Applied Experimental Economics

Lab Experimental Economics in action: Nutritional labels

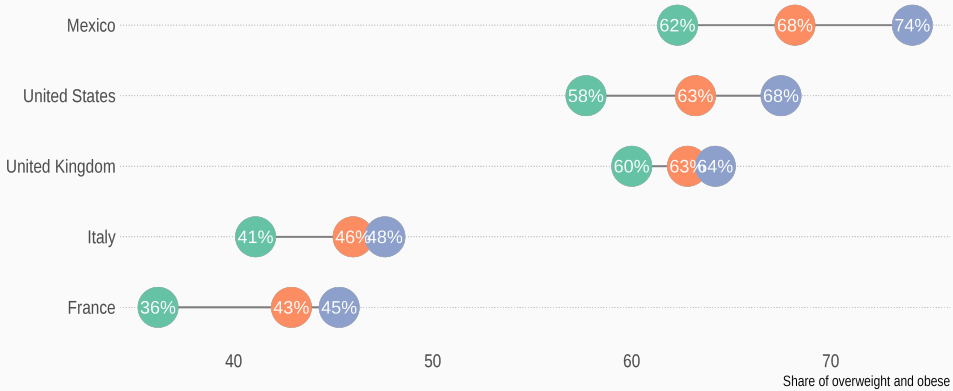
Paolo Crosetto

The problem

We're getting fatter

Evolution of the share of overweight and obese people: 2000, 2010, 2020

Selected OECD countries, all population aged 15+



. . . and this has huge costs

Health-related costs

Direct medical costs (2019):

- US: 300bn
- UK: 22bn
- Global: 1 to 3% GDP

Direct + indirect (projected 2030):

- Africa 1% GDP
- Americas 4% GDP
- Middle EAST 5% GDP

Environment-related costs

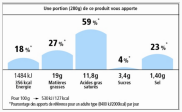
- Food: 34% of GHG emissions
- Obesity: 1.4% extra
- 14% more transport emissions
- 140Mt excess consumption

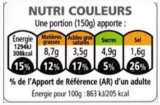
The spectrum of policies

- Information
- Fiscal interventions
- Nudges

The spectrum of policies

- **Information**
- Fiscal interventions
- Nudges





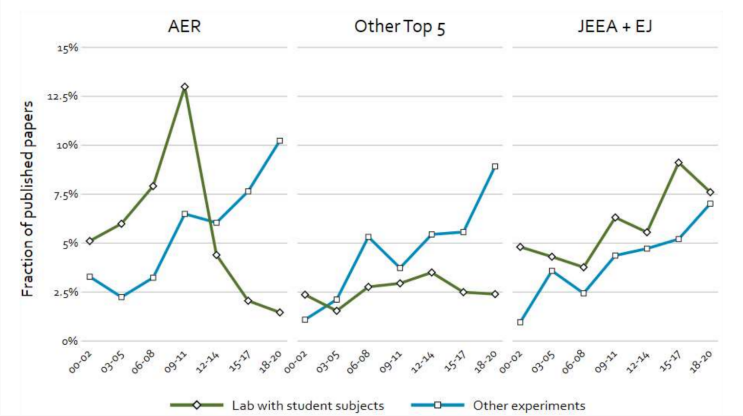
A series of key policy questions

- Do labels **work**?
- **Why** and **how** do they work?
- Do people **use** them? and why?
- Which label design is the **best** to **impact** choice?
- **How much** of an impact labels have?
- . . .

Which role for the lab?

What can we learn for the lab?

The rise & Fall of lab experiments



Reuben et al. (2021)

Behavioral (or "Nudge") Units Explosion

- Most OECD countries have a Behavioral Unit
- Behavioral interventions frequently featured at the EU's Commission JRC
- Behavioral interventions at work during the pandemics
- ...

...in the meantime... (2)

RCTs are the best way of determining whether a policy is working

UK Behavioural Insights Team (2012)

RCTs are the purest and most accurate observation of behaviour, unlike experiments which take place in a laboratory

Bavel et al. (2013)

I speak on behalf of many more. For we represent a movement that is much broader than any one of us. We believe that the Prize recognizes not only what this movement has accomplished, but also what it could accomplish in the future.

Esther Duflo, Nobel Prize Banquet Speech (2019)

Two main roles in an applied policy context

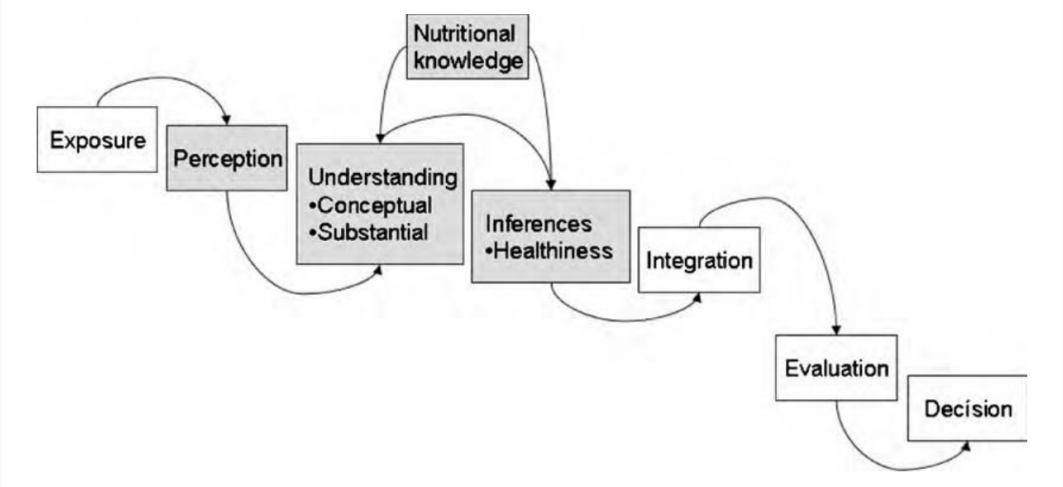
Getting into the mind of subjects

- focus on cognitive aspects
- clearly identify mechanisms
- (if needed) sidestep preferences
- heuristics, choice processes

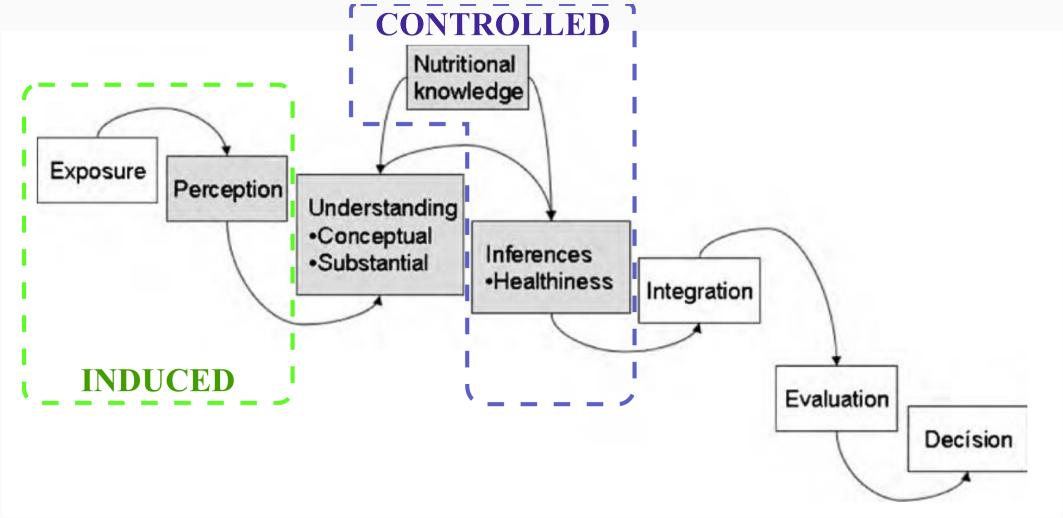
Building counterfactuals

- explore different scenarios
- integrate preferences with control
- track macro consequences
- cheaply explore solutions

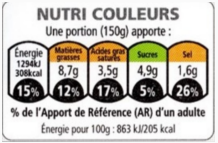
A conceptual framework (Grunert)



A conceptual framework (Grunert)

