



Human decision-making

Adaptive Decision Support Systems



Human decision-making

ADSS support human decisions

It would be useful to know **how** people make decisions

Help them avoid decisions they later regret

Avoid irrational influences on the decision process

Support all aspects of the decision process

It's not just about making a choice!



How we make decisions

A starting point



Rational decisions

Economists assume that people make **rational decisions**

We make calculated choices

Based on the attributes that matter

We have well-defined preferences

They do not depend on particular descriptions

They do not depend on the method of elicitation

Computation is considered not a problem

Maximize the utility of the choice and select accordingly



Example

Brand	Processor	Memory	HD	price
HP	3.0 GHz	32 GB	1 TB	\$ 1499
Dell	3.4 GHz	16 GB	2 TB	\$ 1299
IBM	3.6 GHz	32 GB	512 GB	\$ 1899
Asus	3.4 GHz	32 GB	3 TB	\$ 1099



Weighted Adding

	$W_1 = .3$	$W_2 = .3$	$W_3 = .2$	$W_4 = .2$	Σwu
Brand	Processor	Memory	HD	price	
HP	3.0 GHz 3	32 GB 5	1 TB 7	\$ 1499 5	4.8
Dell	3.4 GHz 5	16 GB 3	2 TB 8	\$ 1299 7	5.4
IBM	3.6 GHz 6	32 GB 5	512 GB 4	\$ 1899 2	4.5
Asus	3.4 GHz 5	32 GB 5	3 TB 9	\$ 1399 6	6.0

Properties: extensive information search, consistent (not selective),
alternative based and compensatory processing



Seriously?

Is that really how we make decisions?



That's a lot of work

In the real world, you have to do this **over and over again**

Why? Because choices are **contingent** on a variety of factors:

- Goals of decision maker

- Complexity of the task

- Context: valuation of option depends on other options

Examples:

- What to drink in summer/winter?

- Dress to impress/to have fun?



That's a lot of work

So, in real life there is an endless number of choices

Because there's an endless number of contingencies, you never make exactly the same choice twice!

Humans have **Bounded Rationality** (Simon, 1955)

When you have to choose, you usually don't have an answer instantly available

You have to **construct** your answer!

The construction process may vary across individuals and situations



Heuristic decisions

Infinite contingencies and bounded rationality lead to heuristic decision strategies

Decisions are made to achieve (meta-)goals:

- Minimizing cognitive effort and maximizing accuracy

- Minimizing the experience of negative emotion

- Maximizing the ease of justification of the choice

Importance and irreversibility of decision will influence the weight put on each of these meta-goals



Heuristic decisions

Some decision strategies require more effort but are more accurate than others

People apply the strategy that best fits their meta-goals

Let's look at some examples of attribute-based decision strategies...



Lexicographic

Select alternative with the best value on the most important attribute

Brand	Processor	Memory	HD	price
HP	3.0 GHz	32 GB	1 TB	\$ 1499
Dell	3.4 GHz	16 GB	2 TB	\$ 1299
IBM	3.6 GHz	32 GB	512 GB	\$ 1899
Asus	3.4 GHz	32 GB	3 TB	\$ 1399

Properties: limited information search, very selective across attributes, attribute-based and non-compensatory processing



Satisficing

Alternatives are considered sequentially, in order of choice set: the first option that passes the cut-off for all attributes is selected

Brand	Processor	Memory	HD	price
HP	3.0 GHz ✗	32 GB	1 TB	\$ 1499
Dell	3.4 GHz ✓	16 GB ✗	2 TB	\$ 1299
IBM	3.6 GHz ✓	32 GB ✓	512 GB ✓	\$ 1899 ✓
Asus	3.4 GHz	32 GB	3 TB	\$ 1399

Properties: information search varies, selective processing, alternative-based and non-compensatory processing



Elimination by Aspects

Eliminate options that do not reach cut-off for most important attribute, then for second most important until one option is left...

