Empirical evidence for behavioral biases in direct and indirect rebound

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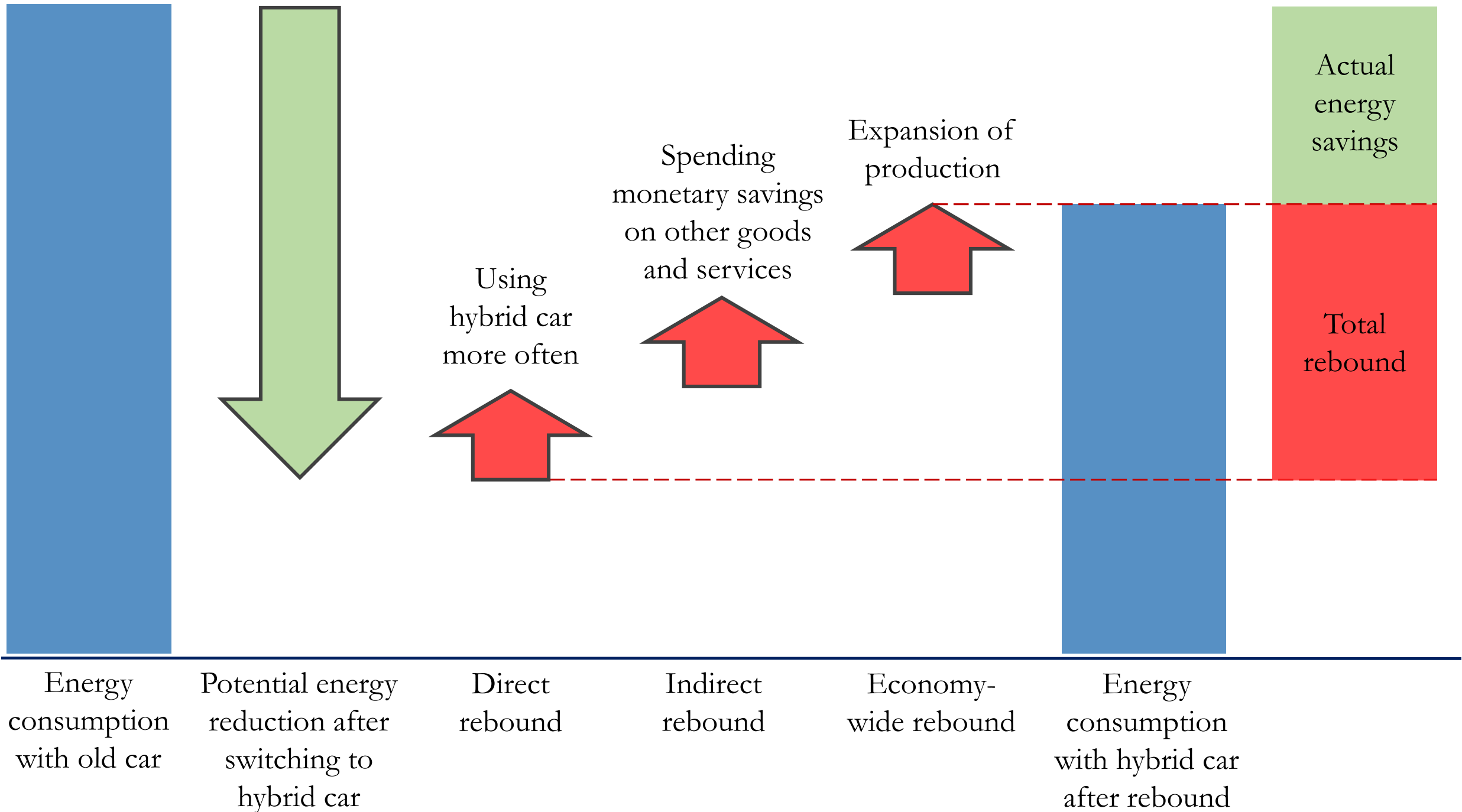
Currently in Loyola University

