# Using the laboratory to investigate food choice and labeling

Paolo Crosetto
INRAE-GAEL, Grenoble, France
paolo.crosetto@inrae.fr

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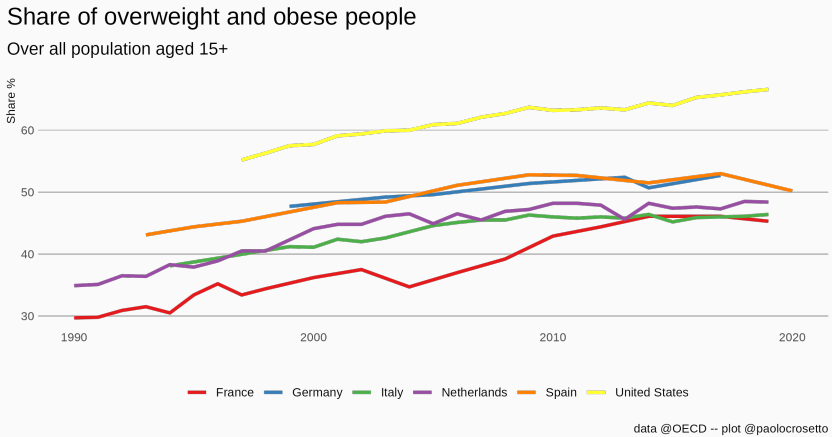
# Intro: the problem

# An obesity explosion



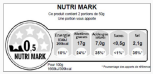

WHO: medical cost of obesity in the U.S.: $147-210 bln

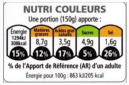
# Policy tools

- Regulation
- Information
- Labeling
- Price policies
- Nudges
- ...

# This talk

- Regulation
- Information
- **Labeling**
- **Price policies**
- Nudges
- …






+

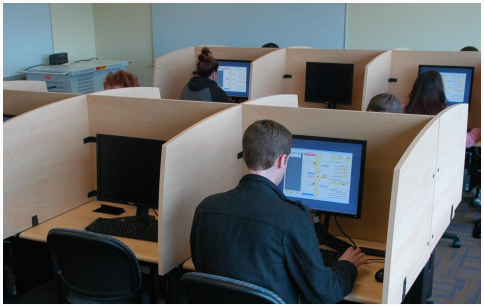
Fat **tax** & thin **subsidy**

# A series of key policy questions

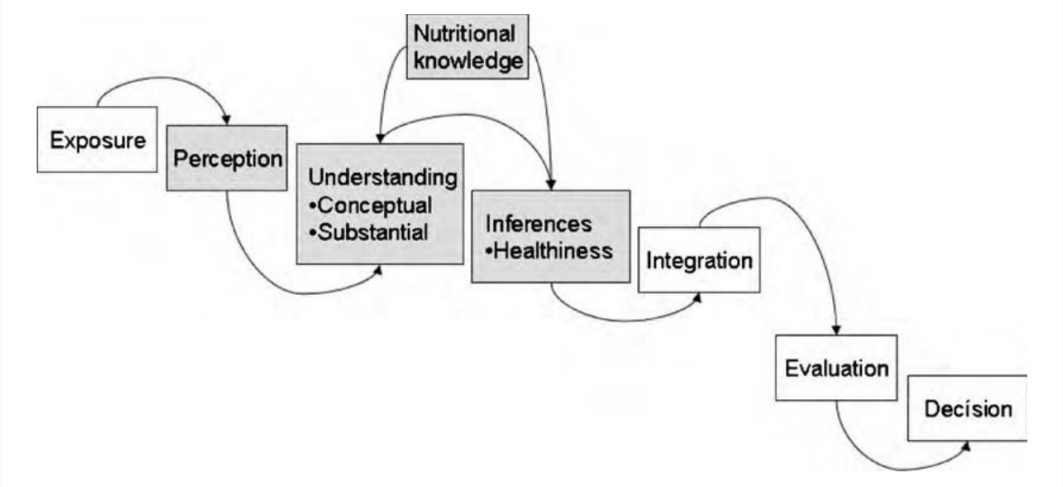
- Do **labels** work?
- Which label design is the **best** to **impact** choice?
- **How much** of an impact labels have?
- Do **price** interventions work?
- Do they work **better** or **worse** than labels?
- How do the two policies **interact**?

# Intro: which role for the lab?

# *What* can we learn from the lab?



# A conceptual framework (Grunert)



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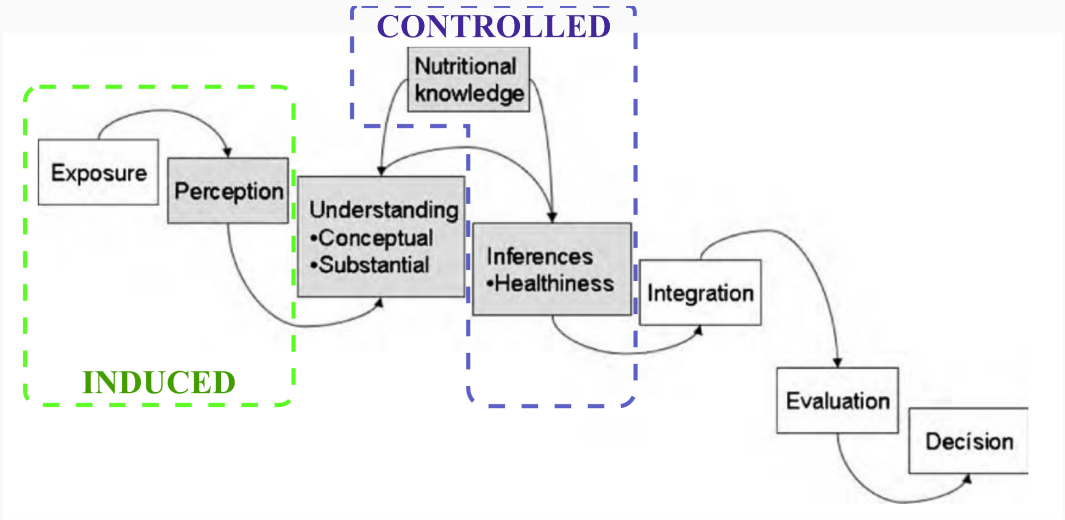