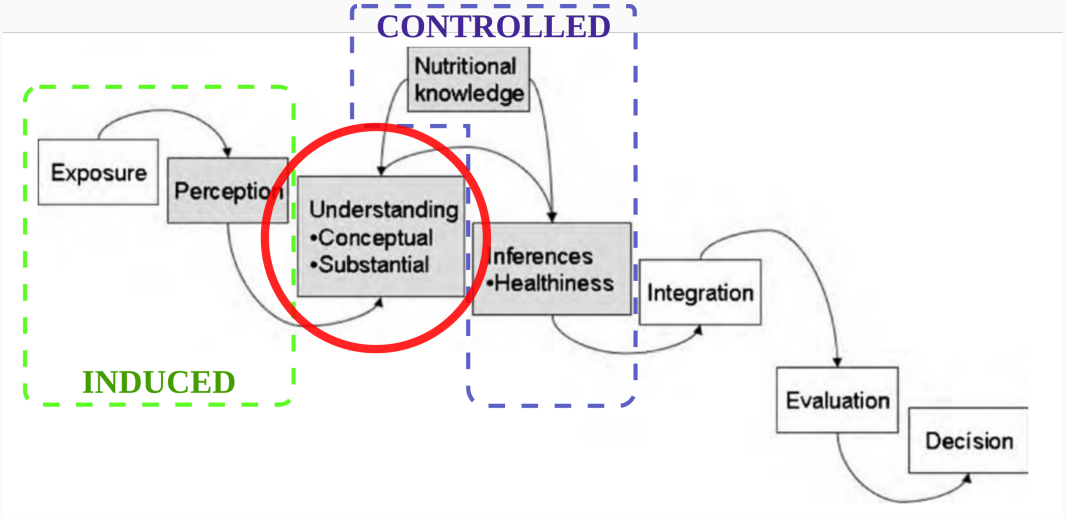


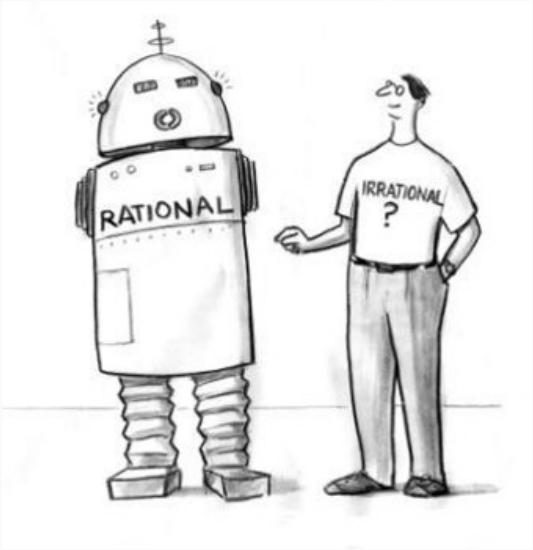
Using the lab to directly contribute to policy



Part 1: into the mind of subjects

Getting into the mind of subjects




RATIONAL
IRRATIONAL
?

How to induce healthier choices?

Homo Oeconomicus

- full attention
- no bias
- time-consistent
- goal: full information

Homo Sapiens

- limited attention
- biases
- time-inconsistent
- goal: salient cues

Nutrition Facts

Serving Size 2 CUPS (30g)
Servings per Container VARIED

Amount per Serving

Calories 150	Calories from Fat 70
	% Daily Value*
Total Fat 7g	**11%**
Saturated Fat 1.5g	**6%**
Cholesterol 0mg	**0%**
Sodium 120mg	**5%**
Total Carbohydrate 20g	**7%**
Dietary Fiber 4g	**15%**
Sugars 9g	
Protein 1g	

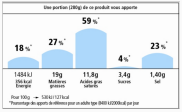
Vitamin A 0% • Vitamin C 0%

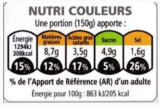
Calcium 0% • Iron 2%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4





Cognitive underpinnings of label use

- Are colors more intuitive than numbers?
- Do numbers result in more accuracy?
- How much time is needed to use the information?
- Is there a time-accuracy trade off?

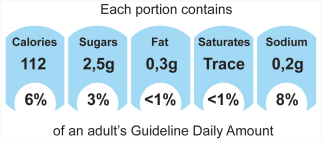
Study 1:

diet building under constraints

(with Laurent Muller, Bernard Ruffieux – Jo Eco Psy (2015))

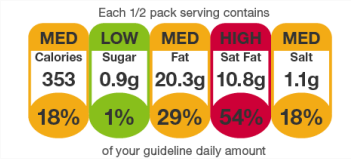
GDA, TL, GDA+TL

Guideline Daily Amount (GDA)



Traffic Lights (TL)

GDA+TL



The usual design

The usual design

What label is better to build a healthy diet?

Diets

- a diet is a complex object, akin to a portfolio
- you won't die for one bad item, but if the overall balance is wrong

Task

- subject "hired as a nutritionist for a canteen"
- must compose daily menu that satisfies nutritional constraints
- subject guided by labels: **numbers**, **colors**, or **both**.

Incentives

- If the daily diet built satisfies nutritional constraints $\Rightarrow$ flat fee (2 euro)
- Several daily diets to build

Daily diet

A daily **diet** is composed of *twelve* food items over *four* meals:

Daily base	120g bread, 10g butter, 20g oil	
Breakfast	*Drink*	The, coffee, milk, hot chocolate, juice...
	Main course	Bread, sweets, *viennoiseries*...
	Fruit	Fruit, jam...
Lunch	*Entrée*	Light dishes, ham, paté...
	Main course	Sandwich, pizza, pasta...
	Seasoning	Oil, butter, spices & herbs
	Dessert	Fruit, sweets...
Afternoon snack	-	Sweets
Dinner	*Entrée*	Light dishes, ham, paté...
	Main course	Meat or fish
	Side	Vegetables, rice...
	Dessert	Fruit, sweets...

Our design: diet-building

Our design: diet-building

Characteristics:

- no preferences
- incentivized
- "realistic"

We add:

- labels
- constraints

Dimensions

Nutrition is multidimensional. We consider three cases:

1-dimension Kcal only are displayed.

4-dimension Kcal + 'bad' nutrients: salt, sugar, fat.

7-dimension 4d + 'good' nutrients: vitamin C, fiber, calcium.

Labels can have numbers, or colors, or both:

Numbers modeled on Guideline Daily Amounts / Reference Intakes

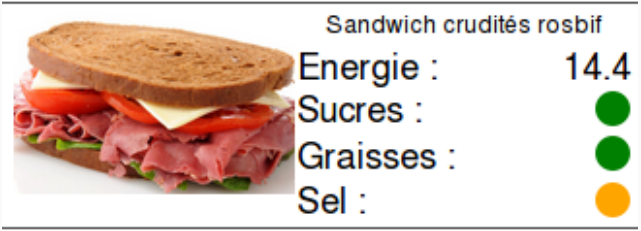
Colors modeled on Traffic Lights

Num+col both of the above combined

Numbers

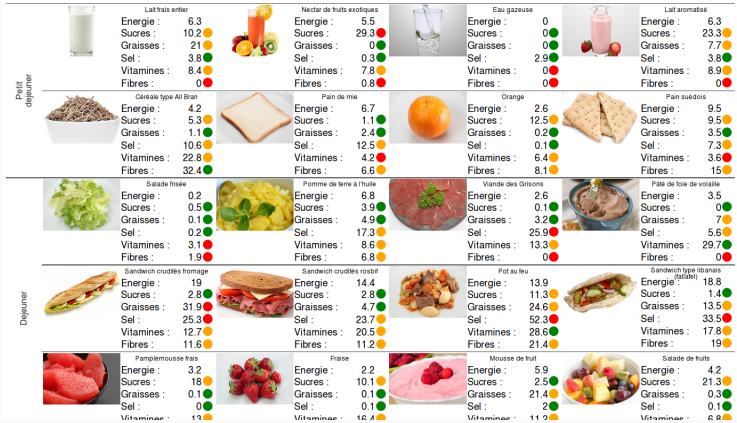
Tarte aux poireaux	
Energie :	12.3
Sucres :	1.7
Graisses :	46.4
Sel :	19.1

Colors



Numbers + colors

A number + colors screen, 7 constraints



Instructions

Screen 1: no info just select what you think is the overall healthiest (but nutritionally enough) menu

Screen 2: numbers, 1D you need to create a menu that has between 90% and 110% of the daily recommended calories.

Screen 3: colors, 4D you need to do as in Screen 1, plus you have to **minimize** salt, sugar and fat.

Screen 4: numbers + colors, 7D you need to do as in Screen 4, plus you have to **maximize** vitamin, calcium and fiber.

Results from the experiment

2014, Grenoble

Two populations, three conditions

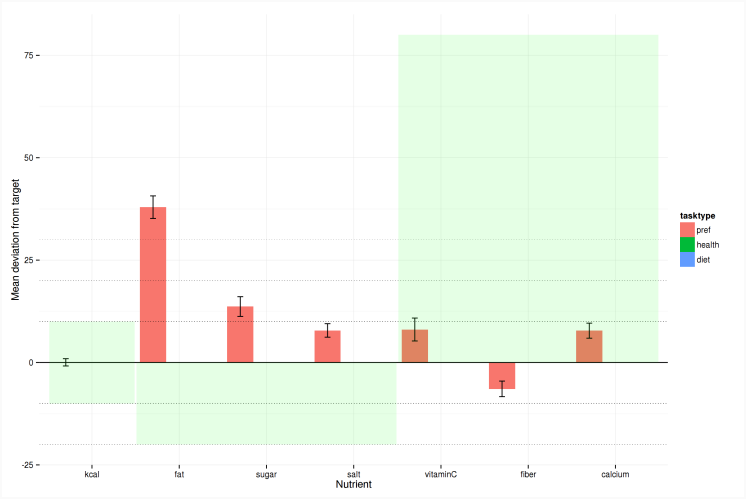
To investigate the role of

- **cognitive resources** and
- **time**

we run three conditions:

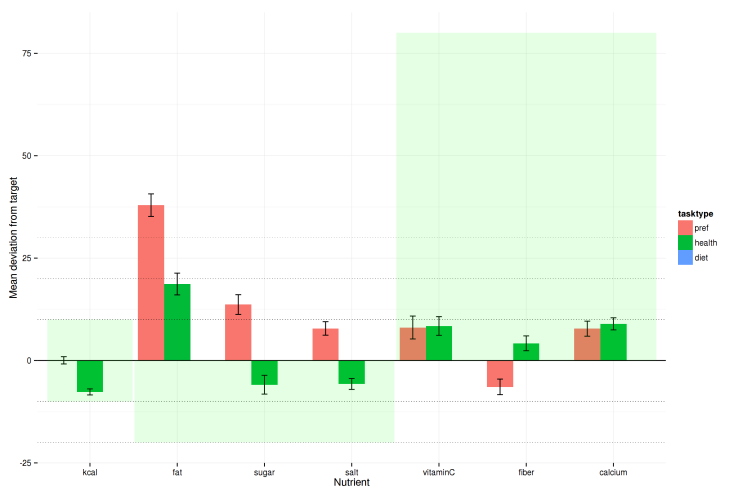
Students	Highly skilled engineering students, no time limit, paper and pencil
Population	Population at large, no time limit, paper and pencil
120 seconds	Population at large, 120 seconds, NO paper and pencil

Average results – no labels – plain preferences



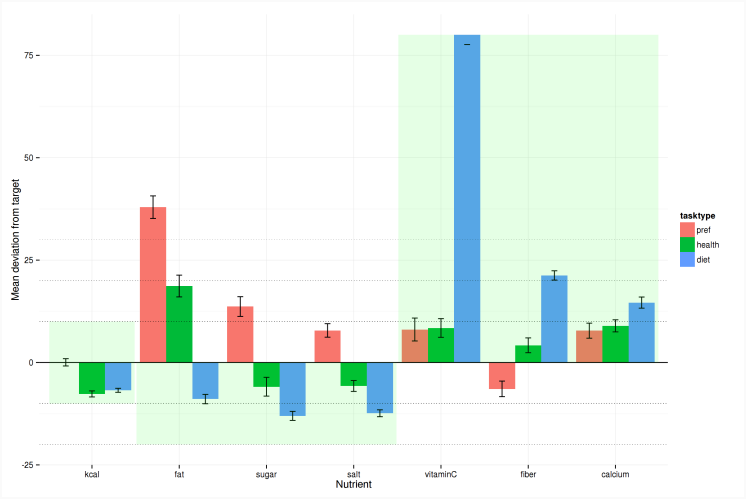
Preferences task, average performance by nutrient.

Average results – no labels – Healthiness

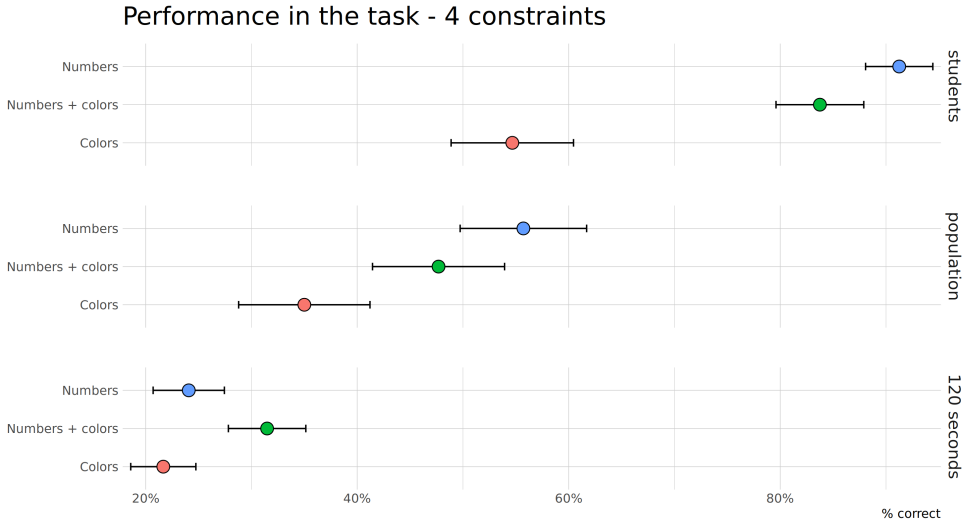


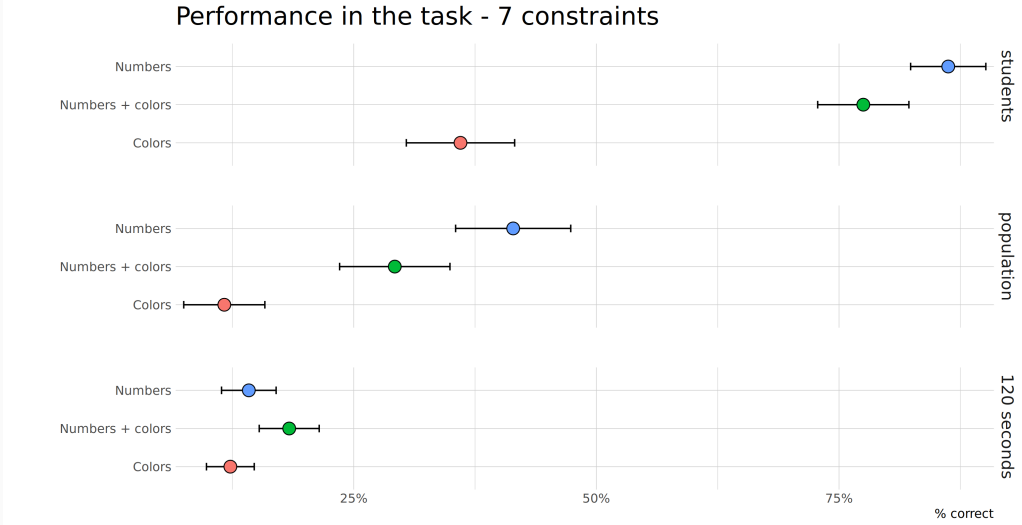
Preferences and healthiness tasks, average performance by nutrient.

Average results – labels – All



Preferences, health and diet tasks, average performance by nutrient.


Performance in the task - 4 constraints
Numbers
Numbers + colors
Colors
students
Numbers
Numbers + colors
Colors
population
Numbers
Numbers + colors
Colors
120 seconds
20%
40%
60%
80%
% correct


Performance in the task - 7 constraints
Numbers
Numbers + colors
Colors
students
Numbers
Numbers + colors
Colors
population
Numbers
Numbers + colors
Colors
120 seconds
25%
50%
75%
% correct

Take-home message

If time is **unlimited**:

- Numbers win
- Especially so for highly skilled
- But also for general population

If time is **limited**:

- Numbers and colors equal
- Number + colors overall better
- Dismal performance in all cases

Study 2:

fast & slow reactions to labels

(with Laurent Muller)

Food choice is both fast & slow

Food choice : fast

Health goals : slow

Labels are both fast & slow

numbers : slow

analytic : slow

colors : fast

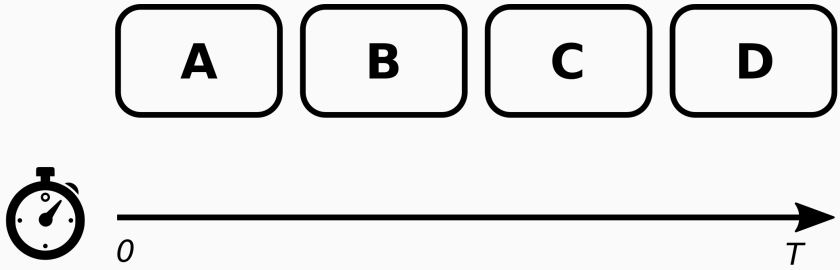
aggregate : fast

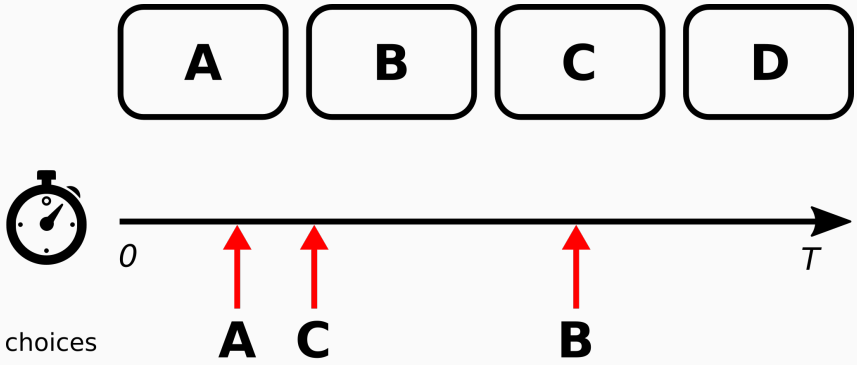
A comprehensive approach

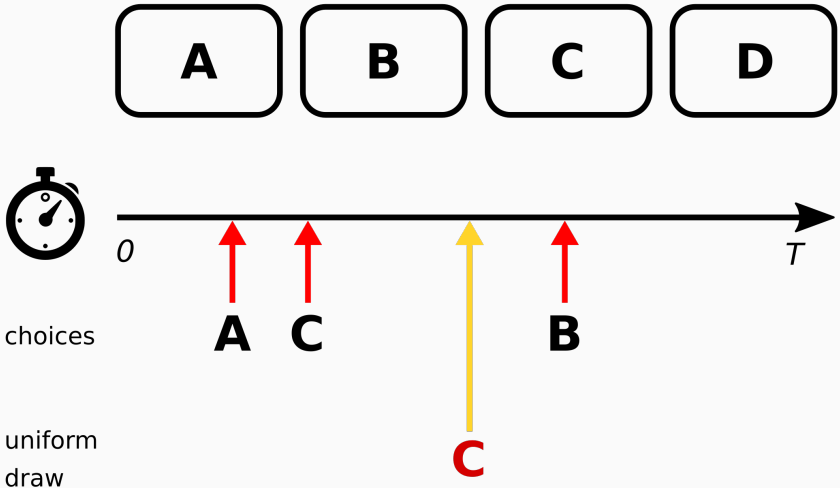
Can we build a tool based on *both* System One and Two?

