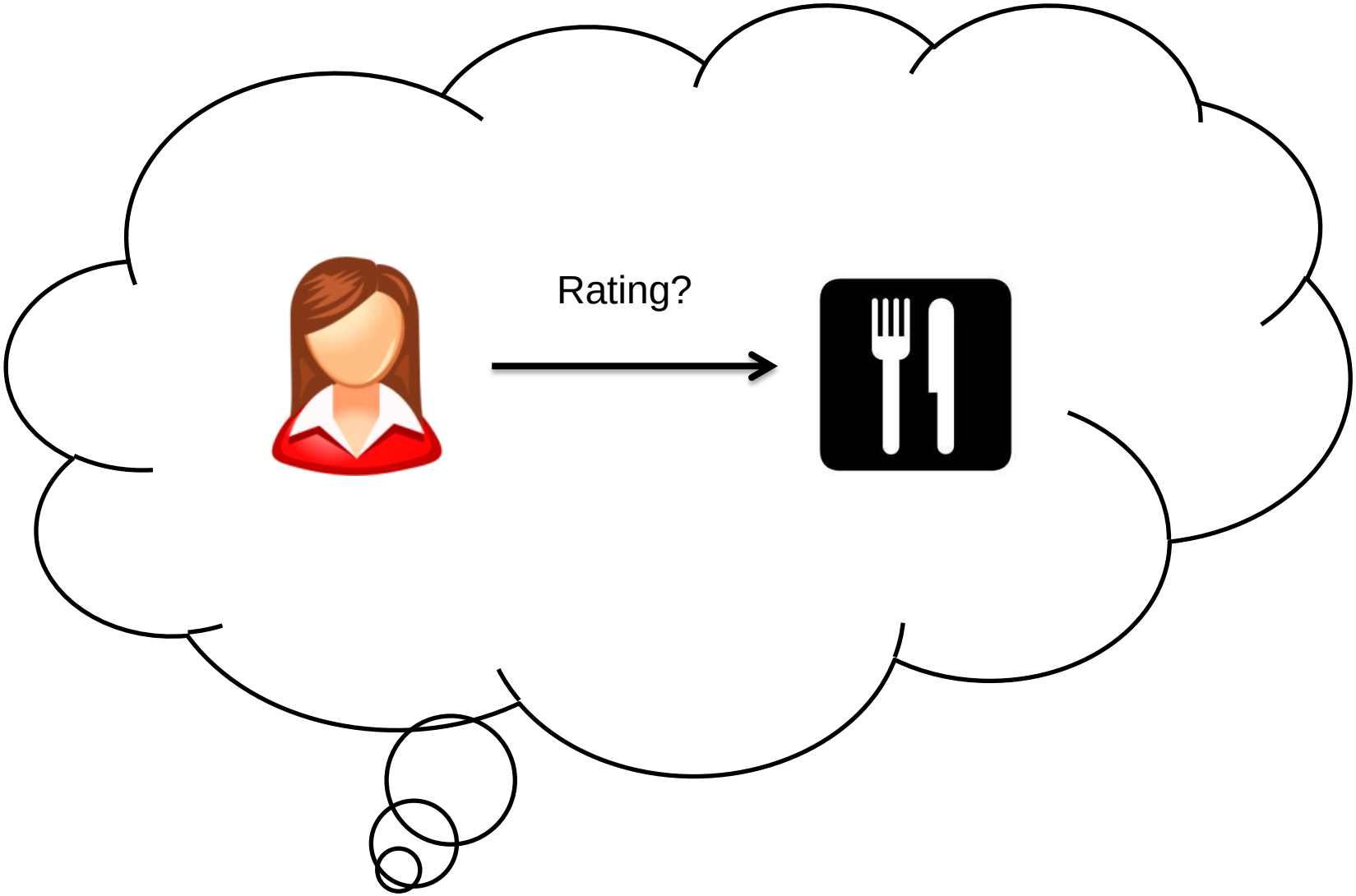
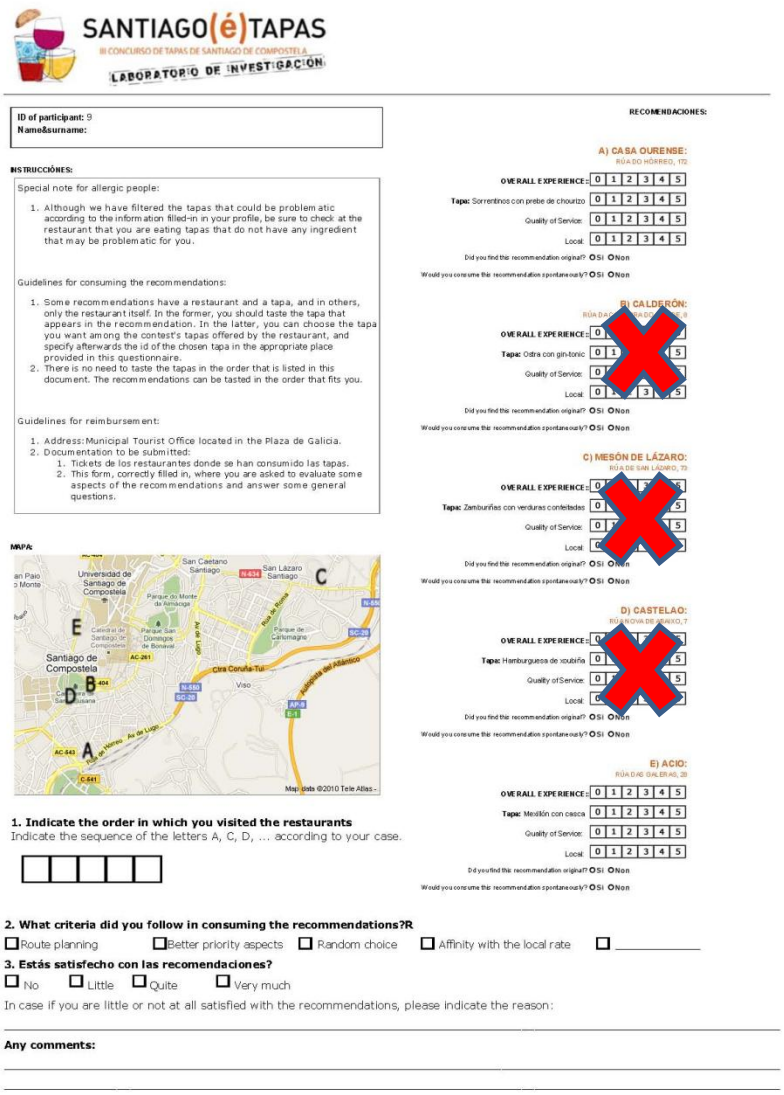
Questions



Experiment



SANTIAGO(é)TAPAS

III CONCURSO DE TAPAS DE SANTIAGO DE COMPOSTELA

LABORATORIO DE INVESTIGACIÓN

ID of participant: 9
Name&surname:

INSTRUCCIÓNES:

Special note for allergic people:

1. Although we have filtered the tapas that could be problem atic according to the information filled-in in your profile, be sure to check at the restaurant that you are eating tapas that do not have any ingredient that may be problematic for you.