# Two main roles of the lab in an applied policy context

## Getting into the mind of subjects

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

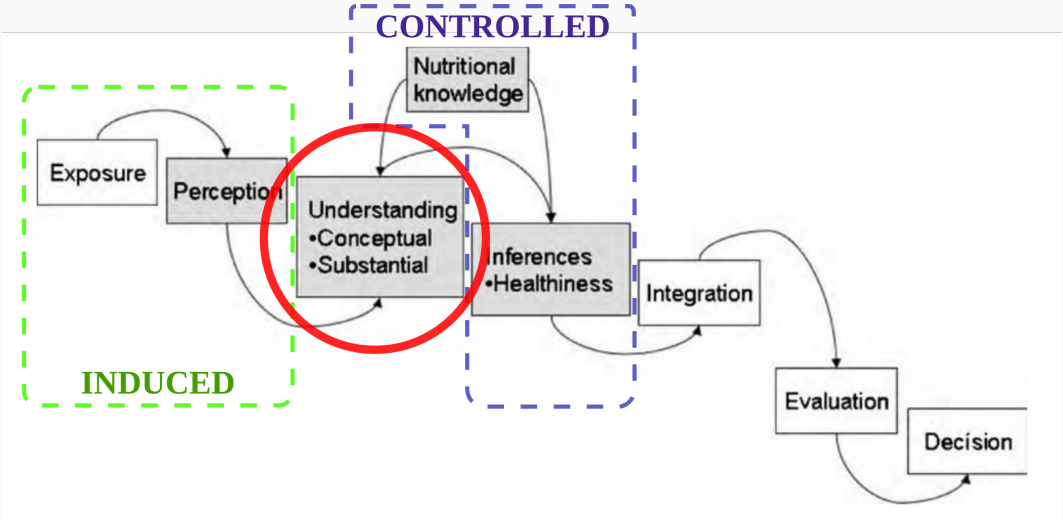
# Two main roles of the lab in an applied policy context

**Building counterfactuals**

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

# Part 1: getting into the mind of subjects

# Getting into the mind of subjects



# The usual design

# The usual design

# Study 1: building *diets*
# [JoEP 2015 – L. Muller, B. Ruffieux]

# 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
- menu must satisfy 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

# 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

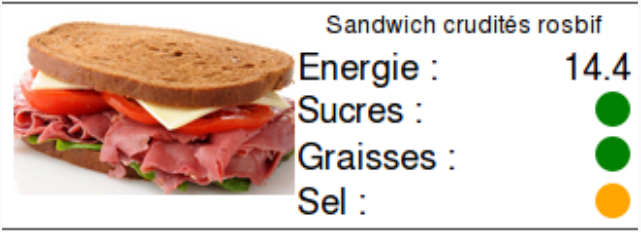
**Colors** modeled on Traffic Lights

**Num+col** both of the above combined

# Numbers

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

# Colors

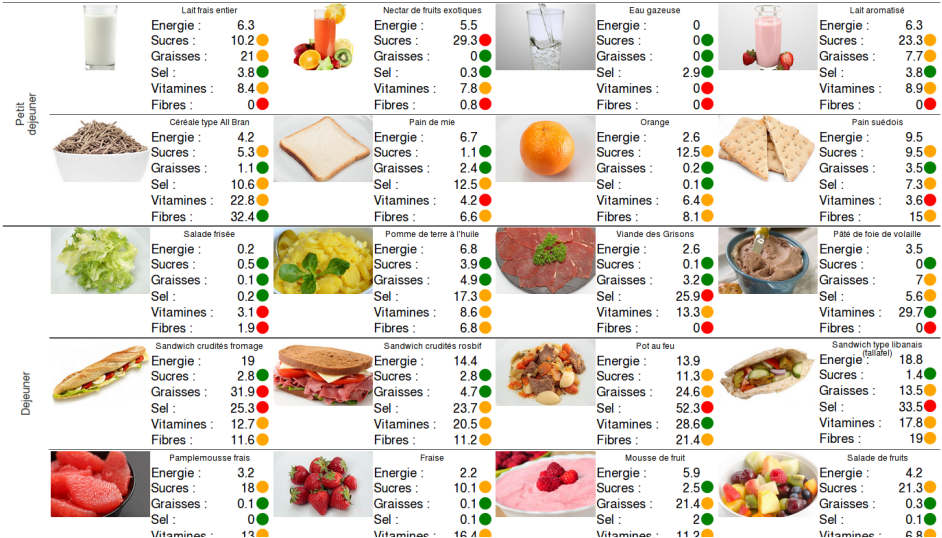


# Numbers + colors

Pêche

| | |
|---|---|
| Energie : | 3 |
| Sucres : | 14 |
| Graisses : | 0 |
| Sel : | 0 |
| Vitamines : | 11 |
| Fibres : | 12 |
| Calcium : | 2 |

# A number + colors screen, 7 constraints



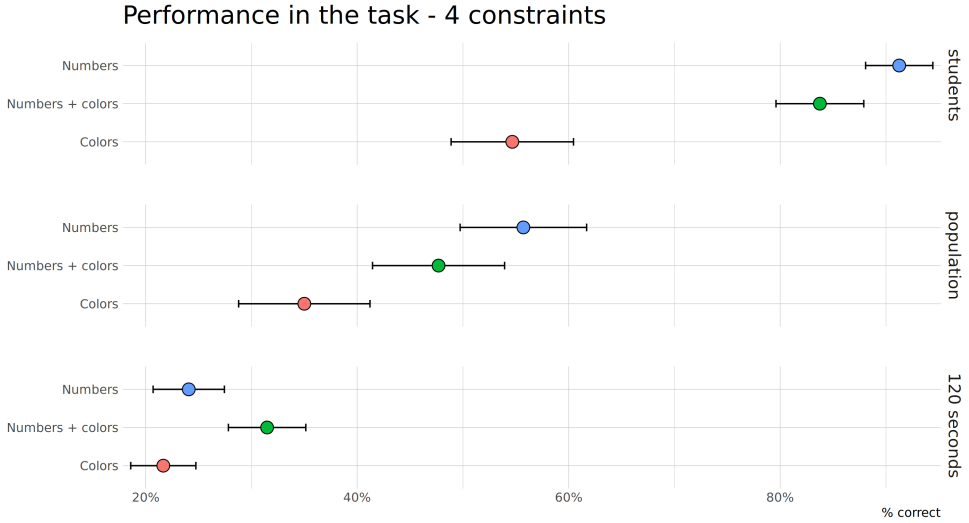
# Two populations, three conditions

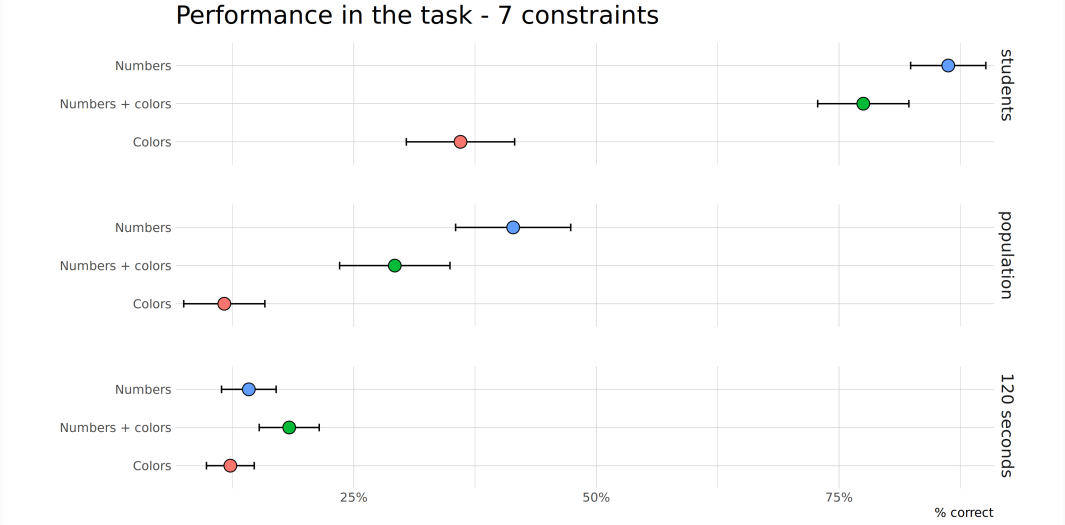
To investigate the role of

- **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 |


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

# What do we learn?

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* vs. *slow* decisions [WIP – L. 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