From September in Universitat de Barcelona

Work done in Autonoma Universitat of Barcelona, ICTA

Joint work with:

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Energy consumption with old car	Potential energy reduction after switching to hybrid car	Direct rebound	Indirect rebound	Economy-wide rebound	Energy consumption with hybrid car after rebound

Using hybrid car more often

Spending monetary savings on other goods and services

Expansion of production

Actual energy savings

Total rebound

Behavioral insights

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Behavioral assumptions of *homo economicus*	Insights from behavioural sciences	Behavioural regularities relevant for rebound

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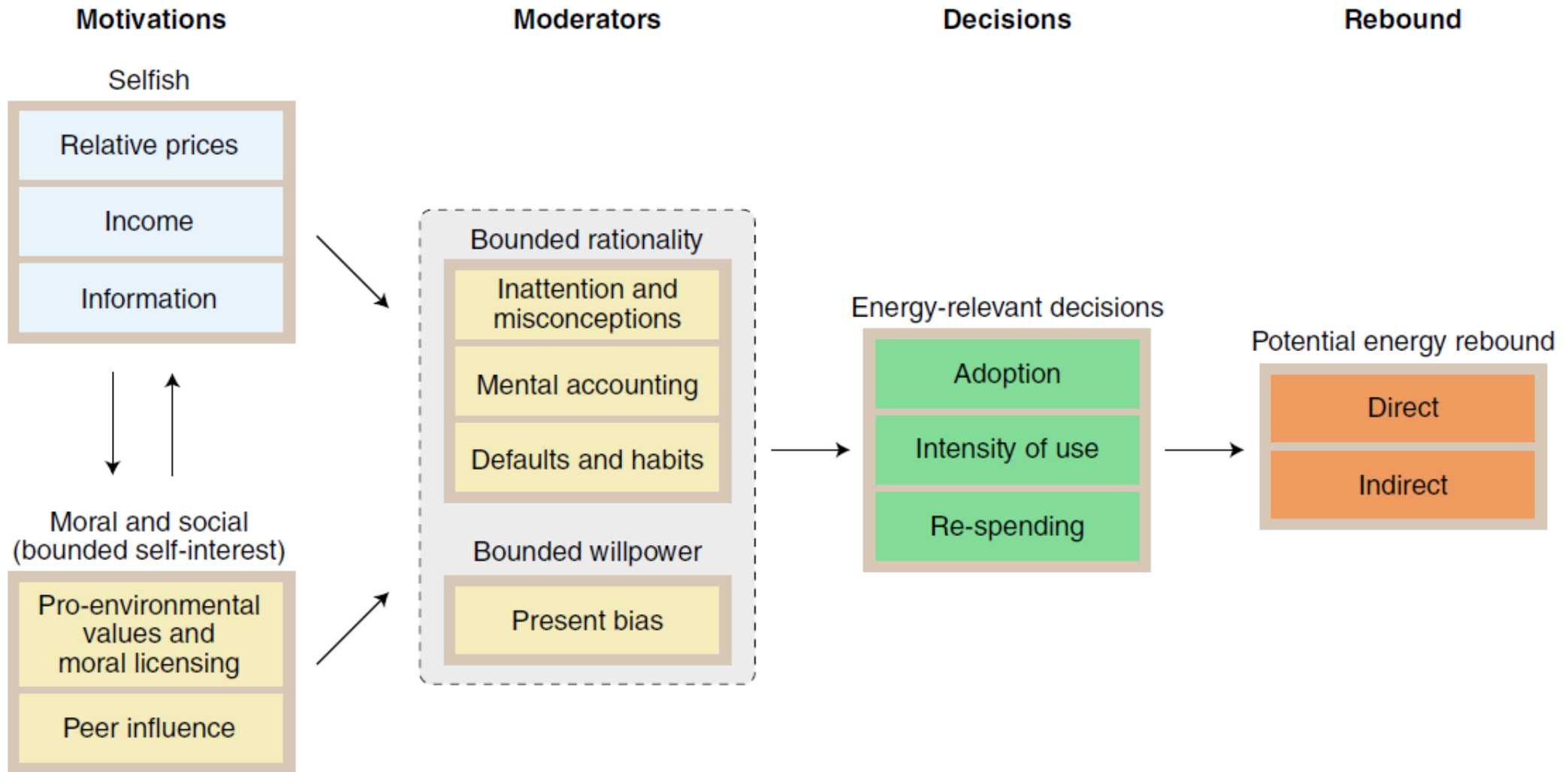|	Behavioral assumptions of *homo economicus*	Insights from behavioural sciences	Behavioural regularities relevant for rebound
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	Socially isolated agents	Social interactions	Peer influence – Social Norms