Guidelines for consuming the recommendations:

1. Some recommendations have a restaurant and a tapa, and in others, only the restaurant itself. In the former, you should taste the tapa that appears in the recommendation. In the latter, you can choose the tapa you want among the contest's tapas offered by the restaurant, and specify afterwards the id of the chosen tapa in the appropriate place provided in this questionnaire.
2. There is no need to taste the tapas in the order that is listed in this document. The recommendations can be tasted in the order that fits you.

Guidelines for reimbursement:

1. Address: Municipal Tourist Office located in the Plaza de Galicia.
2. Documentation to be submitted:
   1. Tickets de los restaurantes donde se han consumido las tapas.
   2. This form, correctly filled in, where you are asked to evaluate some aspects of the recommendations and answer some general questions.

MAPA:

1. Indicate the order in which you visited the restaurants
Indicate the sequence of the letters A, C, D, ... according to your case.

RECOMENDACIONES:

A) CASA OURENSE:
RÚA DO HÓRREO, 172

OVERALL EXPERIENCE: 0 1 2 3 4 5
Tapa: Sorrentinos con prebe de chourizo 0 1 2 3 4 5
Quality of Service: 0 1 2 3 4 5
Local: 0 1 2 3 4 5
Did you find this recommendation original? ○Si ○Non
Would you consume this recommendation spontaneously? ○Si ○Non

B) CALDERÓN:
RÚA DA [illegible]

OVERALL EXPERIENCE: 0 [illegible]
Tapa: Ostra con gin-tonic 0 1 [illegible] 5
Quality of Service: 0 [illegible]
Local: 0 [illegible] 3 [illegible] 5
Did you find this recommendation original? ○Si ○Non
Would you consume this recommendation spontaneously? ○Si ○Non

C) MESÓN DE LÁZARO:
RÚA DE SAN LÁZARO, 73

OVERALL EXPERIENCE: 0 [illegible]
Tapa: Zamburiñas con verduras confeitadas 0 [illegible] 5
Quality of Service: 0 [illegible] 5
Local: 0 [illegible]
Did you find this recommendation original? ○Si ○Non
Would you consume this recommendation spontaneously? ○Si ○Non

D) CASTELAO:
RÚA NOVA DE ABAIXO, 7

OVERALL EXPERIENCE: 0 [illegible]
Tapa: Hamburguesa de xoubiña 0 [illegible] 5
Quality of Service: 0 [illegible] 5
Local: 0 [illegible]
Did you find this recommendation original? ○Si ○Non
Would you consume this recommendation spontaneously? ○Si ○Non

E) ACIO:
RÚA DAS GALERAS, 28

OVERALL EXPERIENCE: 0 1 2 3 4 5
Tapa: Mexillón con casca 0 1 2 3 4 5
Quality of Service: 0 1 2 3 4 5
Local: 0 1 2 3 4 5
Did you find this recommendation original? ○Si ○Non
Would you consume this recommendation spontaneously? ○Si ○Non

2. What criteria did you follow in consuming the recommendations?R
☐Route planning ☐Better priority aspects ☐Random choice ☐Affinity with the local rate ☐ _____

3. Estás satisfecho con las recomendaciones?
☐ No ☐ Little ☐ Quite ☐ Very much
In case if you are little or not at all satisfied with the recommendations, please indicate the reason:

Any comments:

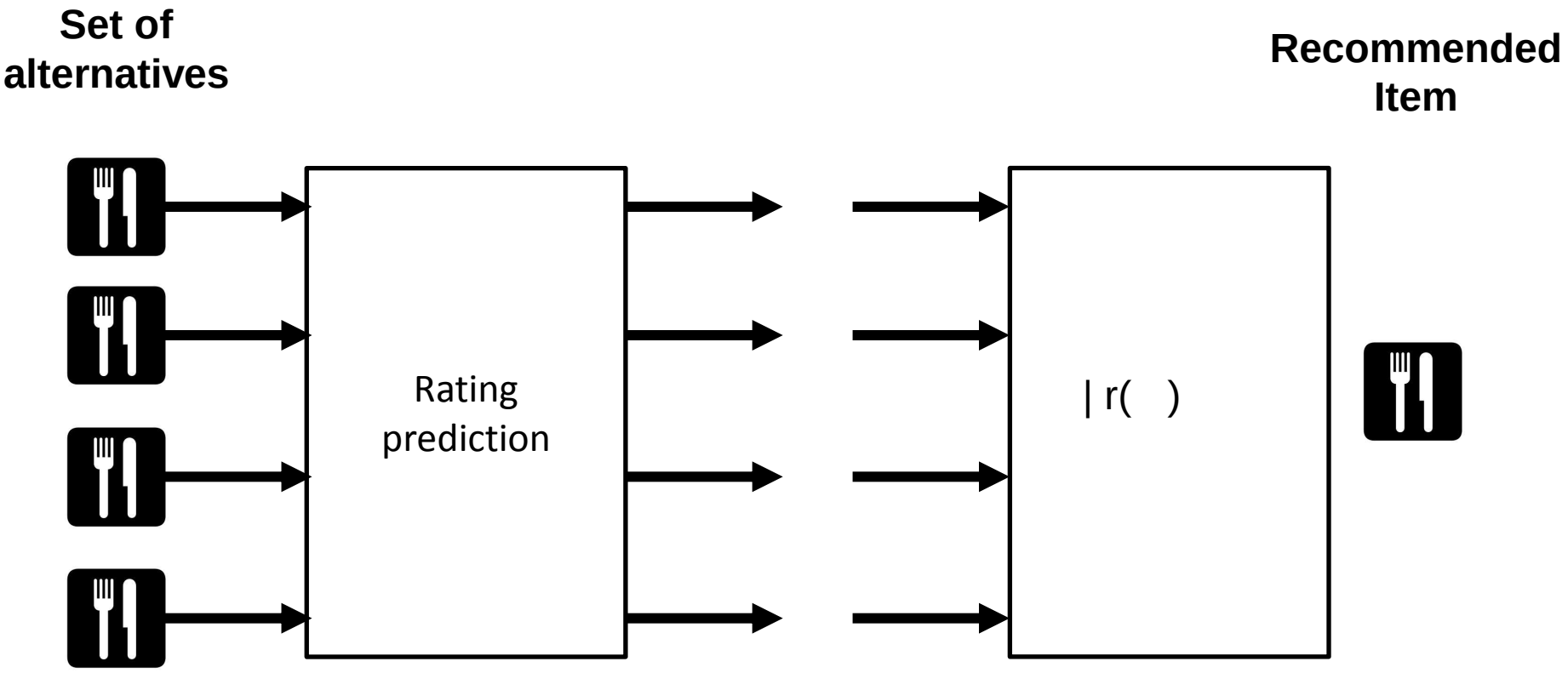
Subjects reported…

« Too far from our location. »