## Nutrition Facts

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

**Amount per Serving**

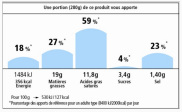
| | |
|---|---|
| **Calories** 150 | Calories from Fat 70 |
| | **% Daily Value*** |
| **Total Fat** 7g | **11%** |
| Saturated Fat 1.5g | **6%** |
| **Cholesterol** 0mg | **0%** |
| **Sodium** 120mg | **5%** |
| **Total Carbohydrate** 20g | **7%** |
| Dietary Fiber 4g | **15%** |
| Sugars 9g | |
| **Protein**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

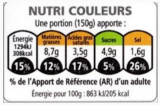
| | |
|---|---|
| Vitamin A 0% • | Vitamin C 0% |
| Calcium 0% • | Iron 2% |

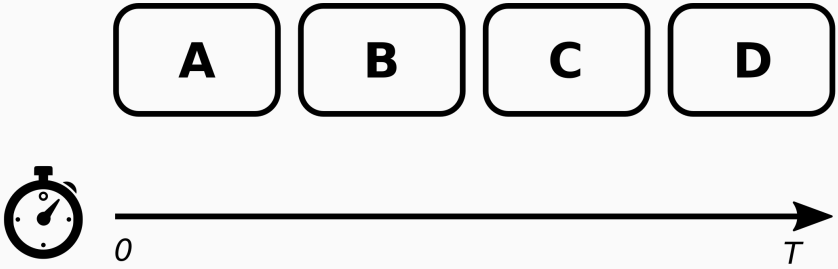
*** Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:**

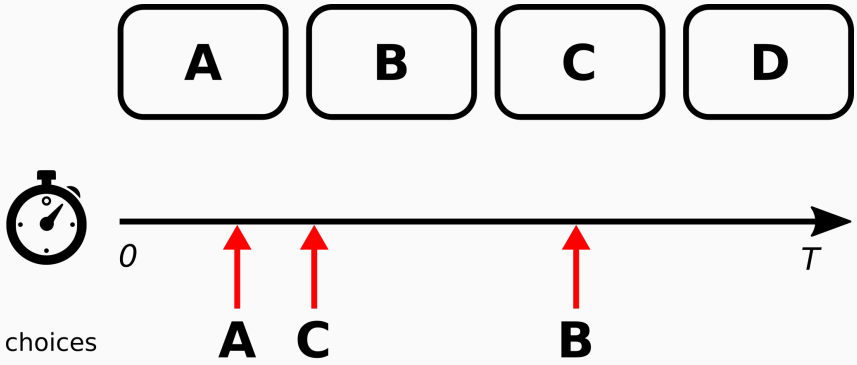
| | Calories | 2,000 | 2,500 |
|---|---|---|---|
| Total Fat | Less than | 65g | 80g |
| Sat Fat | Less than | 20g | 25g |
| Cholesterol | Less than | 300mg | 300mg |
| Sodium | Less than | 2,400mg | 2,400mg |
| Total Carbohydrate | | 300g | 375g |
| Dietary Fiber | | 25g | 30g |

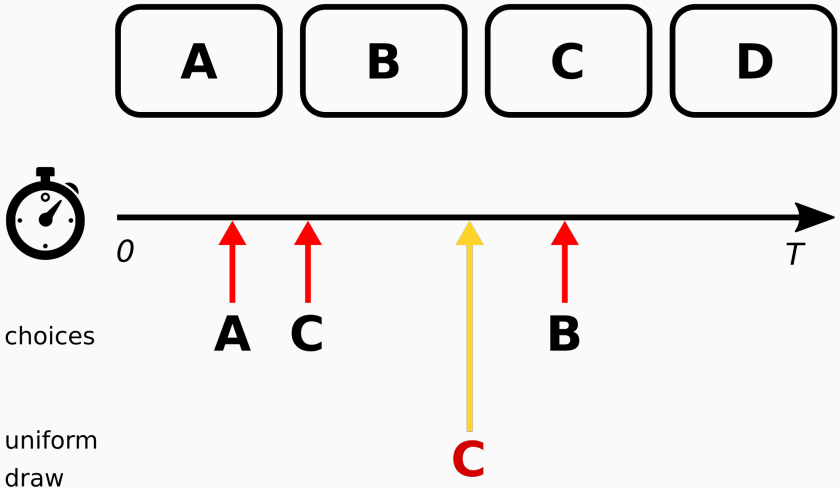
**Calories per gram:**
**Fat 9 • Carbohydrate 4 • Protein 4**