Brand	Processor	Memory	HD	price
HP	3.0 GHz ✗	32 GB	1 TB	\$ 1499
Dell	3.4 GHz ✓	16 GB ✗	2 TB	\$ 1299
IBM	3.6 GHz ✓	32 GB ✓	512 GB	\$ 1899 ✗
Asus	3.4 GHz ✓	32 GB ✓	3 TB	\$ 1399 ✓

Properties: amount information search varies, selective across attributes (varies), attribute-based and non-compensatory processing



Other strategies

Attribute-based choice is just one type of strategy!

Other options (ASPECT):

- Socially-based choice: choose what others chose / advise

- Policy-based choice: follow a predefined strategy (if-then)

- Experience-based choice: choose based on habit

- Consequence-based choice: evaluate actions and consequences (e.g. minimize regret)

- Trial-and-error: try things until you find something you like



Decision biases

Heuristic decisions can be influenced by **external factors**

Things that should not have an influence

This can lead to biased decisions

Let's look at some examples...



Context effects

SAMSUNG 12:03

LocStep

Best friends

John, Dave, Ethan

During work hrs:	Outside work hrs:
☐ nothing	☐ nothing
☐ city	☐ city
☐ city block	☐ city block

Other friends

Ben, Robert, Thomas, Mike, Paul, Steven, Frank

During work hrs:	Outside work hrs:
☐ nothing	☐ nothing
☐ city	☐ city
☐ city block	☐ city block

Continue



Best friends

John, Dave, Ethan

During work hrs:

- ☒ nothing
- ☐ city
- ☐ city block

Outside work hrs

- ☐ nothing
- ☐ city
- ☐ city block



Other friends

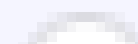
**Ben, Robert, Thomas, Mike, Paul, Steve,
Frank**

During work hrs:



nothing

Outside work hrs



nothing



Best friends

John, Dave, Ethan

During work hrs:

- ☐ nothing
- ☐ city
- ☐ city block
- ☒ exact location

Outside work hrs

- ☐ nothing
- ☐ city
- ☐ city block



Other friends

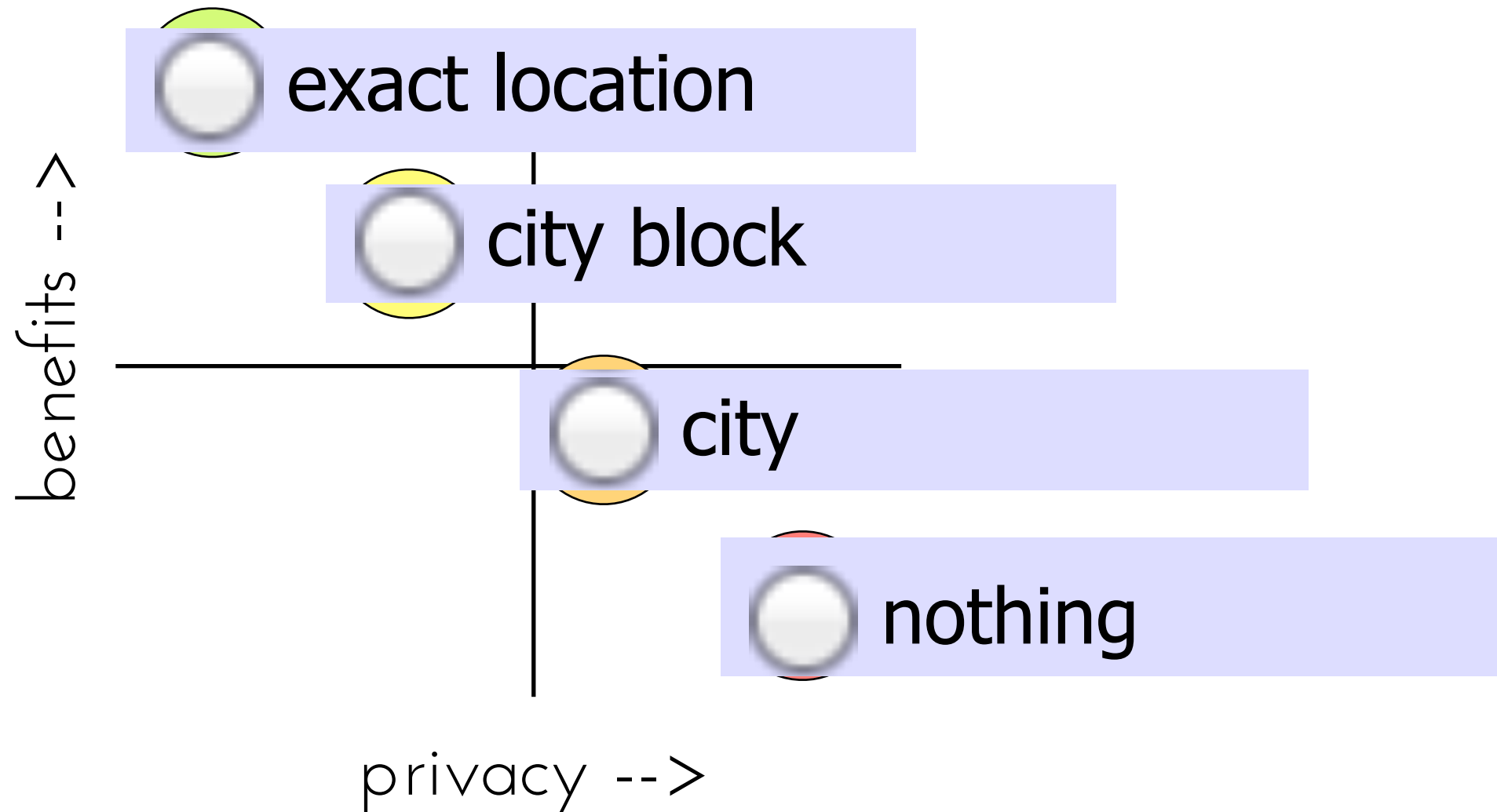
Ben, Robert, Thomas, Mike, Paul, Steve, Frank

During work hrs:

Outside work hrs

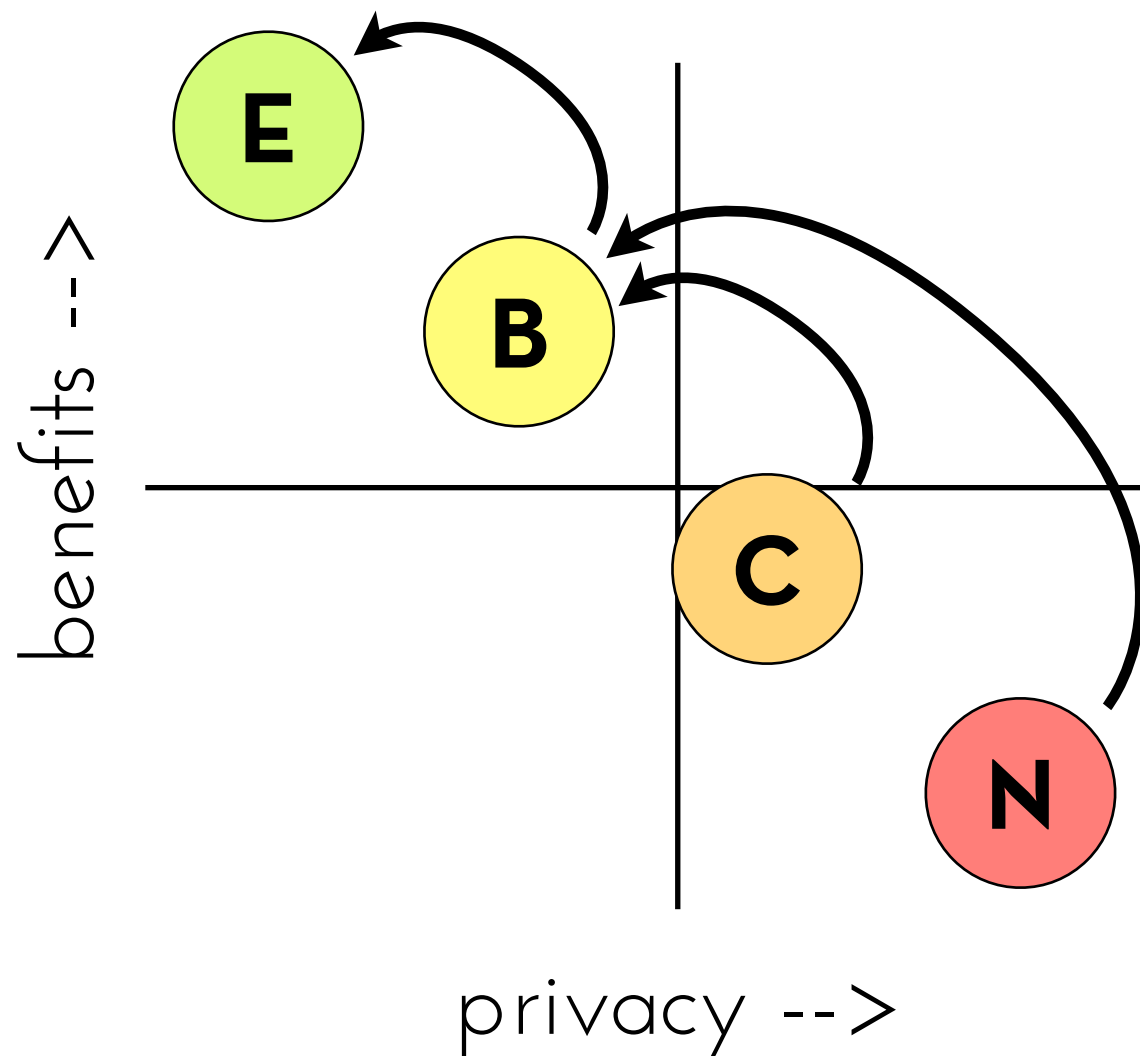


Context effects





Context effects



Introducing an “extreme” sharing option

Expected:

Some will choose Exact instead of Block

Unexpected:

Sharing increases **across the board!**



Order effects

What leads to more disclosure?

Ask non-sensitive questions first, increase sensitivity

Ask sensitive questions first, reduce sensitivity



Defaults + framing

What begets most sign-ups?