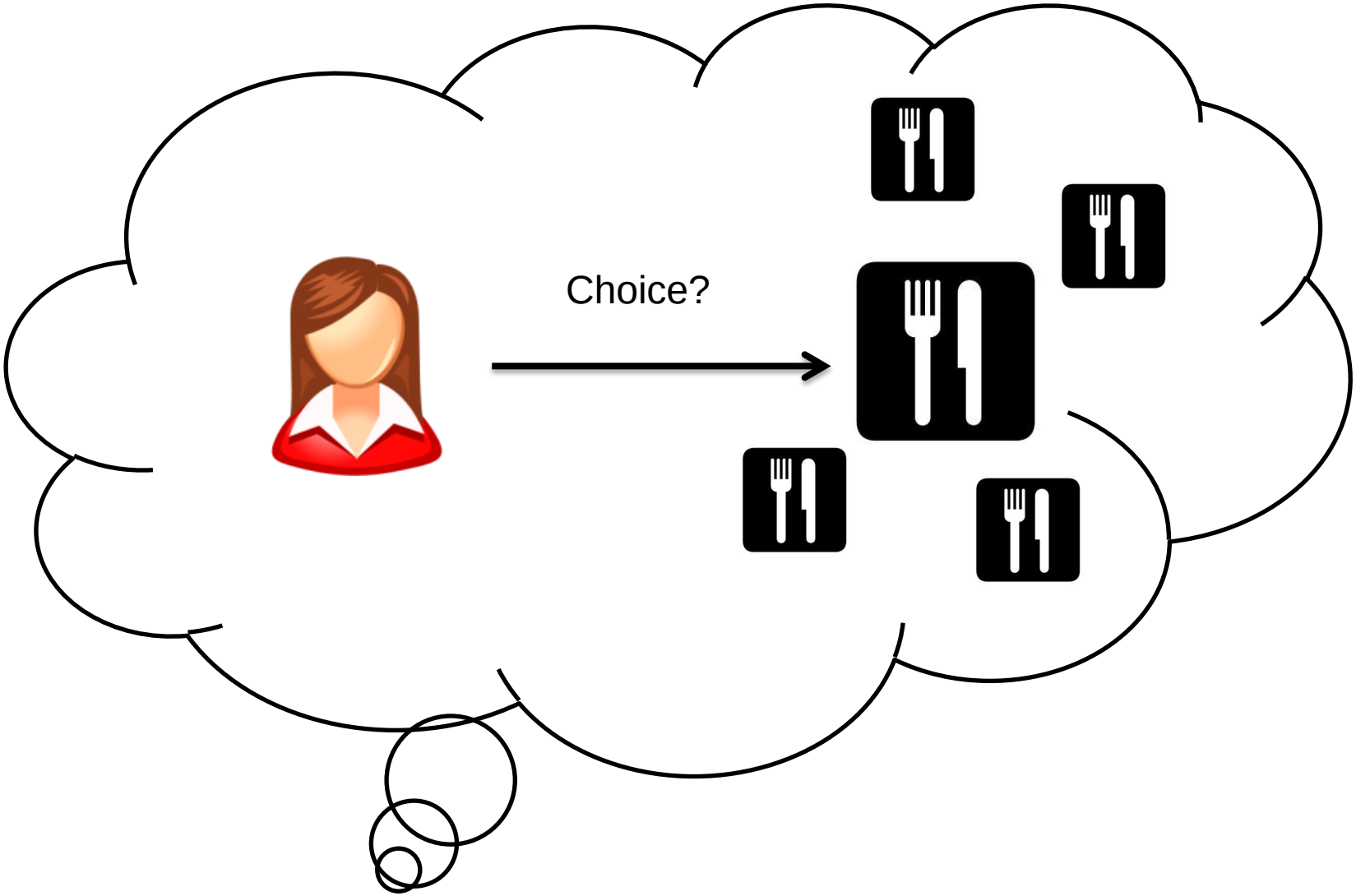
« The place was closed that day. »

« I would have liked it if the tapa were cold. »

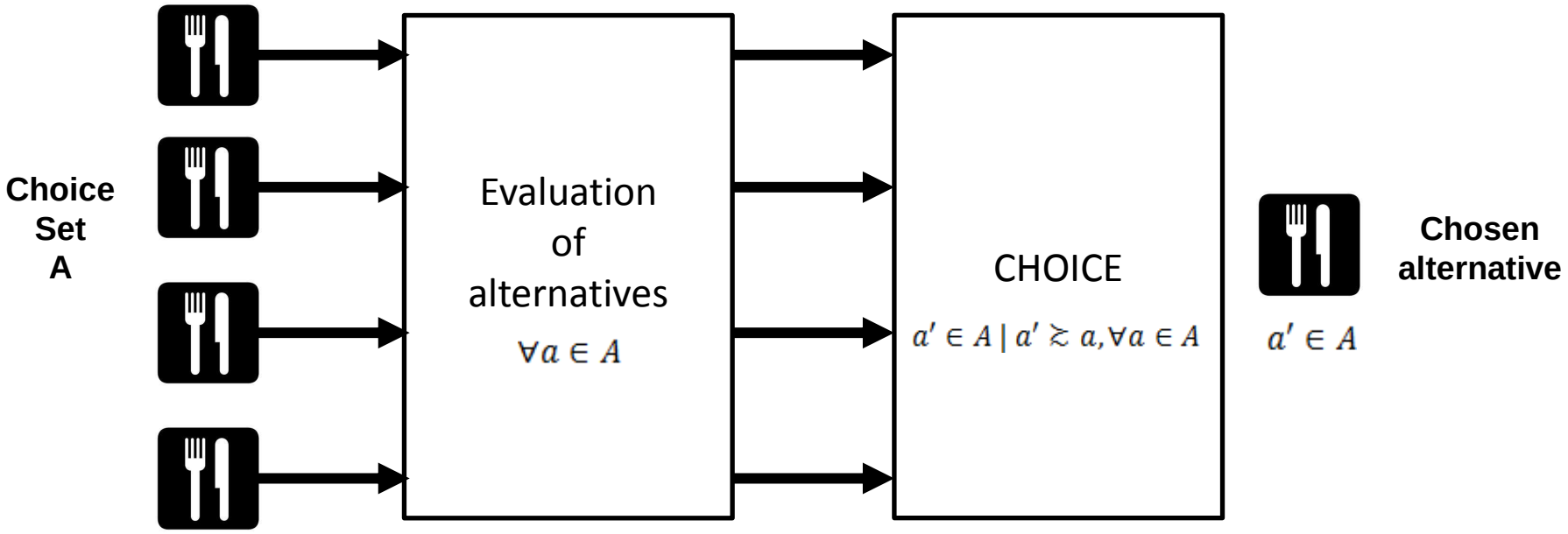
Collaborative Rating-based prediction



Questions



Rational choice



Choice rule with preferences:

$$CR(A, \succsim) = \{a' \in A \,\|\, a' \succsim a, \forall a \in A\}$$

Rational choice

Choice Rule with preferences

$$CR(A, \succeq) = \{a' \in A \,\|\, a' \succeq a, \forall a \in A\}$$

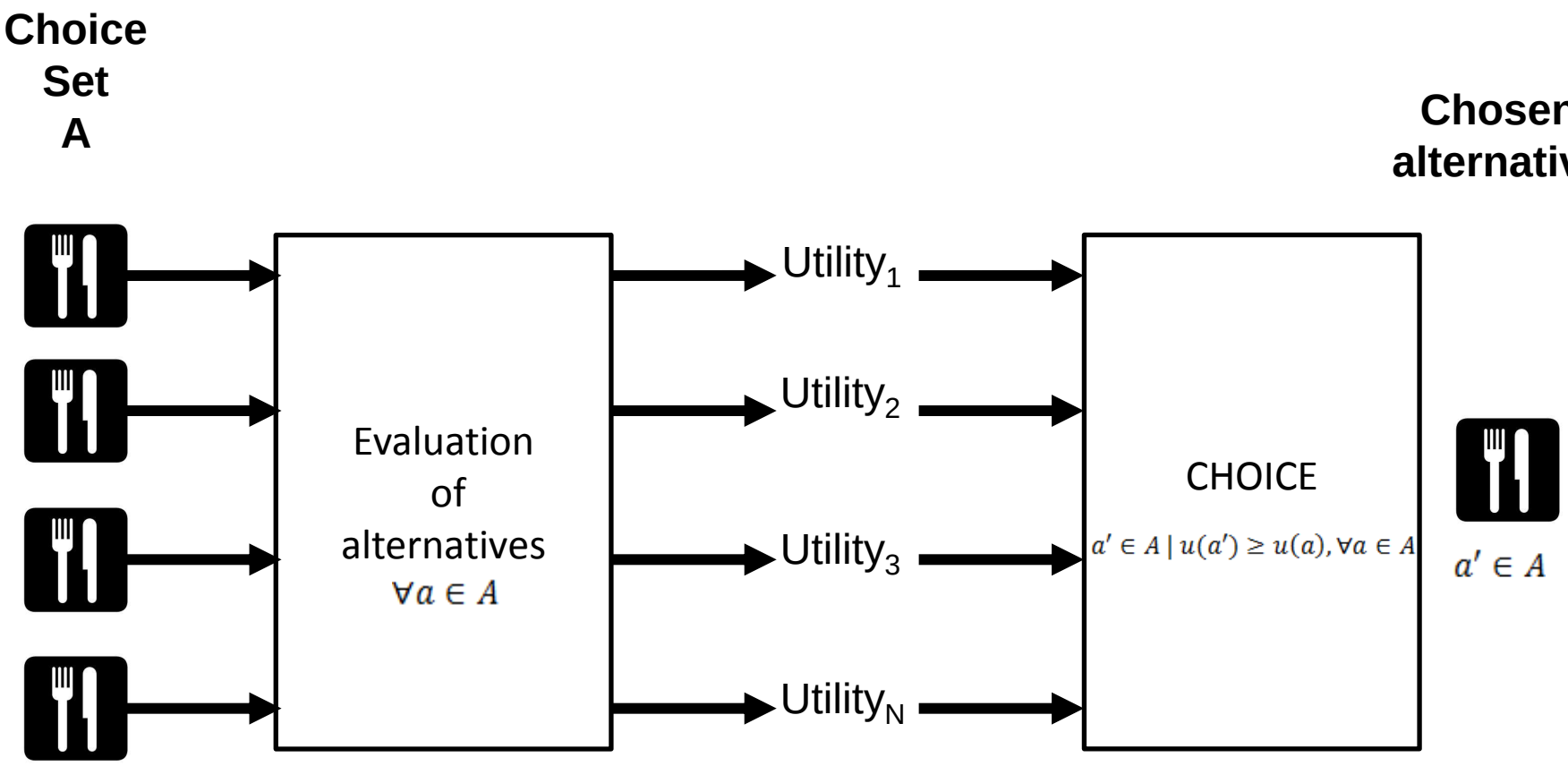
Axiom of utility theory

$$a \succsim b \;\Leftrightarrow u(a) \geq u(b)$$

Choice rule with utilities:

