity is often (in part) explained by different farm or farmer characteristics

- **Scheme design tailored to certain farm groups may increase the likelihood of adoption within each group (and hence probably overall uptake)**

Lessons so far II

- Factors affecting uptake in general:
  - farm size (+)
  - previous experience (+)
  - level of training and education (+)
  - perception of private benefits (+)
  - environmental awareness (+)
  - level of intensification (–)
  - farmer’s age (–)
  - etc.

RUTO & GARROD 2009, ESPINOSA ET AL. 2010, VILLANUEVA ET AL. 2017a, among others

External validity

- Concern:
  - generally: hypothetical bias
  - strategic response to influence policy makers

- Accuracy required?
  - Relative values versus absolute values

External validity

- Extent of bias largely unclear
  - no comparisons yet with uptake data obtained from existing schemes
  - no comparisons yet with WTA measures derived using other methods, e.g. reverse auctions
  - no DCEs yet that directly address incentive compatibility e.g. through making choice(s) made binding

- Limited evidence on convergent validity by comparing WTA to existing payment levels e.g. ESPINOSA ET AL. 2010; VILLANUEVA ET AL. 2017b, 2017c

Serial non-participation

- Some respondents may always choose the ‘no contract’ option – serial non-participants (SNP)

- SNP may reflect ‘**protest**’ against the scenario on offer, e.g.:
  - general rejection of subsidy-based (environmental) schemes
  - unwillingness to deal with additional ‘bureaucracy’
  - lack of trust in institutions involved in scheme

- SNP may also reflect that upper bound of compensation amount in CE was too low to participate: ‘**very high takers**’

- How to identify and deal with SNPs can affect results (probability of uptake; WTA) VILLANUEVA ET AL. 2017

Serial non-participation

- Few WTA studies investigating incentive-based schemes report SNP responses VILLANUEVA ET AL 2017
  - SNPs not or only vaguely characterised
  - different criteria used for identification

- More systematic capturing of reasons for SNP needed across studies, including information specifically to identify ‘very high takers’

- Best practice: remove ‘protesters’ and minimise incidence of VHT in the first place through design of experiment (monetary attribute)

- But: raises questions on sensitivity to context effects in relation design of monetary attribute in general

Serial non-participation

Payment levels used:

EUR 100, 200, 300, 400 ha^{-1} yr^{-1}

VILLANUEVA ET AL 2015

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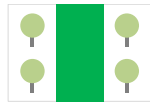
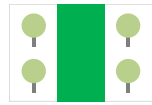
Cover crops area	50% of olive tree area 	50% of olive tree area 	
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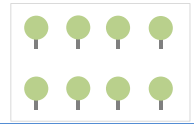
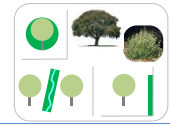
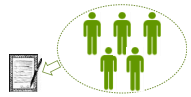
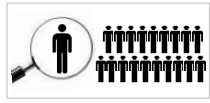
Ecological focus areas	0% of EFA in olive tree area 	2% of EFA in olive tree area 	
Participation	Individual 	Collective 	
Monitoring	Monitoring at 20% 	Monitoring at 5% 	
	I choose A ☐	I choose B ☐	I choose C ☐

Reference-dependence

- Farmers may **differ in their status quo** with respect to adherence to management prescriptions
- Some farmers may **already comply with requirements** on offer – e.g. have buffer strips
  - Compensating such farmers to participate at unchanged or lower levels of commitment *may* violate additionality principle

- If differences in status quo are not taken into account in analysis, this can affect choice model results (probability of uptake; WTA)

- Precise definition of individual farmer's status quo is often not straightforward

Reference-dependence

- Example: Cover crops area VILLANUEVA ET AL. 2017a

25

50

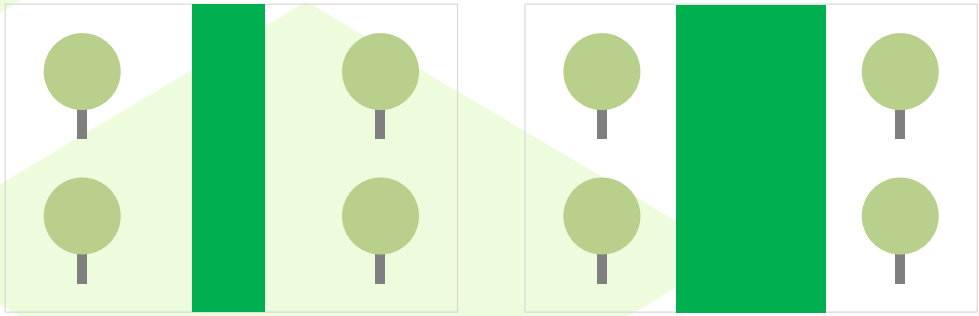
0%

100%

Reference-dependence

- Example: Cover crops area VILLANUEVA ET AL. 2017a

LEVELS: **25%** and **50%** of olive grove area



25 **50**

0% **100%**

- Assumption: no additional compensation required if farmers comply with contract terms in status quo
- Generally: estimates of WTA affected if ignored