☐ Sign me up for newsletters **25%**

☐ Do NOT sign me up for newsletters
37%

☒ Sign me up for newsletters **53%**

☒ Do NOT sign me up for newsletters
0%



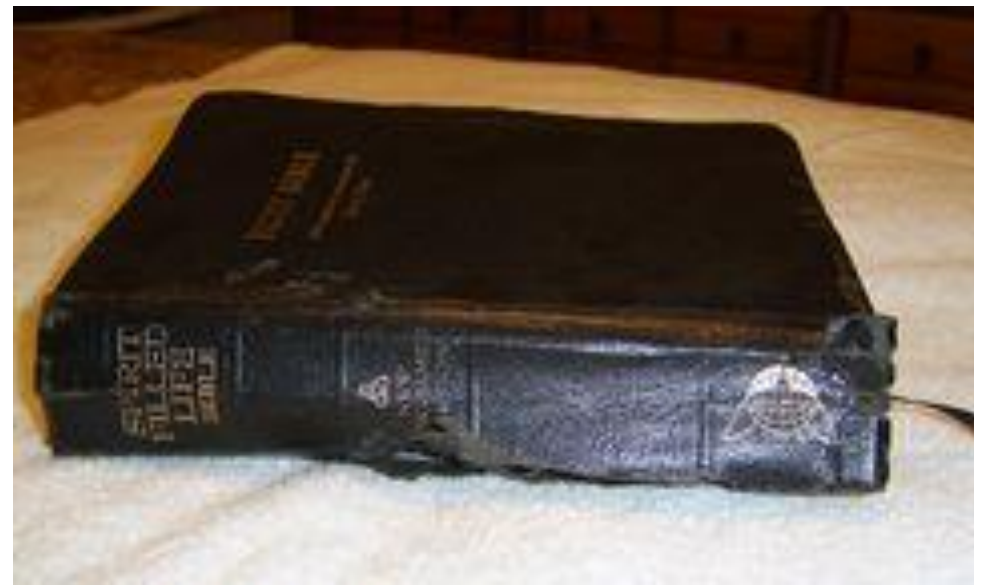
Elicitation effects



Dictionary A

10 000 entries

Like new



Dictionary B

20 000 entries

Cover torn



How to support users

In making their decisions



Decision support

How can we help users make good decisions?

1. MAUT-based recommenders

Using weighted adding as a **prescriptive model** rather than a descriptive model

Downsides:

This only works when attributes are available, shared, and well-defined

Negative correlations between attributes result in difficult trade-offs (see upcoming lecture on choice overload)



Decision support

How can we help users make good decisions?

2. Leverage the decisions of others

Socially-based choice on steroids—collaborative filtering as an example of the **wisdom of the crowd**

Downsides:

What if the crowd isn't that wise? (e.g. because they follow heuristics!)

Could this breed crowd-followers? (more on this next week!)



Decision funnel

Another caveat: there's more to choice than the decision itself

Typical decision phases:

- Explore product information to understand the domain

- Narrow down options to create a consideration set

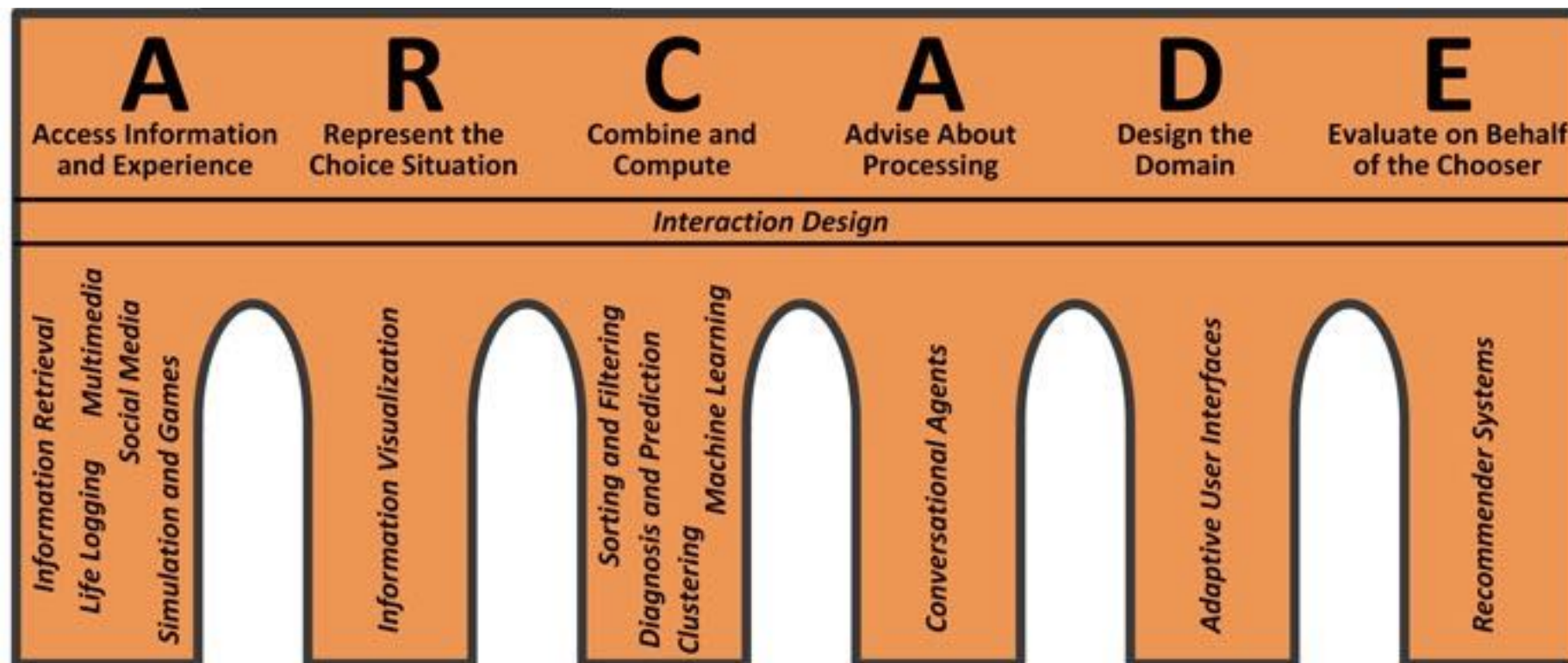
- Evaluate items in the consideration set