$$CR(A, \geq) = \{a' \in A \,\|\, U(a') \geq U(a), \forall a \in A\}.$$

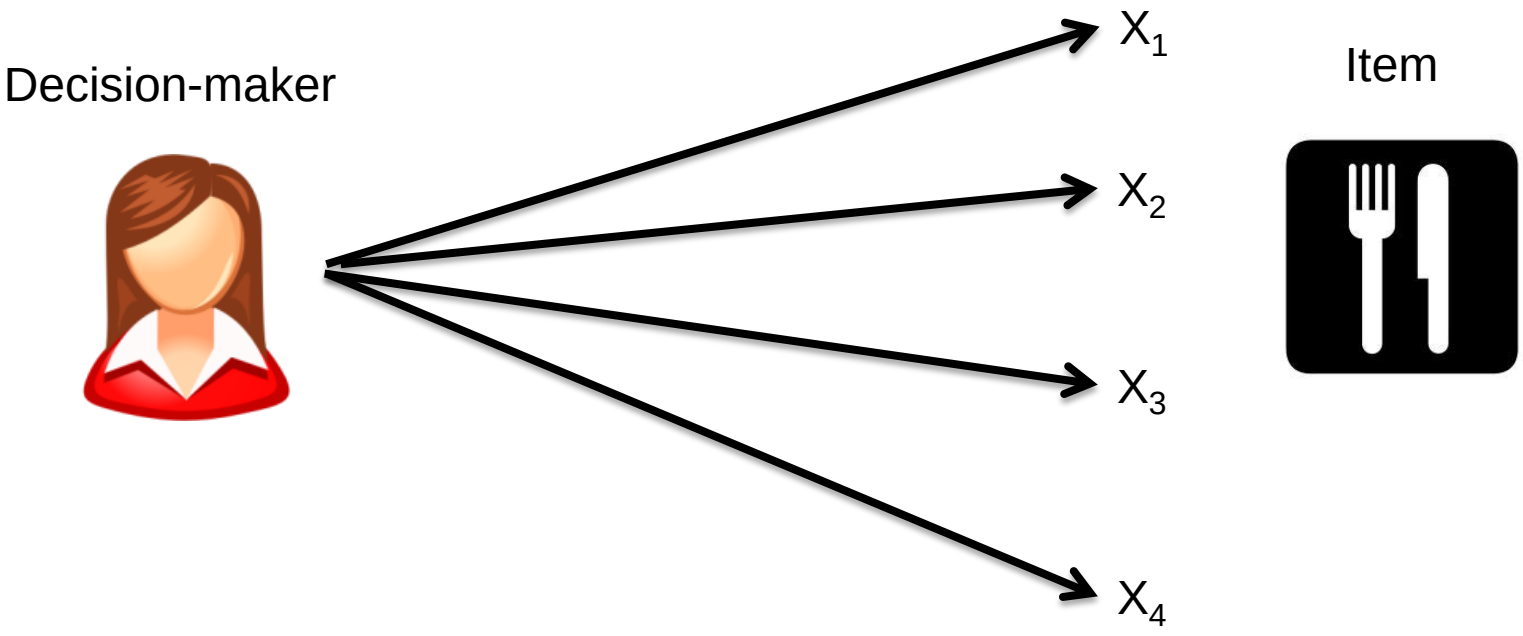
Rational choice



Random utility models

Definition of utility

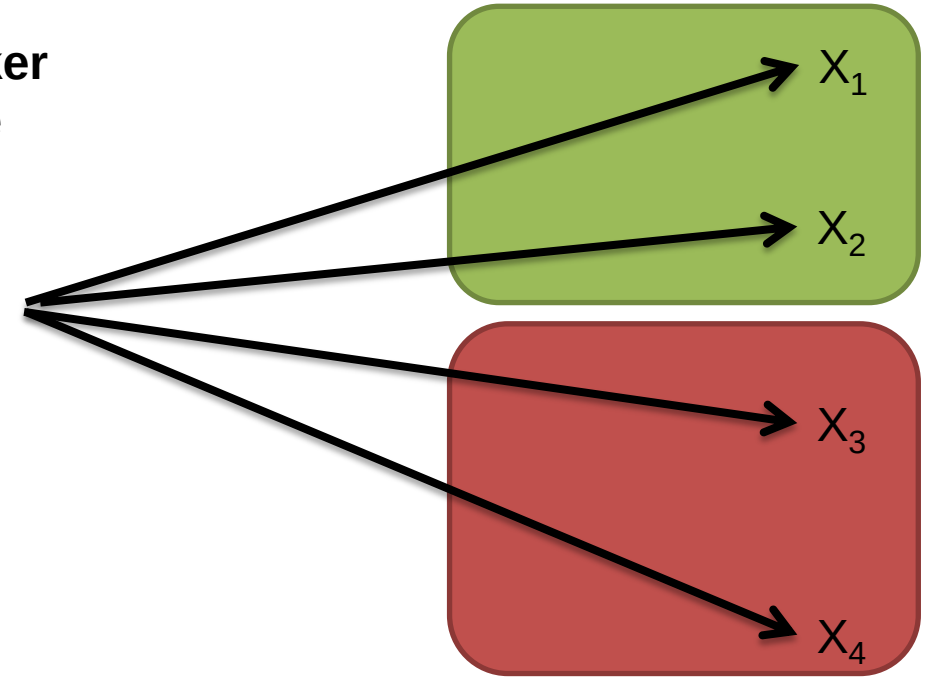
- Vector of alternative's attributes
- Vector of preferences on attributes



Random utility models

Observed factors: Representative utility,

Decision-maker perspective



Item

Unobserved factors: Random variable, ε

Researcher perspective

$$V_{nj} \neq U_{nj}$$

$$U_{nj} = V_{nj} + \epsilon_{nj}$$

Random utility models

Choice Rule becomes probabilistic:

$$CR(A, \geq) = \{a_i \in A \,\|\, \mathbb{P}_i \geq \mathbb{P}_j, \forall a_j \in A\}$$

With probabilities:

$$\mathbb{P}(U_{ni} > U_{nj} \text{ for all } j \neq i) = \mathbb{P}(\epsilon_{nj} - \epsilon_{ni} < V_{ni} - V_{nj} \text{ for all } j \neq i).$$

Integrating over random variable ε, and assuming f as its density:

$$\mathbb{P}_{ni} = \int_{\epsilon} \mathbb{I}(\epsilon_{nj} - \epsilon_{ni} < V_{ni} - V_{nj} \text{ for all } j \neq i) f(\epsilon_n) d\epsilon_n$$

Standard and mixed logit models

If each ε is i.i.d, f(ε) is a Gumbel distribution :

$$f(\epsilon_{nj}) = e^{-\epsilon_{nj}} e^{-e^{-\epsilon_{nj}}}.$$

Standard logit function:

$$\mathbb{P}_{ni} = \frac{e^{V_{ni}}}{\sum_j e^{V_{nj}}}.$$

Mixed logit model: is considered a random variable with density g.

$$\mathbb{P}_{ni} = \int \left(\frac{e^{V_{ni}(\beta)}}{\sum_j e^{V_{nj}(\beta)}} \right) g(\beta|\theta) d\beta.$$

Parameter estimation

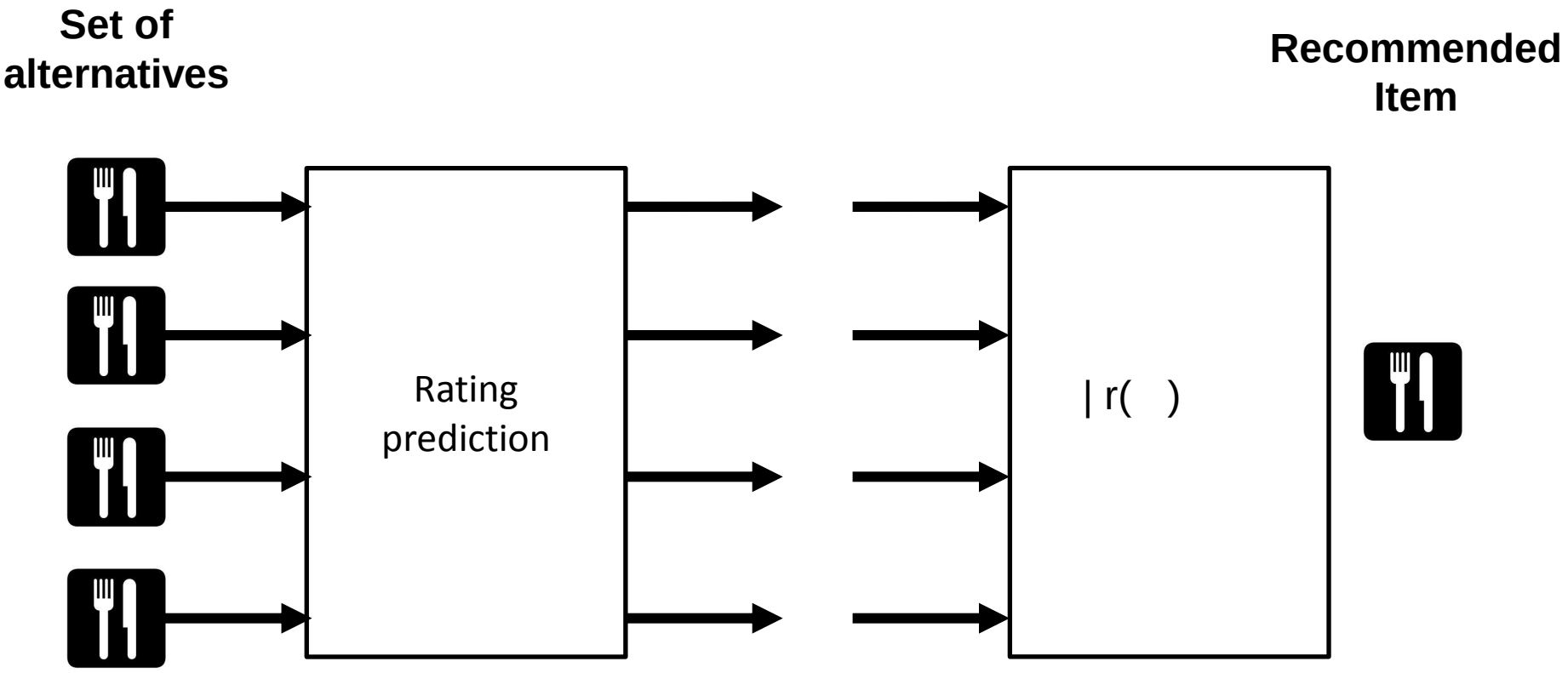
coefficients (preferences) of $\mathbb{P}_{ni} = \frac{e^{V_{ni}}}{\sum_j e^{V_{nj}}}$. estimated by means of :