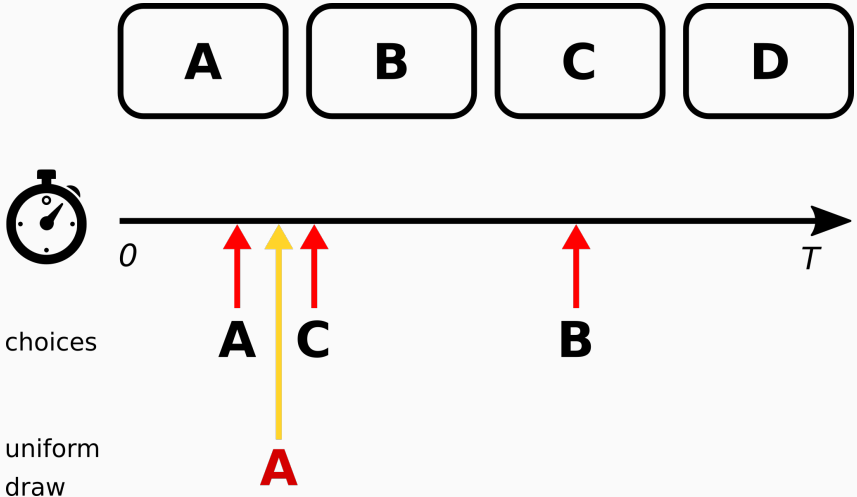


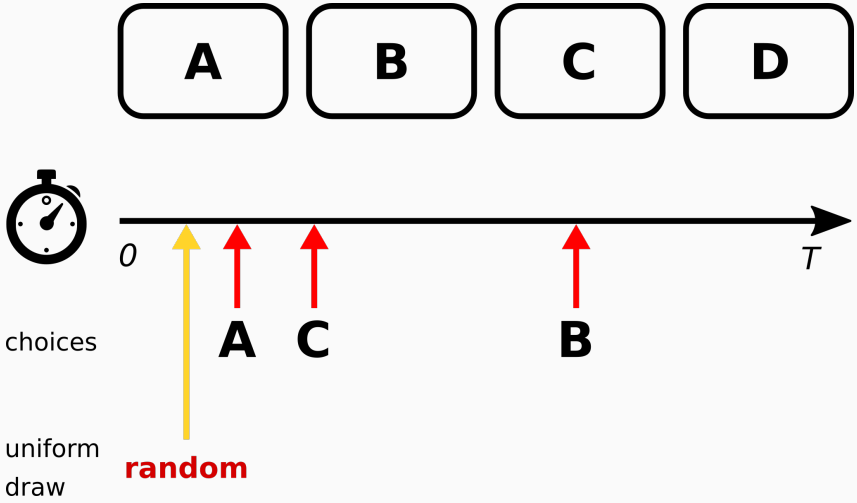




A
B
C
D
0
T


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

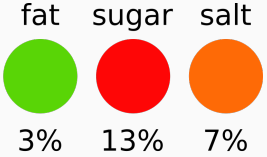
- No choice $\Rightarrow$ random choice: incentive to *fast* reply
- Time is ticking: incentive to *change* first decision upon reflection

- 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

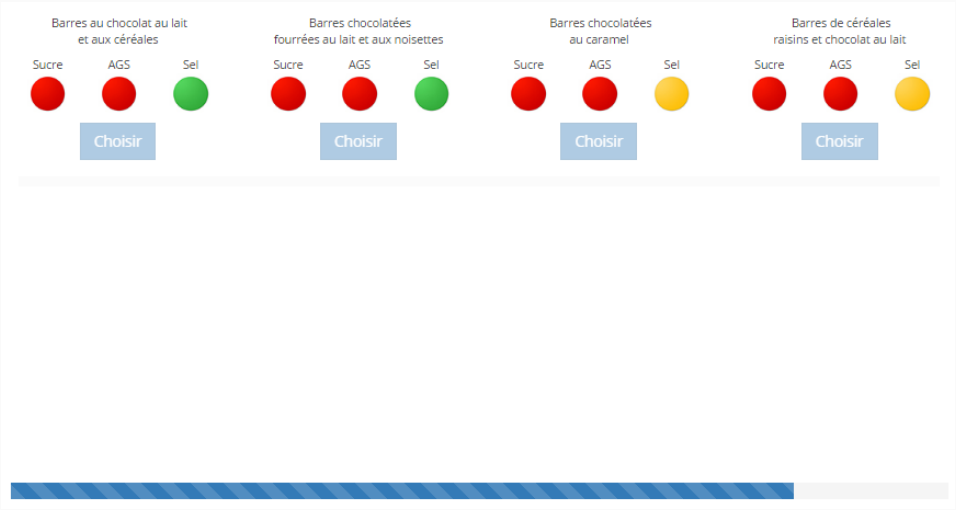
Choisir

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

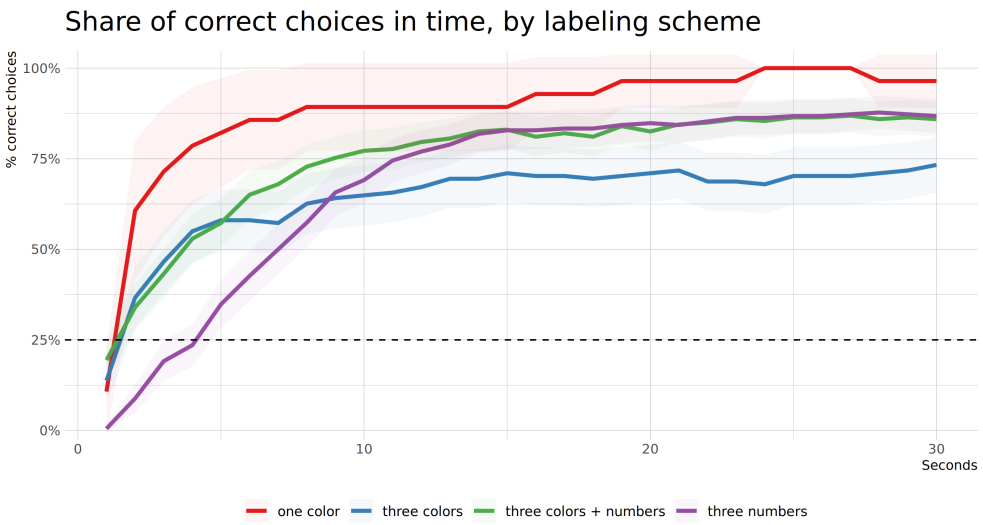
| Sucres | AGS | Sel |
|---|---|---|
| 69% | 42% | 7% |

Choisir

Barres de céréales raisins et chocolat au lait

| Sucres | AGS | Sel |
|---|---|---|
| 34% | 27% | 9% |

Choisir

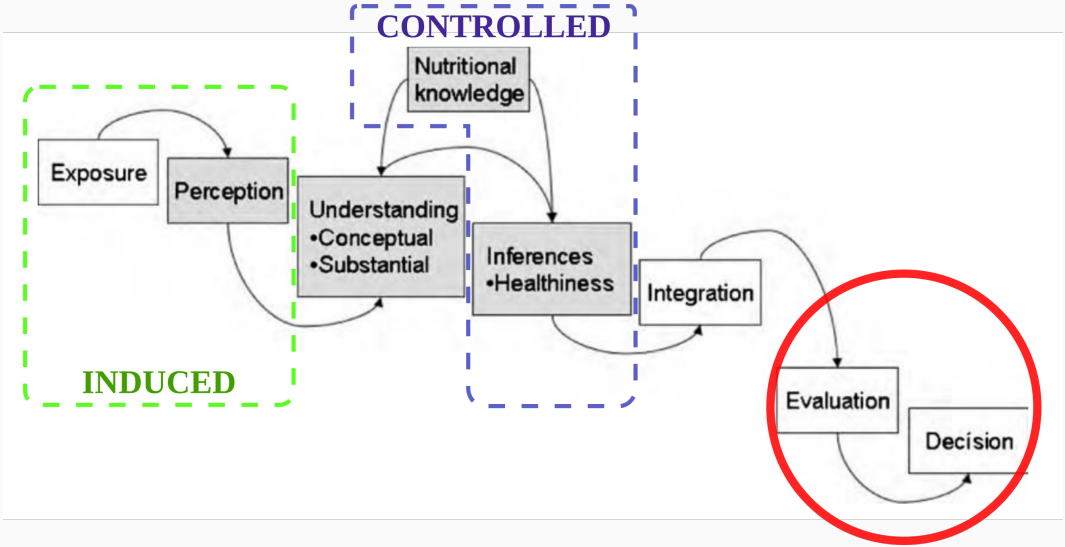

Share of correct choices in time, by labeling scheme
% correct choices
100%
75%
50%
25%
0%
0
10
20
30
Seconds
one color
three colors
three colors + numbers
three numbers
from Fast&Slow labels, wip