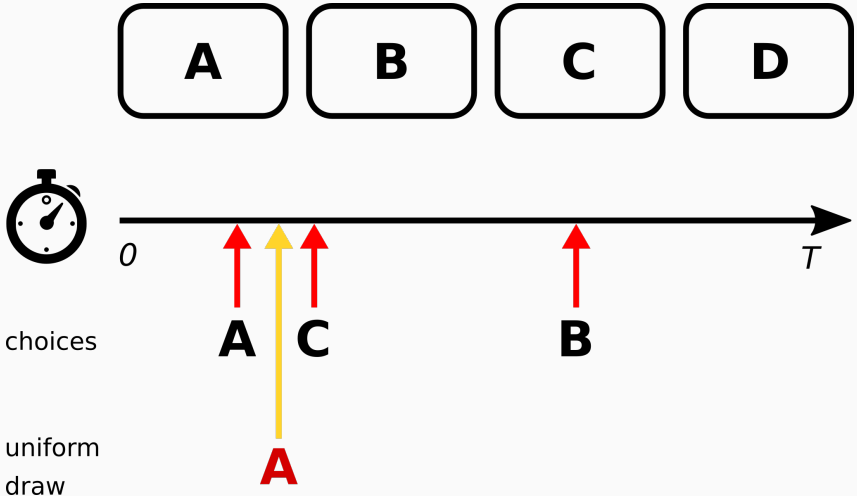
$\forall$ subject, $\forall$ choice, we want to capture

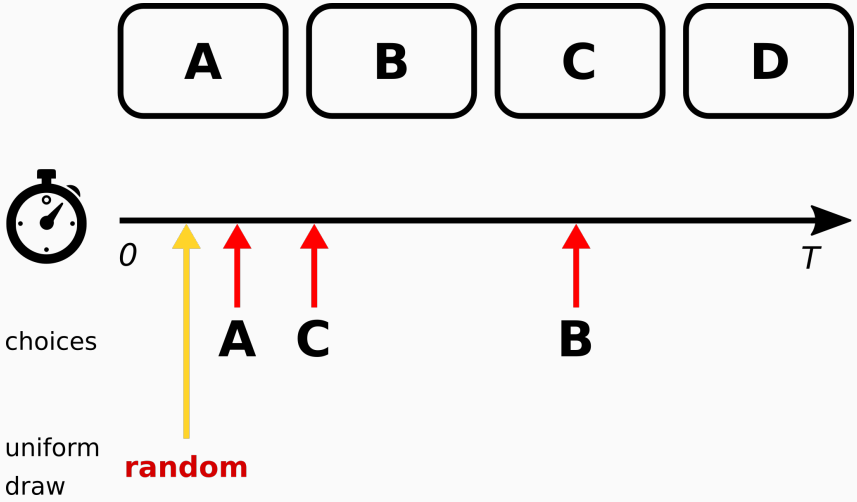
- the fast heuristics used
- *and* the slow reasoning applied
- *and* the moment the subject switched, if any


A
B
C
D
0
T


A
B
C
D
0
T
choices
A
C
B


A
B
C
D
0
T
choices
A
C
B
uniform
draw
C


A
B
C
D
0
T
choices
A
C
B
uniform
draw
A


A
B
C
D
0
T
choices
A
C
B
uniform
draw
random

Our design

Thanks to the design:

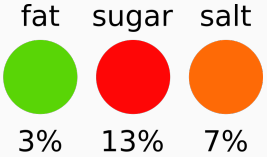
- No choice $\Rightarrow$ random choice: incentive to *fast* reply
- Time is ticking: incentive to *change* first decision upon reflection

- fast to slow *endogenous* (usually: exogenous)
- Data reveal choice *process* (usually: outcome)

This allows us to:

- tell apart how different labels tap on different heuristics
- measure how much *faster* colors are
- assess if numbers do a better job, and when

Labels



fat sugar salt

3% 13% 7%

Barres au chocolat au lait et aux céréales

Choisir

Barres chocolatées fourrées au lait et aux noisettes

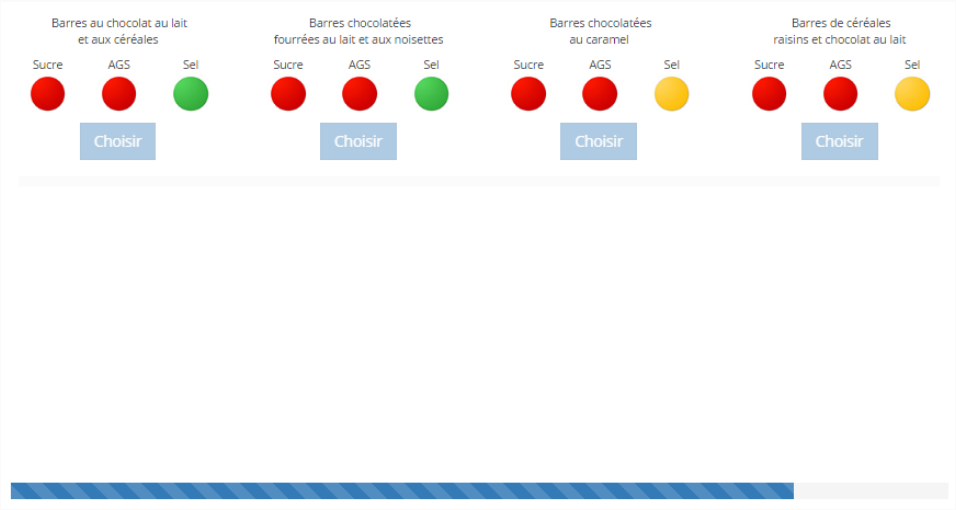
Choisir

Barres chocolatées au caramel

Choisir

Barres de céréales raisins et chocolat au lait

Choisir


Barres au chocolat au lait et aux céréales
Sucre
AGS
Sel
Choisir
Barres chocolatées fourrées au lait et aux noisettes
Sucre
AGS
Sel
Choisir
Barres chocolatées au caramel
Sucre
AGS
Sel
Choisir
Barres de céréales raisins et chocolat au lait
Sucre
AGS
Sel
Choisir

Barres au chocolat au lait et aux céréales

Sucres	AGS	Sel
55%	110%	5%

Choisir

Barres chocolatées fourrées au lait et aux noisettes

Sucres	AGS	Sel
46%	87%	5%

Choisir

Barres chocolatées au caramel

Sucres	AGS	Sel
69%	42%	7%

Choisir

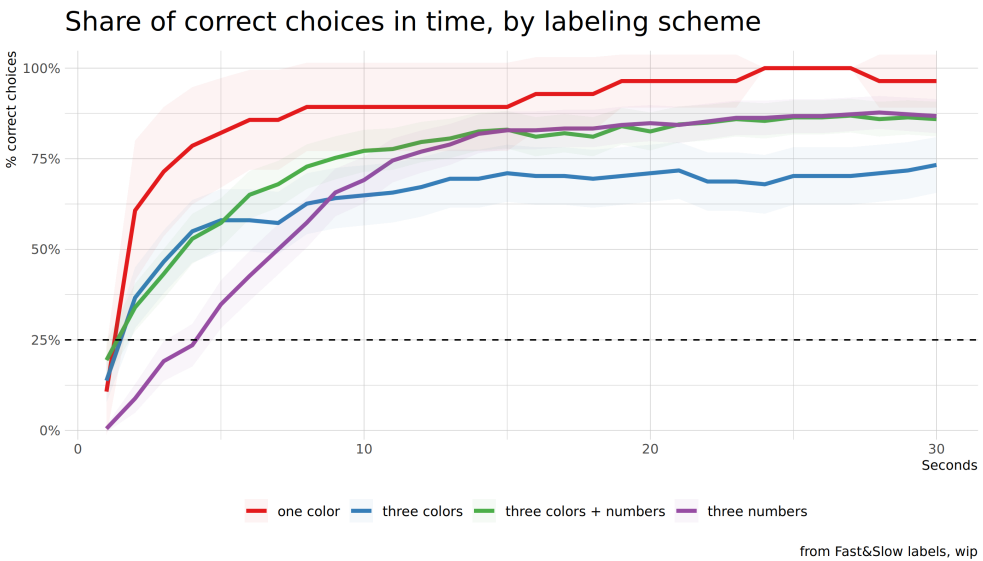
Barres de céréales raisins et chocolat au lait