1. Set of choices: Attributes per chosen alternative a` + Attributes of all the alternatives a in choice set A.

2. Maximum likelihod procedures:

$$LL(\beta) = \sum_n \sum_i y_{ni} \log \mathbb{P}_{ni}$$

Differences with rating-based predictions?



Differences: concept of utility

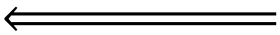
Rational Choice
+
Random utility
Models

Collaborative
Rating-based
Models

Differences: preference estimation

Rational Choice + Random utility Models

Collaborative Rating-based Models

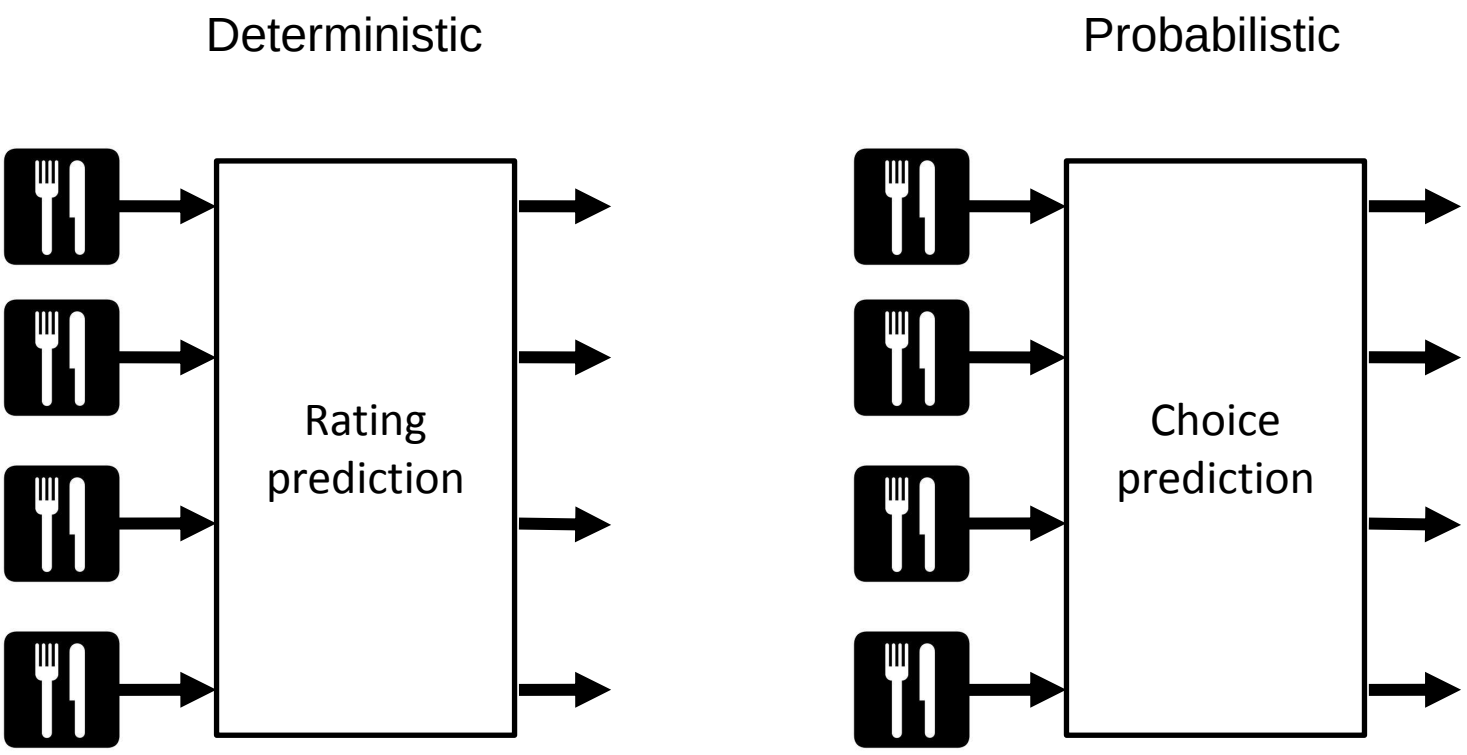


kNN:

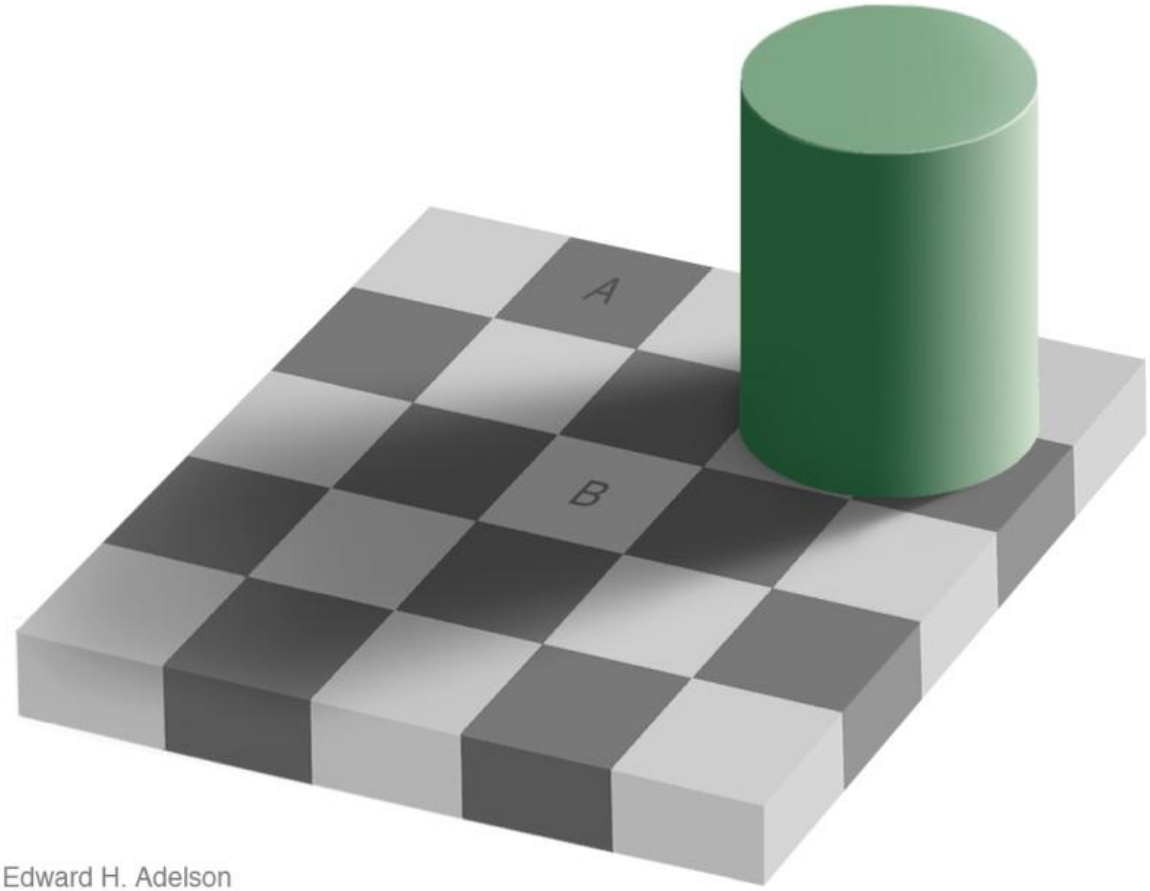
Matrix factorization:

Estimated from r

Differences: Researcher perspective

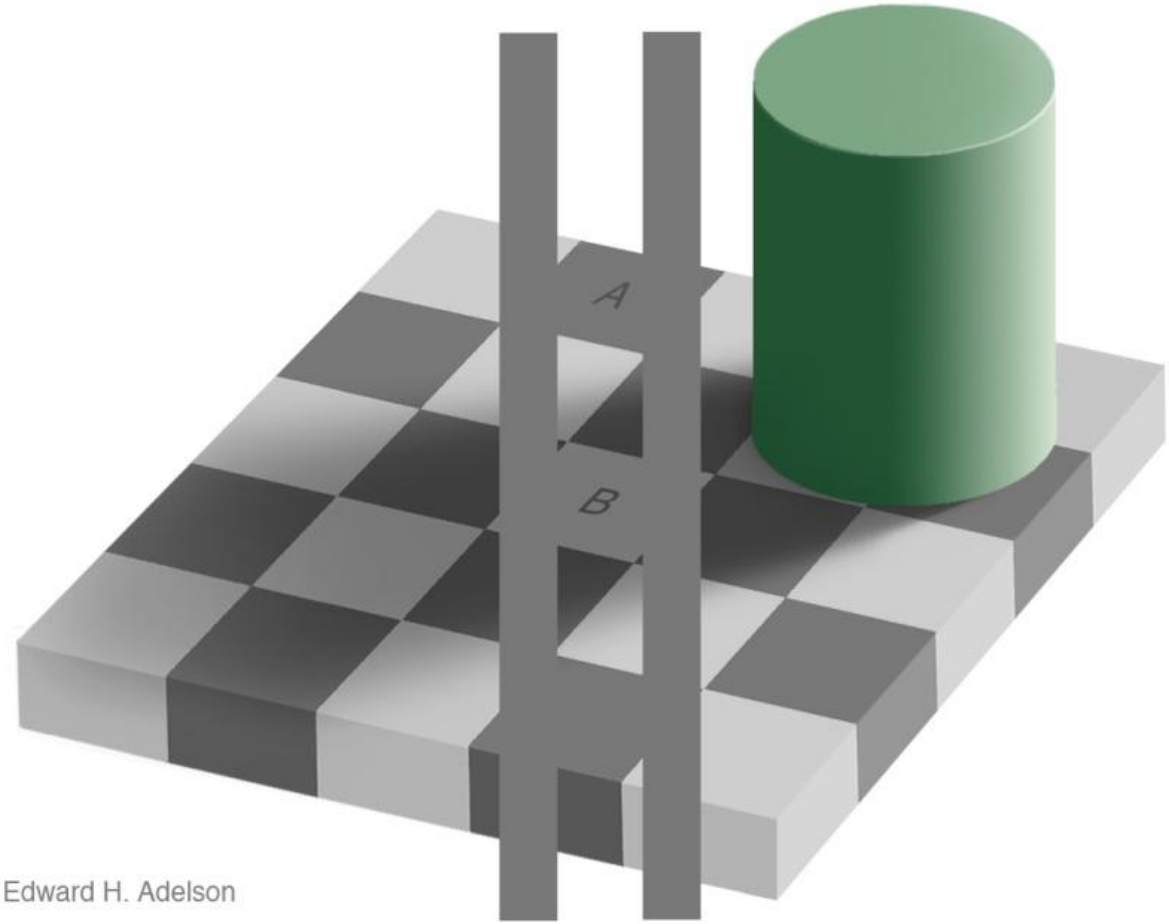


Differences: the choice set



Edward H. Adelson

Differences: the choice set



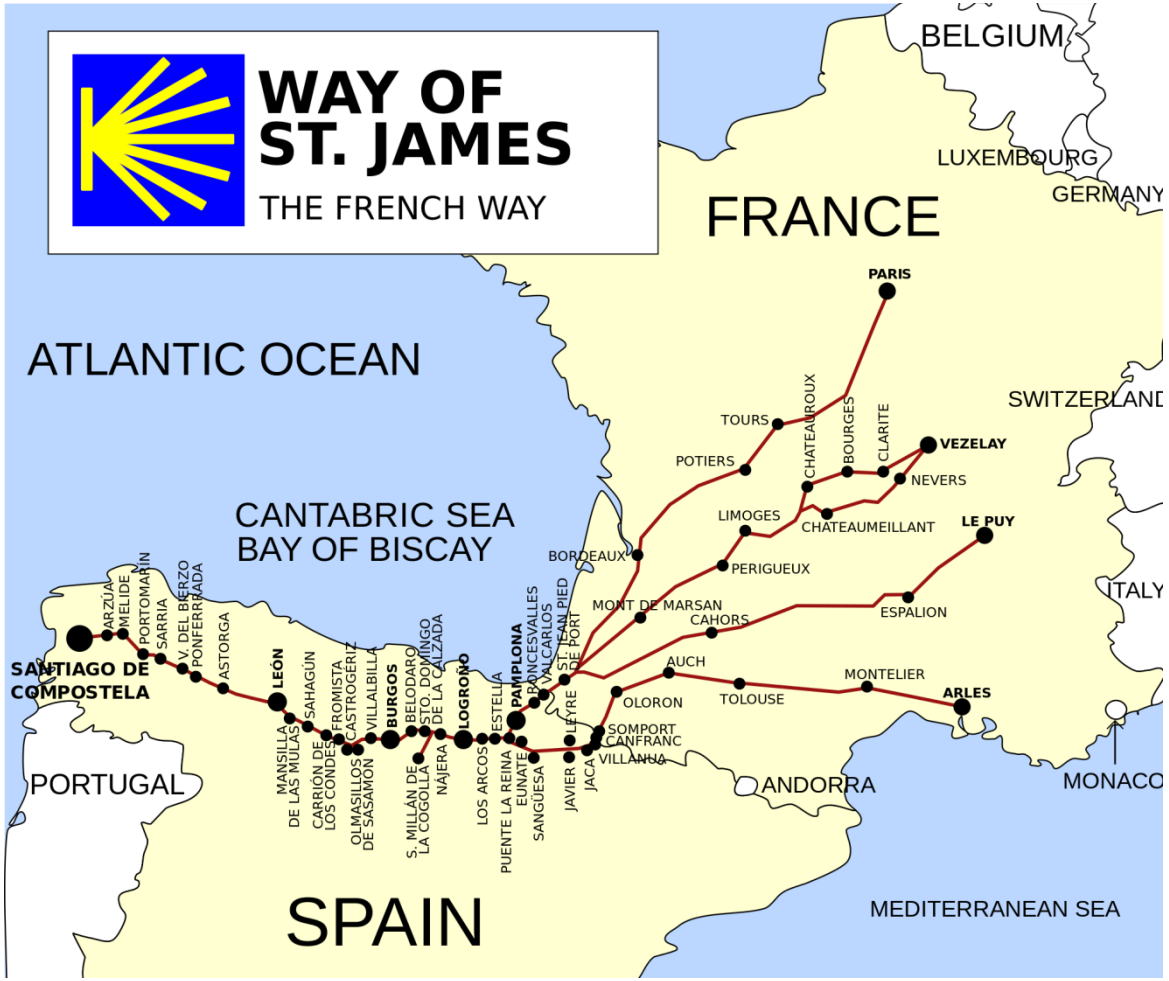
Edward H. Adelson

Differences: the choice set

(Ariely, 2010)

Experimental design

Santiago-Tapas Contest



Experimental design

Experimental design

Experimental design

Participating restaurants	56
Different tapas offered	109
Tapas consumed	35000
Participants in the experiment	100
Participants complete experiment	18
Recommendations generated	500
Recommendations validated	81

Dataset

For each tapa, we gathered:

- Choice sets
  1. Area of tapa
  2. Restaurant of tapa

- Attributes
  1. Type
  2. Character
  3. Restaurant

- Rating

Choice-based models and baselines

- Choice-based models

    1. Standard logit
    2. Mixed logit

- Baselines

    1. Collaborative user-based (kNN)
    2. Basic matrix factorization

Evaluation

- Error Metric I: Given individual c_n, true choice i and recommended item j:

$$\text{error I } (c_n, i) = \begin{cases} 1 & : \text{ if } i \neq j \\ 0 & : \text{ otherwise.} \end{cases}$$

- Error Metric II: Position of real choice in list of recommendations:

$$\text{error II } (c_n, i) = k - 1 \text{ if } i_k \neq i.$$

- Validation: 100 run, two-fold 75-25% training-test sets validation, and leave-one-out validation

Results: Models fitting

	New zone	Old zone	Outlying zone
Cheese	-0.07	**-0.25**	
Egg	**-2.48**	**0.31**	
Fish	**-0.46**	-0.02	0.14
Meat	0.06	**0.28**	**-0.44**
Shellfish	-0.03	**0.21**	**0.38**
Sweet	0.07	**-0.46**	**-0.38**
Vegetable	**-0.18**	**-0.17**	0.26
Traditional	**-0.62**	**-0.15**	**0.24**
Log-Likelihood:	-13772	-36757	-1913.8

Table 1: Estimation by maximum likelihood of the standard logit model coefficients for different areas of the city. Significant coefficients are in black.

	New zone	Old zone	Outlying zone
Cheese	-0.07	-0.24	
Egg	**-2.48**	**0.31**	
Fish	**-0.46**	-0.01	0.13
Meat	-0.07	**0.27**	**-0.67**
Shellfish	-0.03	**0.21**	**0.37**
Sweet	-0.003	**-0.46**	**-0.38**
Vegetable	**-0.18**	**-0.17**	0.26
Traditional	**-0.93**	**-0.09**	-0.01
Log-Likelihood:	-13631	-36680	-1897.9

Table 2: Estimation of the means for mixed logit model coefficients assuming normal distribution for different areas of the city. Significant coefficients are in black.