# 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



# The usual design(s)

**Preferences** are back – and they are **key**:

- WTP studies
- Auctions
- Choice experiments

# Study 3: shopping with labels [ERAE 2019 – L. Muller, B. Ruffieux, A. Lacroix]

# Some context

NUTRI-SCORE

A B C D E

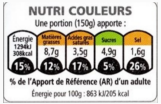
Inserm

La science pour la santé
From science to health

fcd Fédération du Commerce et de la Distribution

ania
Association Nationale des Industries Alimentaires

# The question




**French Ministry of Health – 2016**

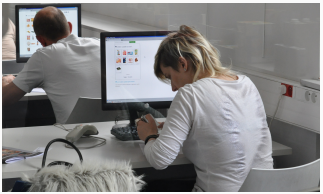
- Which FoPL to choose?
- How large is the effect?

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

# Our setup

**Paper catalog**

**Computer interface**



**Real products**

- Subjects shop for real in the lab
- For two days for their household

- $\sim \frac{1}{4}$ 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

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

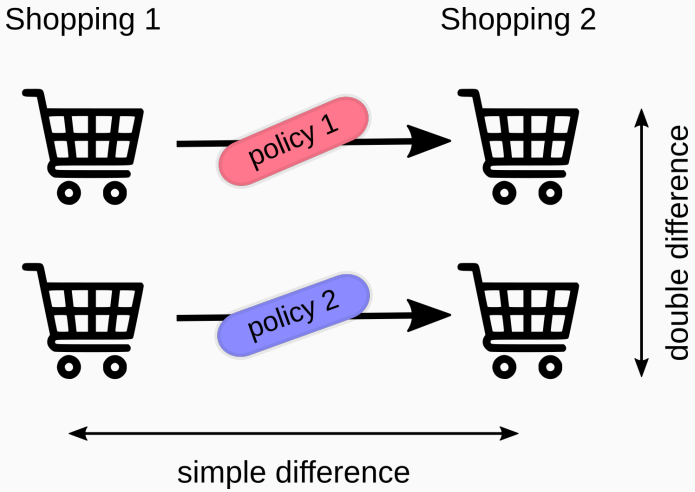
1,62 €
180 g
9,00 €/Kg

1 Ajouter au caddie

## Frites surgelées pour micro-ondes

Ingrédients | Valeurs nutritionnelles

# Experimental design: difference-in-difference



# Metrics: nutrition

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

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

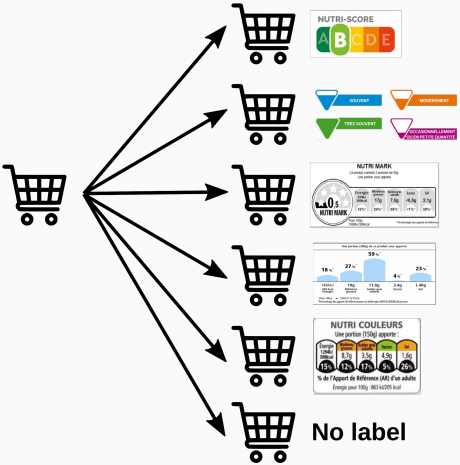
$$scoreFSA_{ij} = \frac{\sum_p Kcal_{pij} \cdot FSA_{pij}}{\sum_p Kcal_{pij}},$$

We focus on $\Delta$**FSA**, the *difference* between carts 1 and 2.

# Treatments

Shopping 1
*no label*

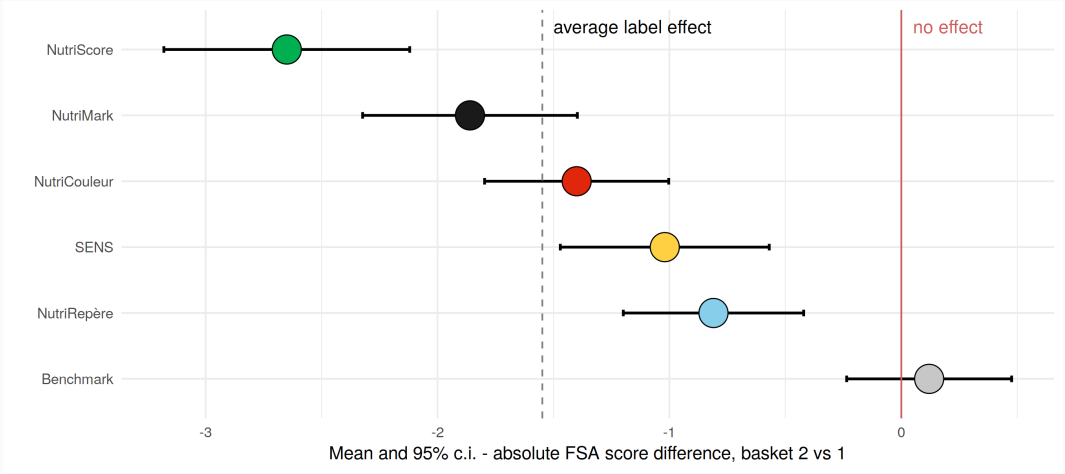
Shopping 2
*different labels*



# 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

# NutriScore leads, by far



# But there is heterogeneity

# 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 as French (and Spanish) standard
- Adopted by Auchan, Fleury Michon, Leclerc, Casino, Nestlé
- The very idea of FOP labels validated
- NutriScore is being proposed by France as EU standard

# Study 3: Lab vs. Field
# [WIP – poster by L. Muller]

# The two studies at a glance

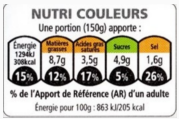
| | Lab | Field |
|---|---|---|
| Location | Grenoble | Paris couronne, Nord, Lyon |
| Supermarkets | "1" | 60 |
| Task | shop for two days' worth | shop |
| Real purchases | "yes" | yes |
| Measure | FSA score for 2000Kcal | FSA score for 2000Kcal |
| Design | Diff-in-diff | Diff-in-diff |
| Time frame | 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 to the experimentation