Sucres	AGS	Sel
34%	27%	9%

Choisir

Results from the experiment

2016, Grenoble

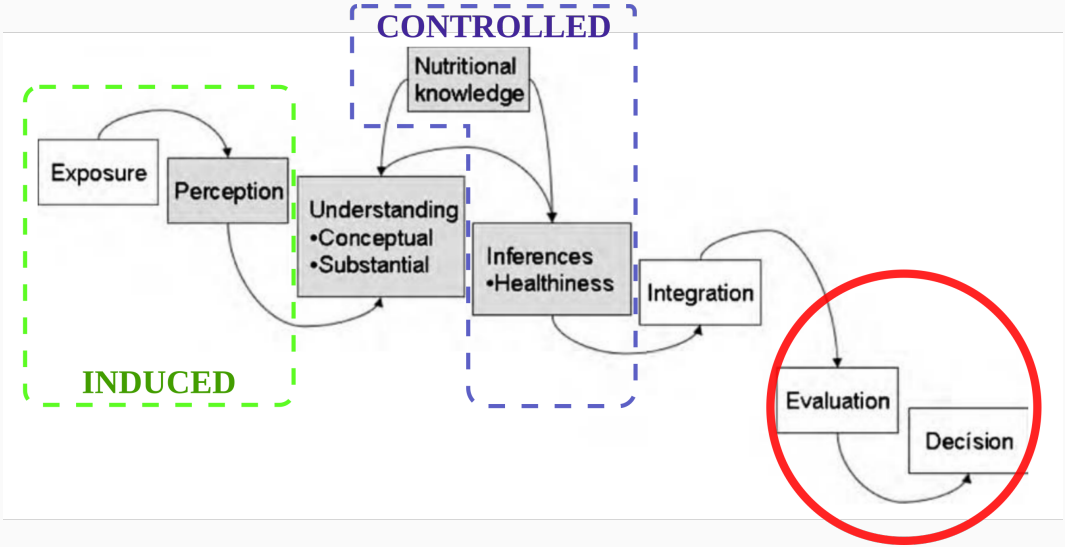

Share of correct choices in time, by labeling scheme
% correct choices
100%
75%
50%
25%
0%
0
10
20
30
Seconds
one color
three colors
three colors + numbers
three numbers
from Fast&Slow labels, wip

What do we learn?

- Trade off time/accuracy
- Heuristics give way to computation in time
- Indirect evidence of different cognitive processes
- We explicitly measure 'how more intuitive' colors are

Part 2: Building counterfactuals

Building counterfactuals



Some context

NUTRI-SCORE

A B C D E

Inserm

La science pour la santé
From science to health

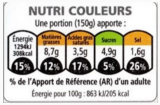
fcd Fédération du Commerce et de la Distribution

ania

Association Nationale des Industries Alimentaires

Testing a labeling policy in the field can be **costly** and **ineffective**

- Labeling all products is costly
- Large samples required
- Lots of noise – special offers, discounts, availabilities. . .
- No control on population switching shops
- Little control on implementation
- Which reference period?



French Ministry of Health

- Which FoPL to choose?
- How large is the effect?

- A RCT in 60 French supermarket
- A large lab experiment (**us!**)

Study 3:

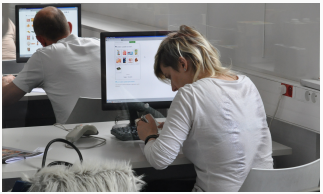
ex-ante evaluation of labels: lab shopping

(with Anne Lacroix, Laurent Muller, Bernard Ruffieux – ERAE (2019))

Our setup

Paper catalog

Computer interface



Real products

- Preferences are back!
- Subjects shop for real in the lab

- $\sim \frac{1}{4}$ of product supply available
- chosen + we have it $\Rightarrow$ buy

A large and representative catalog

- 290 products
- 37 food categories
- custom e-shopping interface
- barcode scanners on the desk
- price, quantity, picture (label) up front
- nutritional table and ingredient list available upon clicking

1138 Chercher

Votre caddie actuel :

Aucun produit dans ce panier.

Terminer

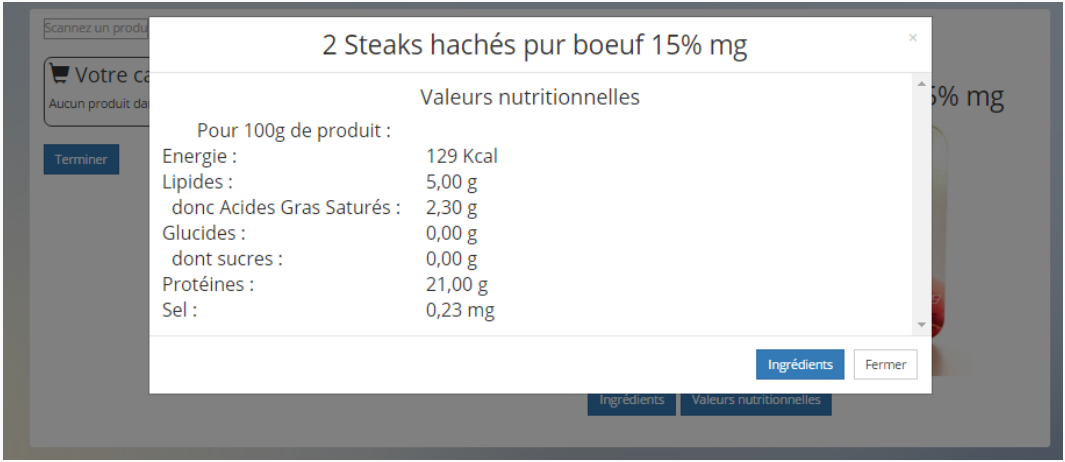
4,25 €
260 g
16,35 €/Kg

1 Ajouter au caddie

2 Steaks hachés pur boeuf 15% mg

Ingrédients Valeurs nutritionnelles

Scannez un produ
Votre ca
Aucun produit da
Terminer
2 Steaks hachés pur boeuf 15% mg
Ingrédients
100% Viande bovine.
Les ingrédients en majuscules sont susceptibles d'entraîner des intolérances ou des allergies
Valeurs nutritionnelles
Fermer
5% mg
x2
15%
de matières
grasses
250 g (2 x 125 g)
Ingrédients
Valeurs nutritionnelles


Scannez un produ
Votre ca
Aucun produit da
Terminer
2 Steaks hachés pur boeuf 15% mg
Valeurs nutritionnelles
Pour 100g de produit :
Energie : 129 Kcal
Lipides : 5,00 g
donc Acides Gras Saturés : 2,30 g
Glucides : 0,00 g
dont sucres : 0,00 g
Protéines : 21,00 g
Sel : 0,23 mg
Ingrédients
Fermer
5% mg
Ingrédients
Valeurs nutritionnelles

Scannez un produ | Chercher

Votre caddie actuel :

x 1 = 4.25 €

1 Articles

Total = 4.25 €

Terminer

4,25 €
260 g
16,35 €/Kg

1 Modifier la quantité Enlever du caddie

2 Steaks hachés pur boeuf 15% mg

Ingrédients | Valeurs nutritionnelles

1814 Chercher

1814

Votre caddie actuel :

x 1 = 4.25 €

x 1 = 3.95 €

x 1 = 1.17 €

x 1 = 2.83 €

x 3 = 1.83 €

5 Articles

Total = 14.03 €

Terminer

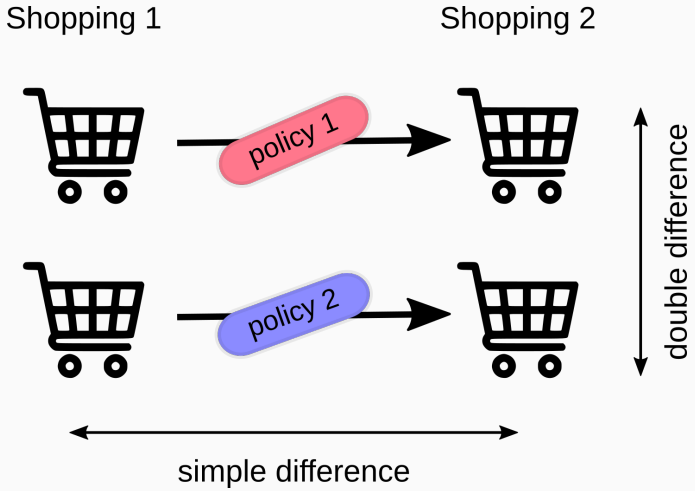
1,62 €
180 g
9,00 €/Kg

1 Ajouter au caddie

Frites surgelées pour micro-ondes

Ingrédients | Valeurs nutritionnelles

Experimental design: difference-in-difference



Snacks

Cacahuètes grillées très pauvres en sel

1,00€
200g
5,00€/Kg
28875

Cacahuètes délicatement salées

1,09€
220g
4,95€/Kg
28849

Chips de maïs nature

2,49€
230g
10,83€/Kg
2659

Chips paysannes nature

2,49€
300g
8,97€/Kg
2696

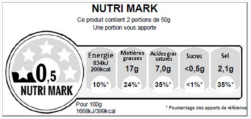
Soufflés de maïs goût cacahuète

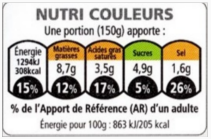
2,25€
250g
9,00€/Kg
2651

Biscuits apéritif à l'emmental

0,52€
50g
10,40€/Kg
2618

Then, we apply (no or) one of five labels





- plus a Neutral (benchmark) treatment (no labels)