A simple model

Motivations

Selfish

Relative prices
Income
Information

Moral and social
(bounded self-interest)

Pro-environmental values and moral licensing
Peer influence

Moderators

Bounded rationality

Inattention and misconceptions
Mental accounting
Defaults and habits

Bounded willpower

Present bias

Decisions

Energy-relevant decisions

Adoption
Intensity of use
Re-spending

Rebound

Potential energy rebound

Direct
Indirect

Literature review results

Effects on rebound-relevant decisions

Behavioural regularities		Adoption	Intensity of use	Re-spending
Bounded rationality	Inattention & misconceptions	🟥	🟥	🟨
	Mental accounting	🟥	🟥	🟥
	Defaults & habits	🟥	🟨	🟨
Bounded willpower	Present bias	🟥	🟥	🟨
Bounded self-interest	Pro-environmental preferences and moral licensing	🟩	🟨	🟩
	Peer influence	🟩	🟨	🟨

🟥 Decreases adoption or increases intensity of use or increases re-spending

🟨 Uncertain effect

🟩 Increases adoption or decreases intensity of use or decreases re-spending

Empirically measuring rebound (in a car context)

Publicly available information about cars by providing plate numbers:

- yearly technical controls (including millage readings)
- technical information (including fuel efficiency)

Design – Sample – Procedures

- A questionnaire measuring driving habits and behavioral regularities
- Sent to 30,000 UK drivers (Dynata panel company)
- Three conditions
  - Have current car more than 3 years
  - Have older car more than 3 years
  - Accept to provide plate numbers of both cars
- Final sample 3,326

Useful sample (has odometer & fuel efficiency info)