# Results: the lab as a magnifying glass

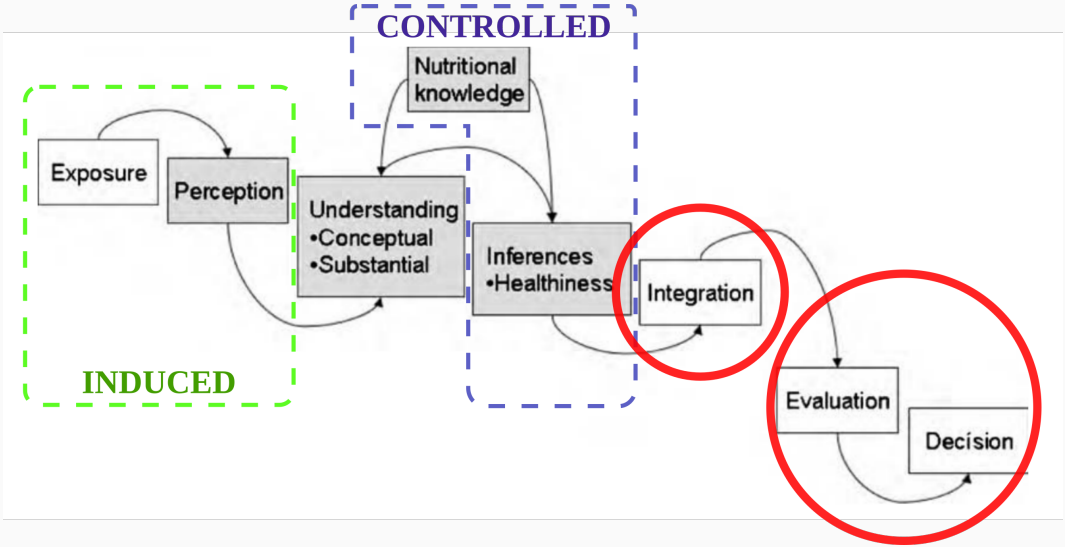
| Label | Δscore FSA | | Corr | Zoom |
|---|---|---|---|---|
| | Field | Lab | | |
| | -0.142* | -2.766*** | | 19x |
|   | -0.115 | -1.513* | 0.88 | 13x |
| | -0.062 | -1.140 | | 18x |
| | -0.024 | -0.924 | | 38x |

# What is going on? Which one is the *correct* estimate?

| | |
|---|---|
| Demand effect | similar in both experiments |
| Strategic behavior | |
| Social desirability bias | |
| 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 4: labels or prices?
# [WIP – L. Muller, B. Ruffieux]

# Integrating different policies



# A bit of context

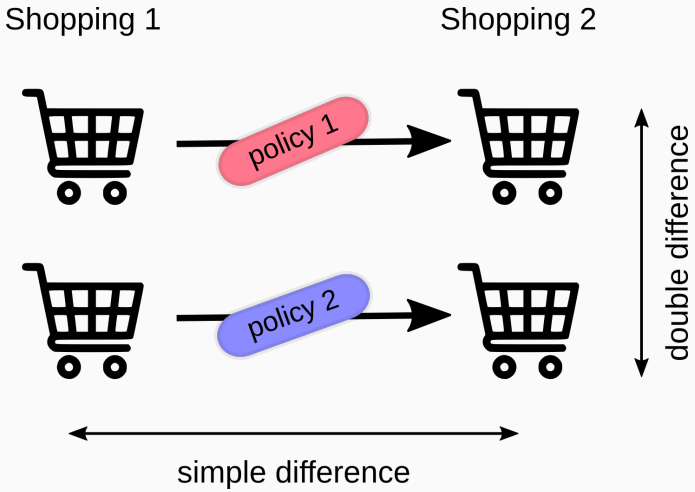
- World Bank: strongly tax unhealthy foods (Shekar and Popkin 2020)
- WHO: introduce dietary taxes on unhealthy food of minimum 20%
- India and Mexico tax unhealthy food & beverages (India : tax of 28%).

# 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 2**

# 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 $\Delta$**Expenditure**, the *difference* between carts 1 and 2.

# Metrics: state investment

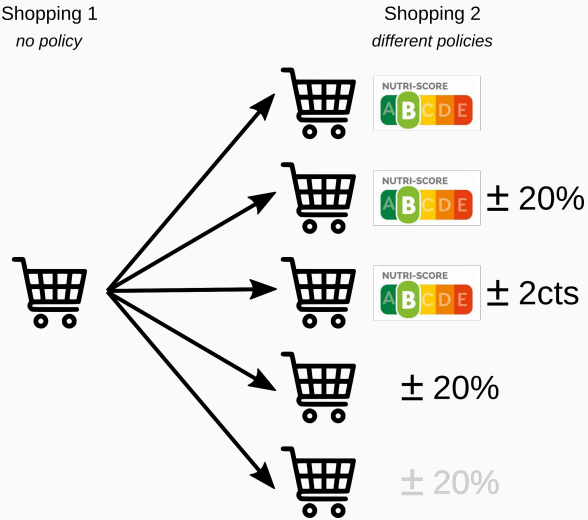
We use the total amount of subsidies minus the total amount of tax revenue, per consumer.

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
± 20%
NUTRI-SCORE
A B C D E
± 2cts
NUTRI-SCORE
A B C D E
± 20%
± 20%

# A *large* price change: ±10% or 20%

# A *small* price change: $\pm 1$ 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

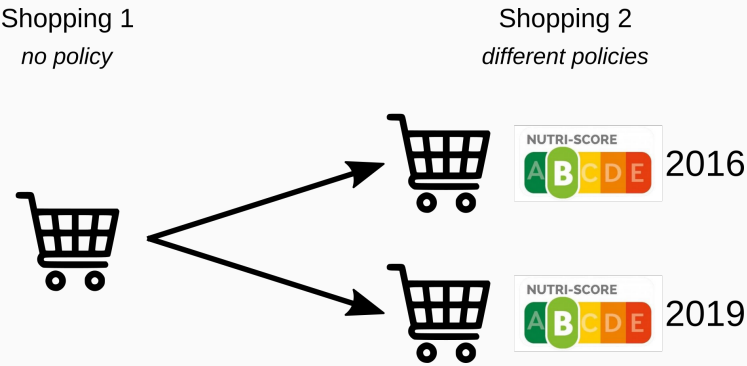
**Traitement 4**
Bonus-Malus implicite
*ad valorem*
de niveau élevé