Snacks

Cacahuètes grillées très pauvres en sel

1,00€
200g
5,00€/Kg
28875

NUTRI-SCORE
A **B** C D E

Cacahuètes délicatement salées

1,09€
220g
4,95€/Kg
28489

NUTRI-SCORE
A B **C** D E

Chips de maïs nature

2,49€
230g
10,83€/Kg
28559

NUTRI-SCORE
A **B** C D E

Chips paysannes nature

2,49€
300g
8,97€/Kg
28696

NUTRI-SCORE
A B C **D** E

Soufflés de maïs goût cacahuète

2,25€
250g
9,00€/Kg
28851

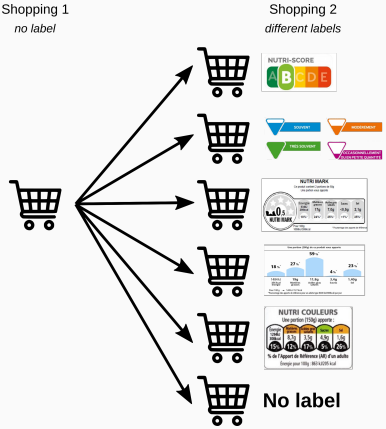
NUTRI-SCORE
A B C **D** E

Biscuits apéritif à l'emmental

0,52€
50g
10,40€/Kg
28618

NUTRI-SCORE
A B C D **E**

Treatments


Shopping 1
no label
Shopping 2
different labels
NUTRI-SCORE
A B C D E
NUTRI MARK
NUTRI COULEURS
No label

Metrics: nutrition

We use the **scoreFSA** normalized by **caloric content**.

For each shopping cart i, for each subject j, for each product p:

$$scoreFSA_{ij} = \frac{\sum_p Kcal_{pij} \cdot FSA_{pij}}{\sum_p Kcal_{pij}},$$

We focus on Δ**FSA**, the *difference* between carts 1 and 2.

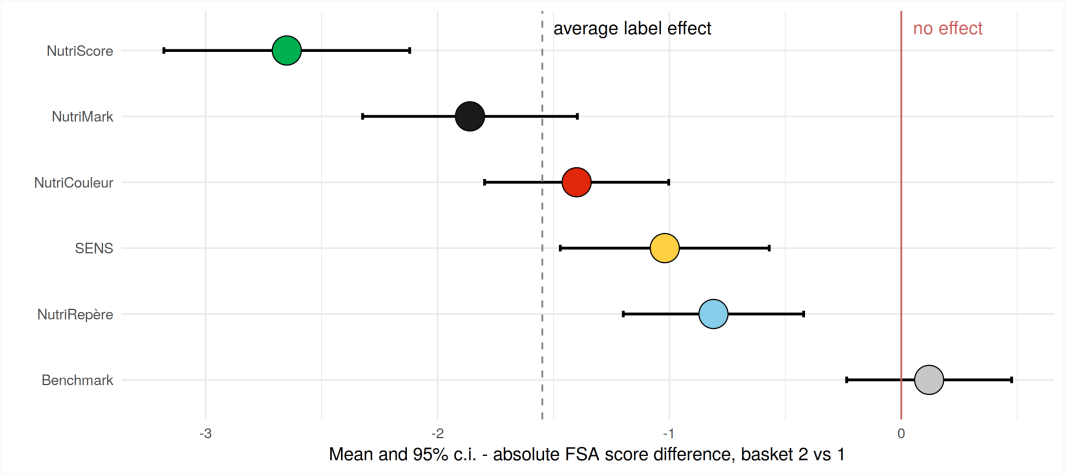
A large and representative subject pool

- 691 subjects
- $\sim$ 110 for each of 6 treatments
- sample issued from the general population
- (recruiting agency boosted our reach into all socio-economic statuses)
- roughly representative

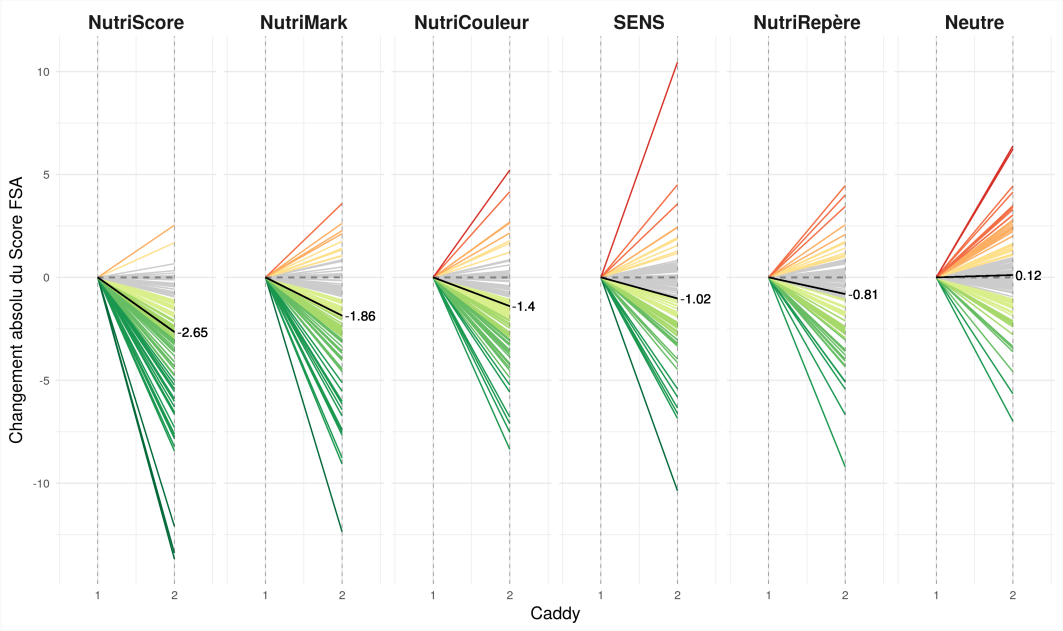
Results from the experiment

2019, Grenoble

NutriScore leads, by far



But there is heterogeneity


NutriScore
NutriMark
NutriCouleur
SENS
NutriRepère
Neutre
Changement absolu du Score FSA
10
5
0
-5
-10
-2.65
-1.86
-1.4
-1.02
-0.81
0.12
1
2
Caddy

What do we learn?

- Color-coded, summary labels perform best
- (but only if they directly relate to quality – not SENS)
- Number-based, analytic labels perform worse

Policy implications

- NutriScore officially selected in FR (and ES, BE, DE. . .)
- Adopted by Auchan, Fleury Michon, Leclerc, Casino, Nestlé. . .
- The very idea of FOP labels validated
- NutriScore is being proposed by France as EU standard
- Even though *some countries* really do **not** like it

PRESENTI.....311
VOTANTI.....299
ASTENUTI.....12
MAGGIORANZA..150
FAVOREVOLI...299
CONTRARI.....0
APPROVATO
MARTEDI
10
OTTOBRE

Study 4:

Lab vs. *Field RCTs*

(Dubois et al., Jo. Ac. Mark. Sci. 2020,)

The two studies at a glance

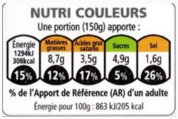
	Lab	Field
Location	Grenoble	Paris couronne, Nord, Lyon
Supermarkets	"1"	60
Task	shop for two days' worth	shop
Real purchases	"yes"	yes
Measure	FSA score for 2000Kcal	FSA score for 2000Kcal
Design	Diff-in-diff	Diff-in-diff
Time frame	2x, same session	5 weeks, 1 year apart
Participants	691	171.827
Products (of which labeled)	290 (all)	3586 (1266)
Food categories	37	4
Purchases	27.882	1.668.301
Manpower needed	8	$\sim$ 100
Cost	$\sim$100k	$\sim$4 million

Field study: "instructions"

Field study: product display

Field study: alerting the subject

Results: the lab as a magnifying glass

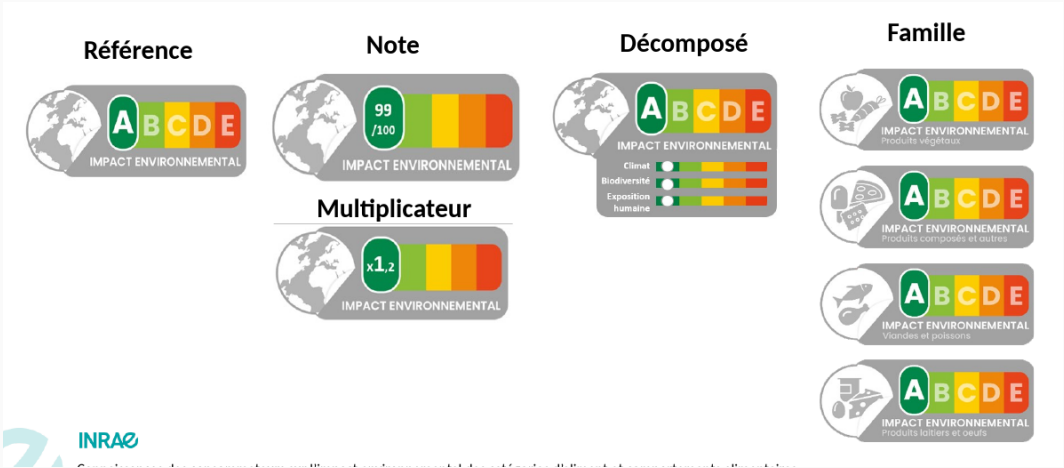
Label	∆score FSA		Corr	Zoom
	Field	Lab		
	-0.142*	-2.766***		19x
	-0.115	-1.513*	0.88	13x
	-0.062	-1.140		18x
	-0.024	-0.924		38x

Which one is the *correct* estimate?