Reference-dependence

- Prior knowledge about the system targeted by scheme (to define attribute levels which effectively entail improvements in farmers' supply of public goods)
- Include specific questions (before the CE questions) to accurately identify farmers' individual SQ
- Possibly use this information to explain contract requirements to farmers
- Consider differences in status quo in analysis GLENK 2011

Discrete & continuous response

- Discrete choice: enrol land or not
- Continuous choice: how much land to enrol

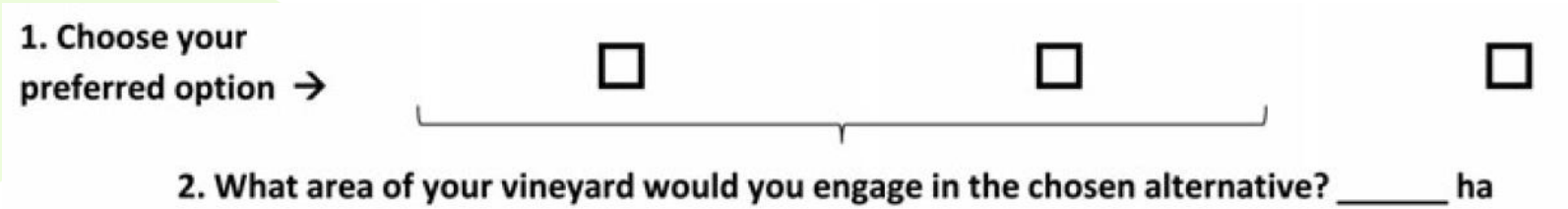
- Typically farmers express their WTA for an undefined or pre-defined quantity of land enrolled
  - An exception is KUFUSS ET AL. 2016a, b

- Only relying on discrete response may tell little about supply curve
  - in terms of quantity provided (land enrolled) depending on compensation amount/contract terms

- Such information can be useful to e.g. understand
  - how much land will be enrolled at a given budget
  - the budget needed to achieve a given area enrolment target

Discrete & continuous

- KUHFUSS ET AL. 2016a



- Some studies use ‘area enrolled’ as an attribute
- More work building on this is clearly desirable!

- Possibility to consider discrete-continuous choice over *several* alternative schemes & start understanding substitution patterns
  - Multiple Discrete Continuous Extreme Value (MDCEV) model
    BHAT 2008

Other aspects …

- Context effects
  - Choice complexity, role of information and time to respond
- Survey format
- Sampling and selection bias
- Analysis
  - Non-profit maximising objective functions
  - Simplifying decision rules
  - Spatial preference heterogeneity

Summary

- DCEs are useful tools to inform ex-ante scheme design
- Influence of contractual attributes on participation in incentive-based schemes well established
- Farm and farmer characteristics determine participation
- Careful design of studies crucial to minimise potential biases in results & facilitate interpretation of findings

Outlook

- More work desirable on validity & accuracy of DCEs in this specific context
  - Criterion/convergent validity testing
  - Protesters, very high takers and attribute design
  - Understanding reference-dependence
- Can estimates of WTA for participation in AES be transferred across contexts (within and between countries)?
- Explore/improve links with farm level data & analysis e.g. efficiency analysis

Outlook

- Understanding discrete and continuous decisions
- Understanding complementarities and substitution patterns across different scheme options
- Novel, innovative applications
  - e.g. outcome-based and collaborative schemes
  - links to actual public good/ ecosystem service provision (demand)
  - expand ‘fields’ of application e.g. livestock genetics, health & animal welfare

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BWS additional thoughts

- Simpler rating or ranking may(!) just do the job

- Unlike rating, creates clear ranking of options at both individual and sample level, but more time-consuming
- Unlike ranking, choice format relatively easy to complete

- "Anchoring": what if none of the practices on a choice card are feasible? LAGERKVIST ET AL. 2012

- Position bias CAMPBELL AND ERDEM 2015
  - Coefficients (and potentially rankings) are affected by position on card (top versus bottom)
  - More important for 'worst' decisions
  - Mitigation via randomisation, which is easier in online formats than in other survey modes

BWS additional thoughts

- Use of innovative response mechanisms
  - e.g. trio-wise ERDEM AND CAMPBELL 2017

Most important		Least important
❑	Where it happens	❑
❑	Its format	❑
❑	Its focus	❑