New car

Old car

n=1996

n=710

n=1006

n=547

+ Fuel efficiency new > fuel efficiency old
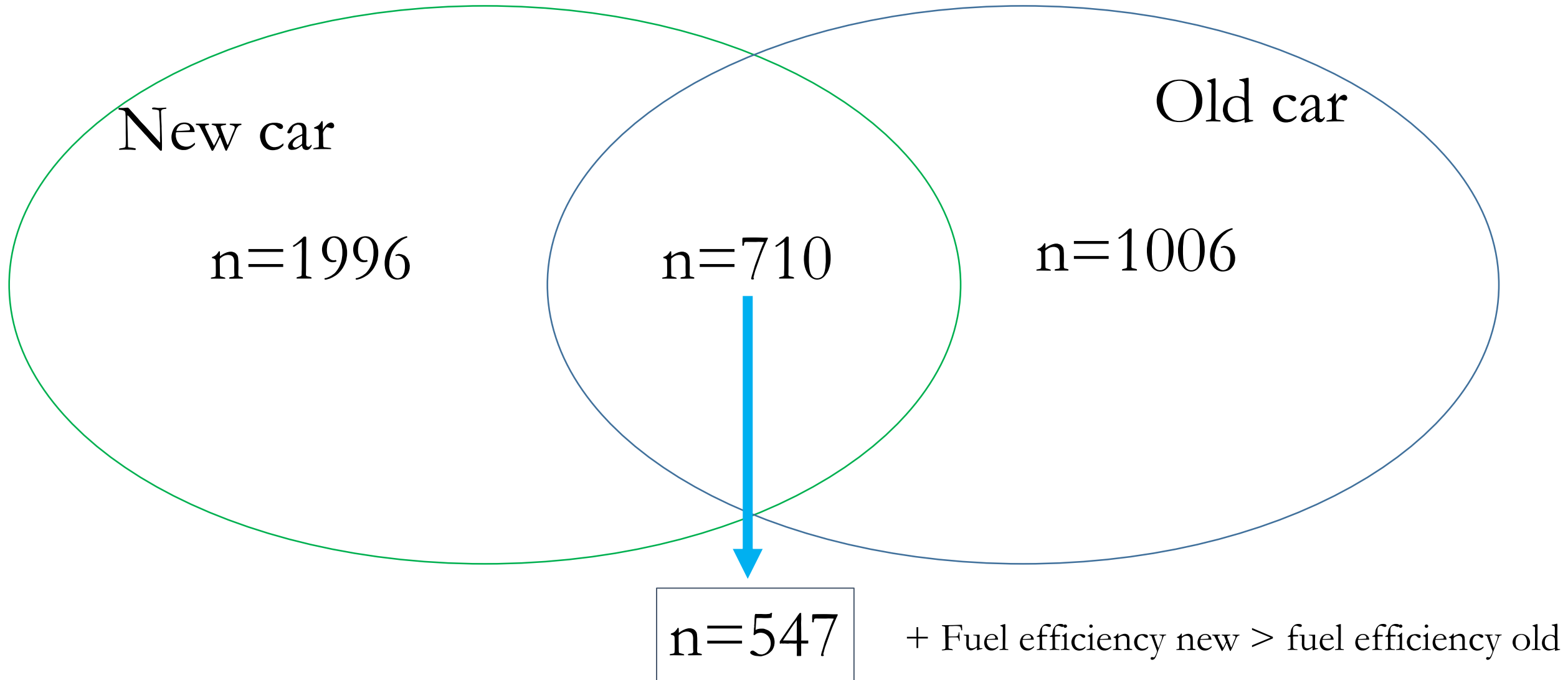
Measures

Inattention /Misconceptions

1. What is the fuel efficiency of your new car?

   (<30, 30-35, 35-40, 40-45, 45-50, 50-55, 55-60, >60   miles per gallon)

2. What is the fuel efficiency of your old car?

3. How much do you spend monthly on fuel?

   (accuracy=+/- £ 20)

4. Do you drive more, the same or less with the new car?

5. Energy literacy

 "A 100-watt incandescent light bulb uses 100 units of energy in one hour. How many units of energy do you think each of the following devices typically uses in one hour?"

6. Financial literacy

"Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account? : more/same/less"

Measures: controls

1. Sociodemographic

   Age, Gender, Income, Education, Family size, Employment status, Location (rural vs urban)

2. Use of cars

   1. Type of car use: for working, commuting, trips, etc.
   2. Frequency of use
   3. Miles driven per year

3. Cars' characteristics

   1. Fuel efficiency of cars
   2. Type of cars (small, medium, sports, SUVs)
   3. Engine size,

Results

Regressing mpy new – mpy old

Sociodemographics

only working status matters

Car use

The more you drive, the more you 'overdrive'

Car types

The bigger the efficiency difference, the more you 'overdrive'

Age	-6.86 (20.929)
Female	454.523 (386.092)
Income	81.382 (86)
Education	-167.853 (147.715)
Working full or part time	-1507.972** (668.087)
Retired	-1304.073* (718.703)
Urban	1.665 (5.002)
Frequency of using car	585.246** (277.07)
Miles per year driven (new)	.253*** (.055)
Fuel effic: difference new-old	107.273*** (21.294)
Fuel efficiency (new)	-81.775*** (21.975)
Type of car (new)	-143.036 (209.436)
Type of car (old)	-1277.219*** (228.557)
Constant	2727.825 (2045.965)
Observations	607