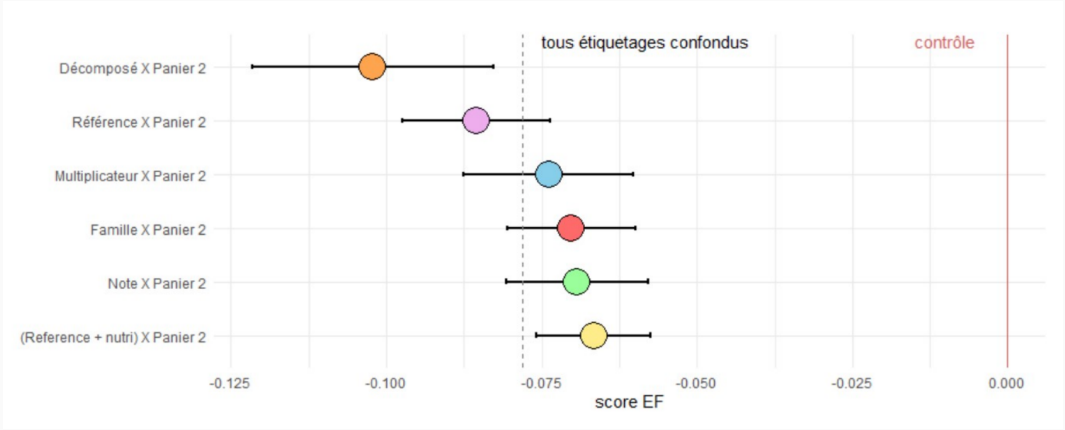
Demand effect Strategic behavior Social desirability bias	similar in both experiments
Game form misconception & complexity	mostly same simple everyday task
Incentive compatibility	same in both experiments
Subject pool differences	not really
Self-selection	not much, but our lab sample *is* selected
Focality and attention	**stark** difference
Time contraction	**stark** difference and generates focality

Study 5: environmental labels?
[WIP – P. De Lattre, L. Muller]

The design can be used for environmental labels too



The design can be used for environmental labels too



What do we learn?

- Consumer seem to take environmental labels into account
- Small effects
- Different formats do not make different impacts

Study 6:

ex-ante evaluation: labels or prices?

(with Laurent Muller, Bernard Ruffieux)

A bit of context

- World Bank: strongly tax unhealthy foods (Shekar and Popkin 2020)
- WHO: introduce dietary taxes on unhealthy food of minimum 20%
- India and Mexico tax unhealthy food & beverages (India : tax of 28%).

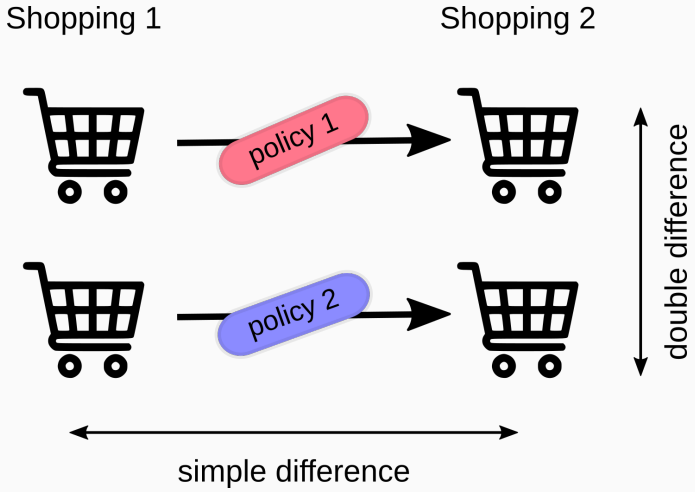
> *Existing evidence suggests that taxes are likely to shift consumption in the desired direction, although policy makers need to be wary of changes in other important nutrients. However, the tax would need to be at least 20% to have a significant effect on population health.' (Mytton, Clarke, and Rayner 2012)*

Question and design

- Suppose we want to couple a **label** with an **incentive** scheme
- e.g. tax unhealthy (soda tax) and subsidize healthy food.
- Does it work? How?
- Will the intervention be (sub/super)additive?
- i.e. label **or** price $\gtrless$ label **plus** price?

Exact same design as Study 3

Experimental design: difference-in-difference



Metrics: expenditure

We use the **expenditure** on a basket, normalized by **2000Kcal**.

For each shopping cart i, for each subject j, for each product p:

$$expenditure_{ij} = 2000 * \frac{\sum_p Price_{pij}}{\sum_p Kcal_{pij}},$$

We focus on Δ**Expenditure**, the *difference* between carts 1 and 2.

Metrics: state investment

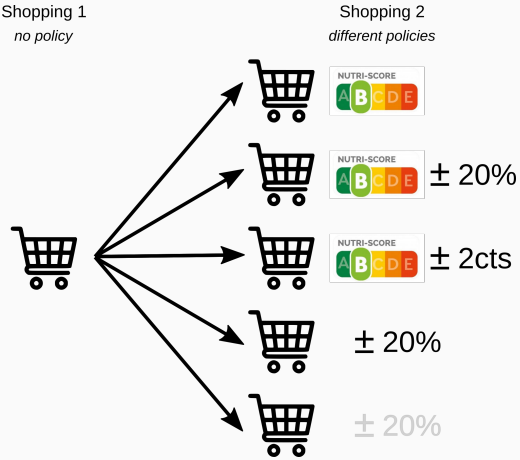
We use the total amount of subsidies minus the total amount of tax revenue, per consumer.

Since consumers had to buy for 2 days, we divide by 2 to get a daily cost.

for each subject j, for each product p:

$$stateaid_j = \frac{\sum_p (tax_{pj} - subsidy_{pj})}{2},$$

Treatments


Shopping 1
no policy
Shopping 2
different policies
NUTRI-SCORE
A B C D E
NUTRI-SCORE
A B C D E
± 20%
NUTRI-SCORE
A B C D E
± 2cts
± 20%
± 20%

A *large* price change: $\pm$10% or 20%

A *small* price change: ± 1 or 2cents

Stimuli

Référence
Sans Nutri-Score
sans Bonus-Malus

Traitement 1
Nutri-Score
sans Bonus-Malus

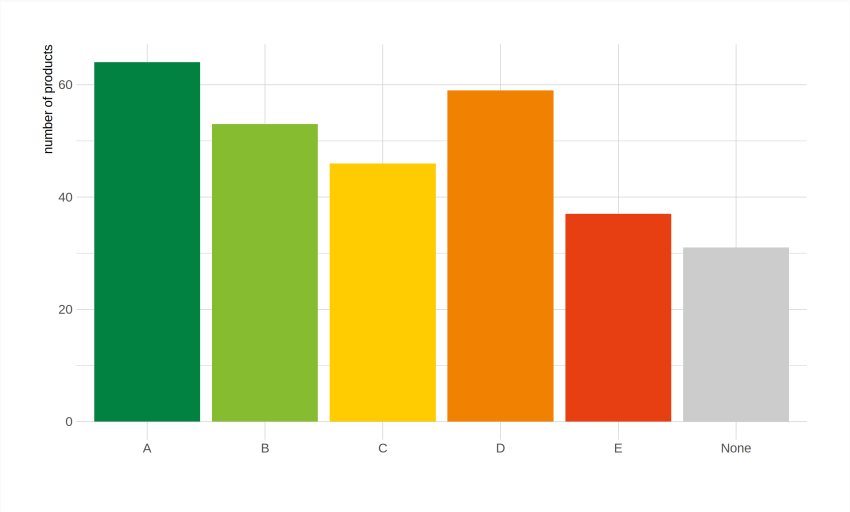
Traitement 2
Nutri-Score
avec Bonus-Malus explicite
ad valorem
de niveau élevé

Traitement 3
Nutri-Score
avec Bonus-Malus explicite
par unité de
niveau symbolique

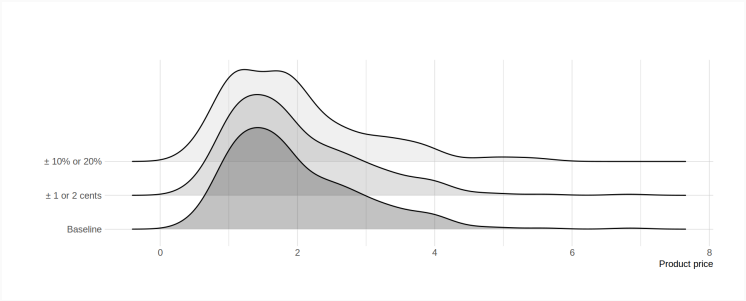
Traitement 4
Bonus-Malus implicite
ad valorem
de niveau élevé