Results: Prediction errors

	Choice model		UBCF		MF	
	Top 1					
Error	CV_1	CV_2	CV_1	CV_2	CV_1	CV_2
I	0.982	0.987	1	1	1	1
II	27.005	26.921	43.908	43.862	43.843	43.787
	Top 5					
I	0.905	0.904	1	1	1	1
II	23.141	23.097	41.013	40.964	40.945	40.970

Table 5: Cross validation predictions errors for standard logit choice model, user-based collaborative filtering and matrix factorization algorithms in the old area of the city. Random and leave-one-out cross validation are denoted by CV_1 and CV_2, respectively. In this zone, the number of different tapas to be recommended is 62.

Results: Prediction errors

	Choice model		UBCF		MF	
	Top 1					
Error	CV_1	CV_2	CV_1	CV_2	CV_1	CV_2
I	0.955	0.954	1	1	1	1
II	14.552	14.060	25.438	25.475	25.511	25.499
	Top 5					
I	0.795	0.789	1	1	1	1
II	10.606	10.481	22.606	22.640	22.658	22.506

Table 4: Cross validation predictions errors for standard logit choice model, user-based collaborative filtering and matrix factorization algorithms in the new area of the city. Random and leave-one-out cross validation are denoted by CV_1 and CV_2, respectively. In this zone, the number of different tapas to be recommended is 37.

Results: Prediction errors

	Choice model		UBCF		MF	
	Top 1					
Error	CV_1	CV_2	CV_1	CV_2	CV_1	CV_2
I	0.895	0.876	1	1	1	1
II	5.057	4.741	8.885	9.006	8.868	8.824
	Top 5					
I	0.408	0.409	1	1	1	1
II	1.841	1.859	6.262	6.295	6.128	6.115

Table 3: Cross validation predictions errors for standard logit choice model, user-based collaborative filtering and matrix factorization algorithms in the outlying area of the city. Random and leave-one-out cross validation are denoted by CV_1 and CV_2, respectively. In this zone, the number of different tapas to be recommended is 14.

Discussion: Ratings useful in choice models?

- Sure! Ratings can enhance the prediction power of choice-based models!

- Current research: Testing models with possitive results.

Discussion: Real recommendations?

- Project: Smart City Coruña

1. Goal: Event recommendations.
2. Technology: Recommendation Engine

Choice-based Recommender Systems

Paula Saavedra

Pablo Barreiro

Roi Durán

Rosa Crujeiras

(School of Mathematics)

María Loureiro

(School of Business)

Eduardo Sánchez Vila

eduardo.sanchez.vila@usc.es

CITIUS

Grupo de Sistemas Inteligentes

Universidad de Santiago de Compostela