**Traitement 5**
Bonus-Malus explicite
*ad valorem*
de niveau élevé

# 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)

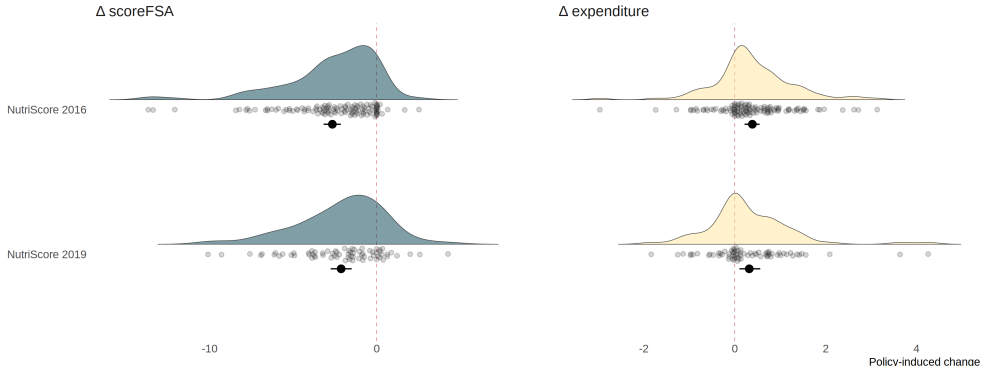
# Replication




**Hp:** we will *replicate* the 2016 findings re. NutriScore

# Results: replication

| | ScoreFSA | | | | Expediture | | | |
|---|---|---|---|---|---|---|---|---|
| | cart 1 | cart 2 | difference | p-value | cart 1 | cart 2 | difference | p-value |
| NutriScore 2019 | 3.1 (2.95) | 0.97 (3.07) | -2.13 (2.67) | 0.205 | 5.85 (1.64) | 6.17 (1.97) | 0.32 (0.95) | 0.621 |
| NutriScore 2016 | 4.74 (3.43) | 2.09 (3.47) | -2.65 (2.84) | | 5.24 (1.6) | 5.63 (1.65) | 0.39 (0.86) | |



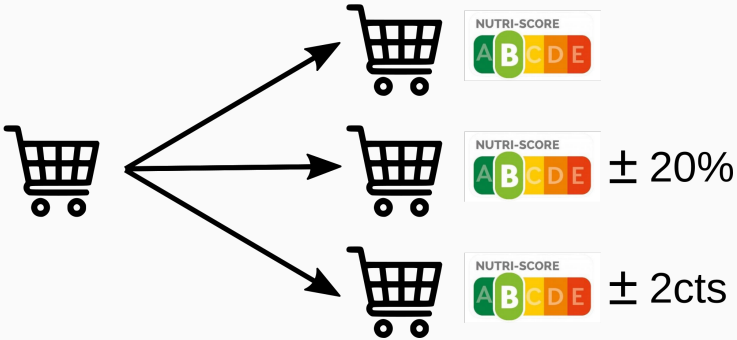
# Policy mix additivity

Shopping 1

*no policy*

Shopping 2

*different policies*

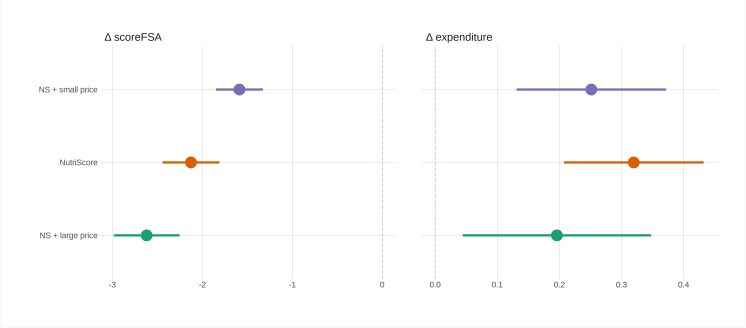



**Hp:** policies are subadditive: $A \mid B \leq f(A,B) \leq A + B$

# Additivity: results

| comparison | expenditure | scoreFSA |
|---|---|---|
| large vs small | 0.394 | 0.020 |
| NS vs large | 0.243 | 0.411 |
| NS vs small | 0.851 | 0.171 |