Results

	mpy (new-old)	mpy (new-old)
Fuel eff. (new)		
overestimation	2764.532***	2717.149**
	(-1.007.181)	(-1.072.598)
underestimation	1514.891***	2485.747***
	(-534.379)	(-575.824)
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Fuel eff (old)				
overestimation			-517.553 (-589.226)	-1136.039* (-617.381)
underestimation			-351.331 (-453.117)	352.592 (-490.477)
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Miles driven								
overestimation					5386.719*** (-454.043)	4404.031*** -500.419		
underestimation					-493.011 (-336.759)	-319.356 (-356.538)		
Observations	710	607	710	607	705	603		

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Monthly cost (new)								
overestimation							-455.53 (488.43)	-423.413 (-505.184)
underestimation							1348.2*** (-395.498)	344.985 (-454.655)
Observations	710	607	710	607	705	603	666	574

Measures: mental accounting

1. ***Depreciation costs***

Q25. Please now estimate the average monthly cost of your **current primary car.**

Q26. Which of the following costs have you considered in your cost estimation?
- Monthly depreciation of original purchase cost
- Monthly operating cost (fuels, motor oil, battery charging)
- Monthly cost through insurance and taxes
- Monthly repair cost
- Other [Specify]

2. ***Car budget***

Does your household have a "car budget", i.e. a fixed amount of money or share of your income assigned to car-related spending?

3. ***General mental accounting propensity***
- I reserve money for specific expenses, such as food, clothing, transportation, etc.
- I never spend more than a certain amount on food, clothing, transportation, etc.
- If I spend more on one thing, I save on other expenses
- If I spend more than the usual amount on something in one month, I spend less on it the next month

Results

	mpy (new-old)	mpy (new-old)	mpy (new-old)	mpy (new-old)	mpy (new-old)	mpy (new-old)
depreciation	229.144 (-477.488)	604.52 (-484.955)				
car budget			668.082 (-492.396)	277.506 (-500.693)		
general prop.					265.573 (-183.805)	-110.854 (-195.613)
Observations	710	607	710	607	710	607

Measures: pro-environmental preferences

1. *Self-reported values*

Thinking **on the way you use** your current primary car, how much do you agree with each of the following?

- I feel personally obliged to reduce the number of car trips in order to limit my impact on the environment
- I feel guilty for the environment when I use my car a lot for short distance trips
- Many people who are important to me reduce their number of car trips to limit their impact on the environment
- Many people who are important to me expect me to reduce the number of my car trips in order to limit my impact on the environment

Thinking **on decision to buy** your current primary car, how much do you agree with each of the following sentences?

2. *Self-reported pro-environmental habits*

How often do you undertake any of the following actions?
- Purchase second-hand products, such as clothes or furniture
- Reduce indoor temperature and instead put on warmer clothes
- Keep car tires at the right pressure to minimize fuel use
- ….(10 in total)

Measures: moral licensing

1. *Drop of values*

Values for BUYING – values for USING

- Thinking **on decision to buy** your current primary car, how much do you agree with each of the following sentences?
- Thinking **on the way you use** your current primary car, how much do you agree with each of the following?

2. *General moral licensing propensity*

- It does not matter how much energy you use if you are on a green energy tariff
- It is okay to drink bottled water if you limit the number of car journeys that you make
- Walking to the supermarket can compensate for buying highly packaged food
- Not driving a car compensates for flying on holiday
- Flying abroad can be made up for by being a vegetarian (i.e., not eating meat)

Results

	mpy (new-old)	mpy (new-old)	mpy (new-old)	mpy (new-old)	mpy (new-old)	mpy (new-old)	mpy (new-old)	mpy (new-old)
values	-317.886** (157.359)	-206.901 (162.655)						
peb habits			813.529** (347.308)	613.604* (358.589)				
value drop					112.762 (190.125)	-17.537 (202.525)		
ML index							-287.205 (261.982)	-480.483* (278.787)
Observations	710	607	710	607	710	607	710	607

Conclusions

Inattention/ Miscalculations increases direct rebound

Mental accounting does not

Not clear role for pro-environmental preferences

Overall, argument for policy intervention correcting "misperceptions"

Thank you!