Traitement 5
Bonus-Malus explicite
ad valorem
de niveau élevé

Catalog: NutriScore

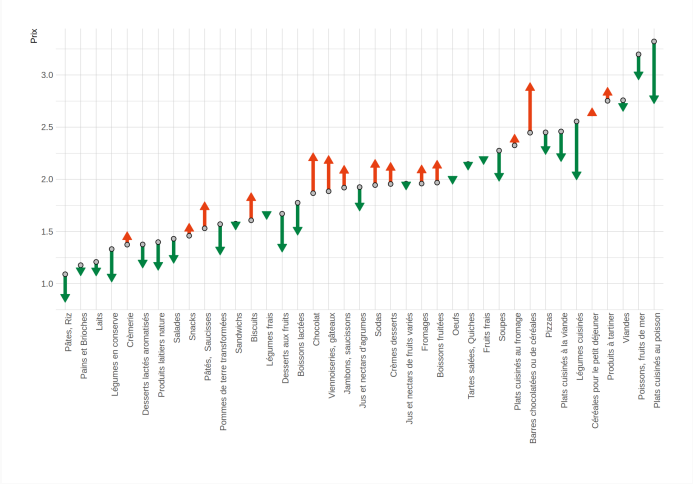


Catalog: Price distribution



	price	p-value
baseline	1.96 (0.96)	
cents	1.96 (0.96)	0.841
percent	1.94 (1)	

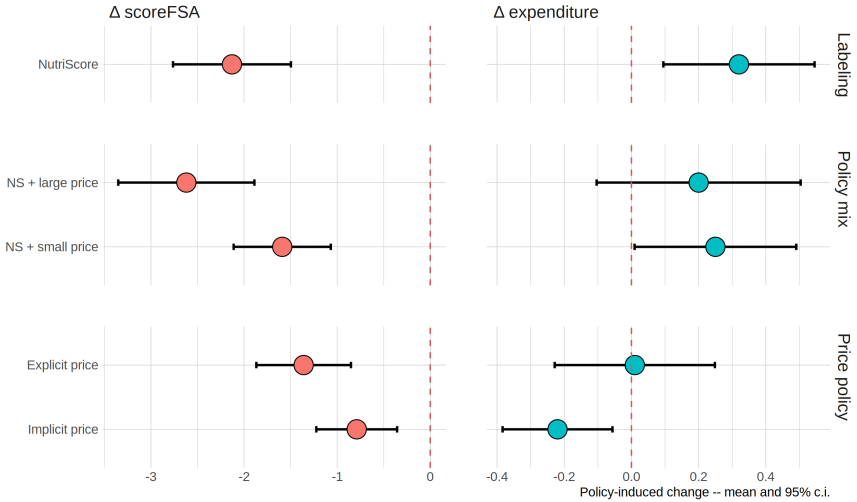
Catalog: price changes by microcategory



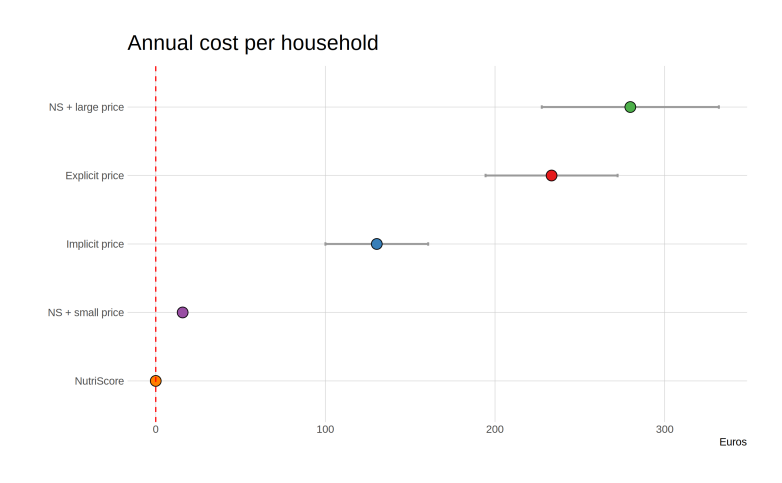
A large(ish) and representative subject pool

- 386 subjects
- $\sim$ 75 for each of the 5 treatments
- sample issued from the general population
- roughly representative (++women, ++educated)

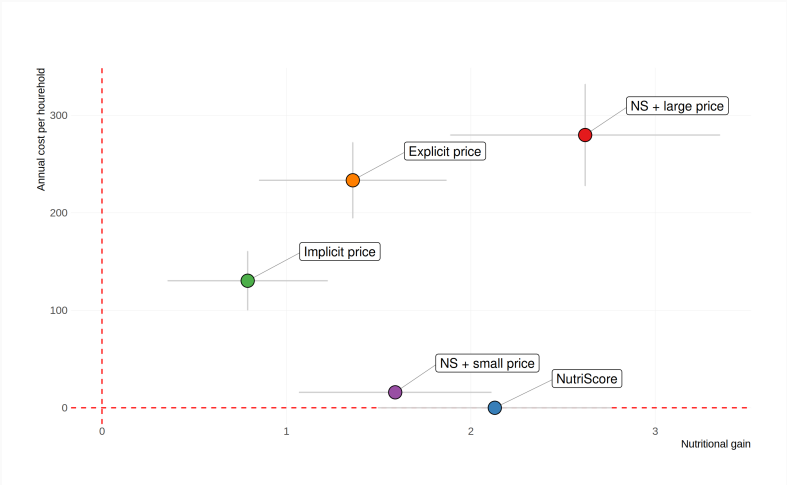
Results


Δ scoreFSA
Δ expenditure
NutriScore
NS + large price
NS + small price
Explicit price
Implicit price
Labeling
Policy mix
Price policy
-3
-2
-1
0
-0.4
-0.2
0.0
0.2
0.4
Policy-induced change -- mean and 95% c.i.

Welfare analysis: cost for the state



Welfare analysis: trade-offs



What do we learn?

- Nutritional policies are subadditive
- *Too small* an incentive reduces the effect (Gneezy & Rustichini)
- Price policies have better be explicit (Chetty et al.)
- Labeling appears as more cost-effective than the policy mix
- ...still, it's just the lab!

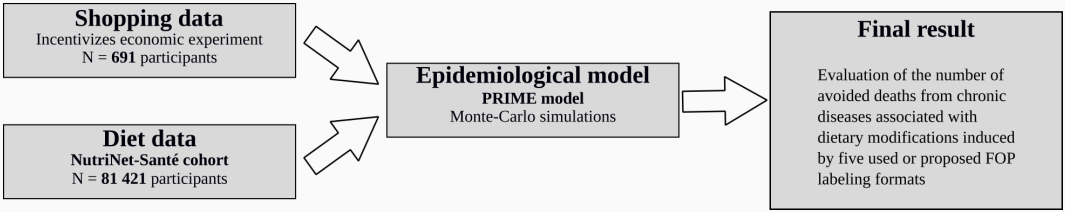
Part 3: does it matter?

Study 7:

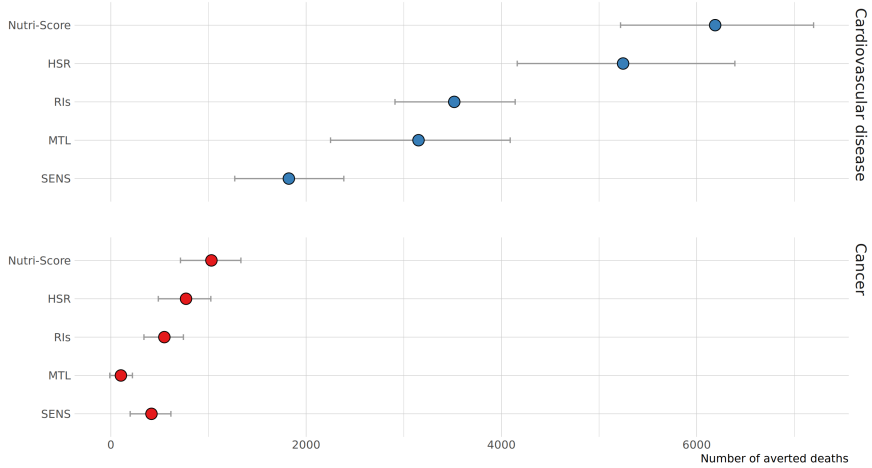
epidemiological consequences of labels

(with Egnell, d'Almeida, Kesse-Guyot, Muller, Ruffieux, Hercberg, Julia)

From micro to macro



Estimated number of averted deaths, France



What do we learn?

- Labels have non-negligible impacts on mortality
- Results from the lab can be used to feed macro models
- Better, intuitive labels are used and save lives.

What next

for behavioral label research?

Some open questions: consumers

How externally valid are our results?

- Integration: can all the effects just be summed up?
- Label proliferation
- Information overload

What other forces are at play?

- Cultural arena: the battle for label perception
- Nutrition vs tradition
- A contrarian view from Italy

Some open questions: firms

Firms react strategically

- Price discrimination
- Multiple labeling
- Labels as anti-competitive devices

Interaction firm/consumers

- Labels working for the *wrong* reasons
- Normative messages
- "*Bisogna che tutto cambi, affinché tutto resti uguale*"

Thank you