Wilcoxon rank-sum p-values



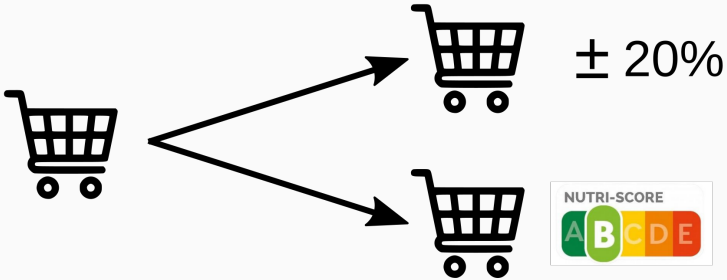
# Information *vs.* incentives

Shopping 1

*no policy*

Shopping 2

*different policies*

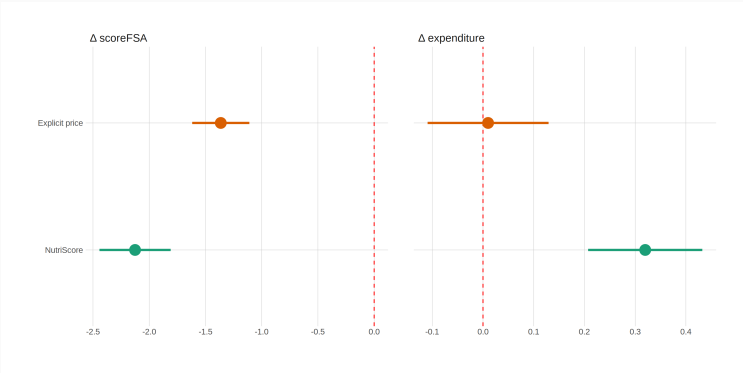



**Hp:** Labels have a higher impact than prices

# Information *vs.* incentives: results

| indicator | p.value |
|---|---|
| expenditure | 0.005 |
| scoreFSA | 0.099 |

Wilcoxon rank-sum p-values



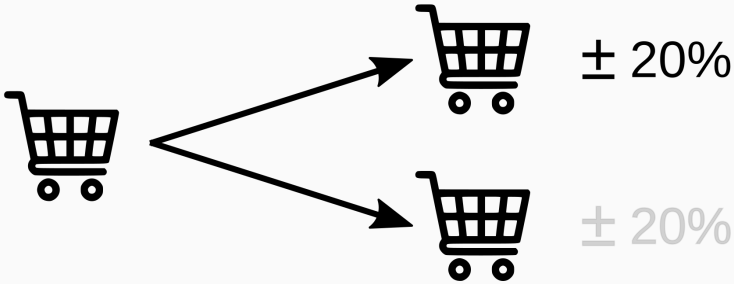
# Price salience

Shopping 1

*no policy*

Shopping 2

*different policies*

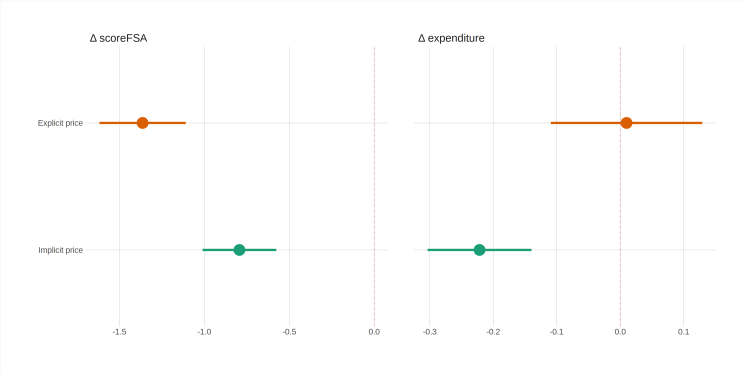



**Hp:** *salient* price changes have a larger impact

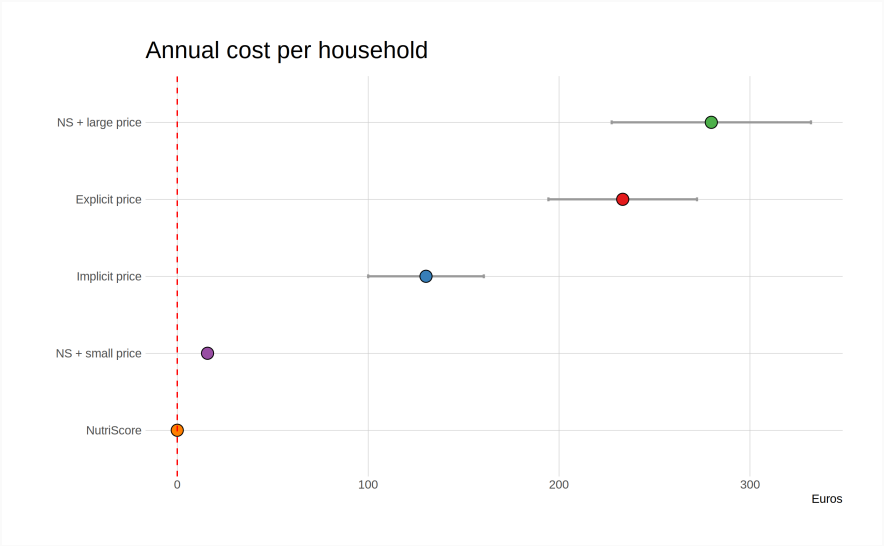
# Price salience: results

| indicator | p.value |
|---|---|
| expenditure | 0.564 |
| scoreFSA | 0.046 |

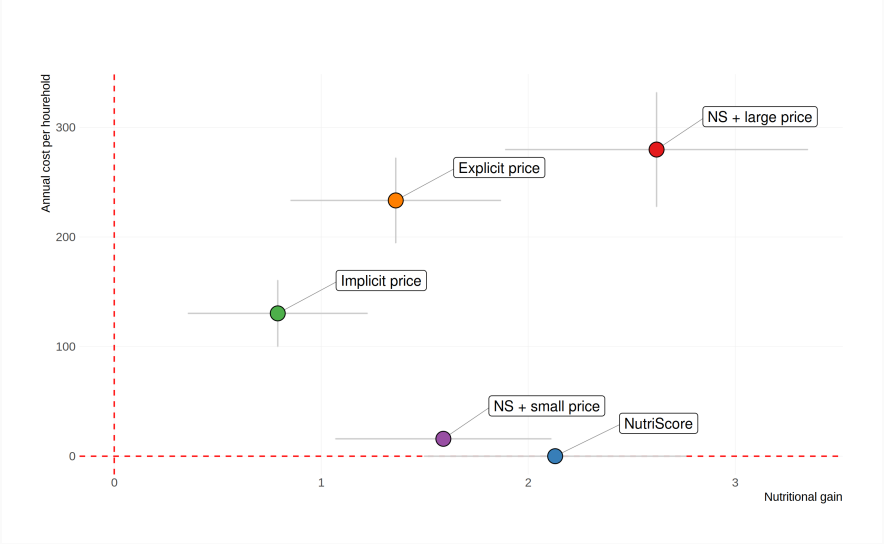
Wilcoxon rank-sum p-values



# Welfare analysis: cost for the state



# Welfare analysis: trade-offs



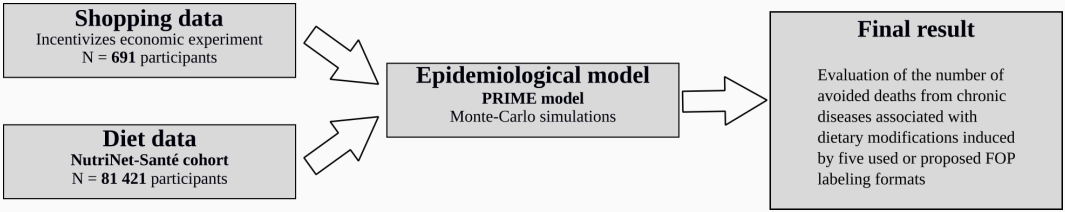
# What do we learn?

- 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!

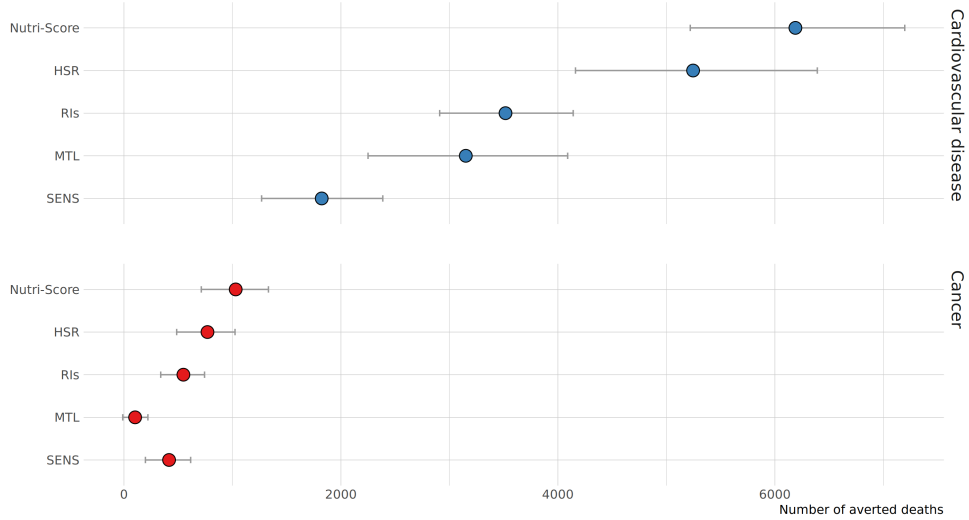
# Part 4: does it matter?

# Study 5: epidemiology [IJBNPA 2019 – S. Hercberg et al]

# 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.

# Part 5: the future

# Asking an AI

"Nutritional labeling for human beings"

"colorful impactful relevant simple effective nutritional labeling"

# Some open questions: consumers

**How externally valid are our results?**

- Andrew Gelman: if all these biases were true, they would dwarf main effects
- How to integrate all these labels?
- Label proliferation
- Information overload

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

# Some open questions: firms

**There is a world beyond consumers: firms**

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

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

thank
you