- Choose (an) item(s)

Recommender systems really only help with the last step!



Access information





Access information

Gather information that can help the user in making the decision

Attribute information, consequences, past experiences, evaluations by others, etc.

From user data, search engines, social media, simulations, etc.



Represent the choice

Visualize the information in a way that supports the decision

E.g. an attribute table, a list of possible consequences / longer-term effects, overview of opinions, etc.

Straightforward presentation is important here!



Combine + compute

Integrate the information about the items with knowledge about the user's preferences

Sorting/filtering by attribute, predicting consequences, clustering of other users' opinions, applying a decision policy

Help the user make the decision, don't make the decision for them!



Processing advice

Even after these steps, some decisions are still really difficult!

Decision-makers will have to carefully weigh pros and cons, make comparisons, make trade-offs, break ties

Provide personalized advice in a conversational format



Design the domain

Reconceptualize the decision-domain to support simpler decision-making

Example from privacy: use machine learning to boil down a hundreds of privacy decisions into a small set of default privacy profiles



Use case:

2,800 public IoT-related scenarios + decisions from 200 participants

Manipulate scenarios along 5 dimensions

Example: “A device of a friend (who) records your video to detect your presence (what). This happens continuously (when), while you are at someone else’s place (where), for your safety (why).”

Choice to allow or reject this scenario



Results

Let's say we create a **layered** settings interface

What parameter should be at the top?

What has the **most influence** on the user's decision?

Regression modeling to determine parameter order

Result: who > what > why > when > ~~where~~



Results

What about the **default setting**?

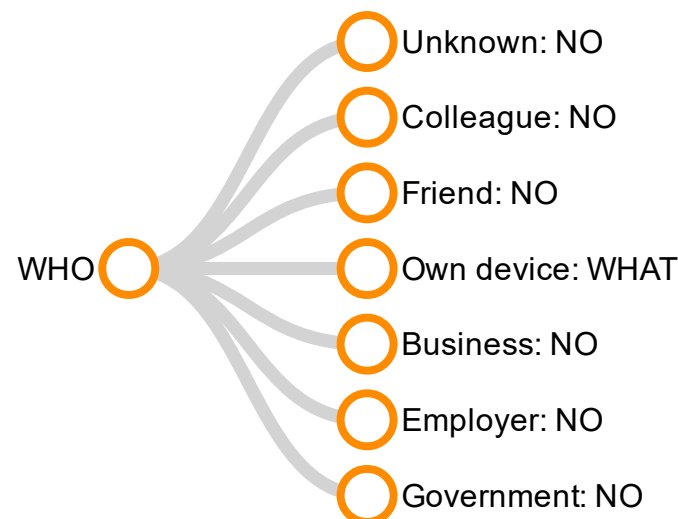
Everything on by default: 28% correct

Everything off by default: 72% correct

What if we make our **best guess**?

Predict based on who, what, where, when, why:

75% correct

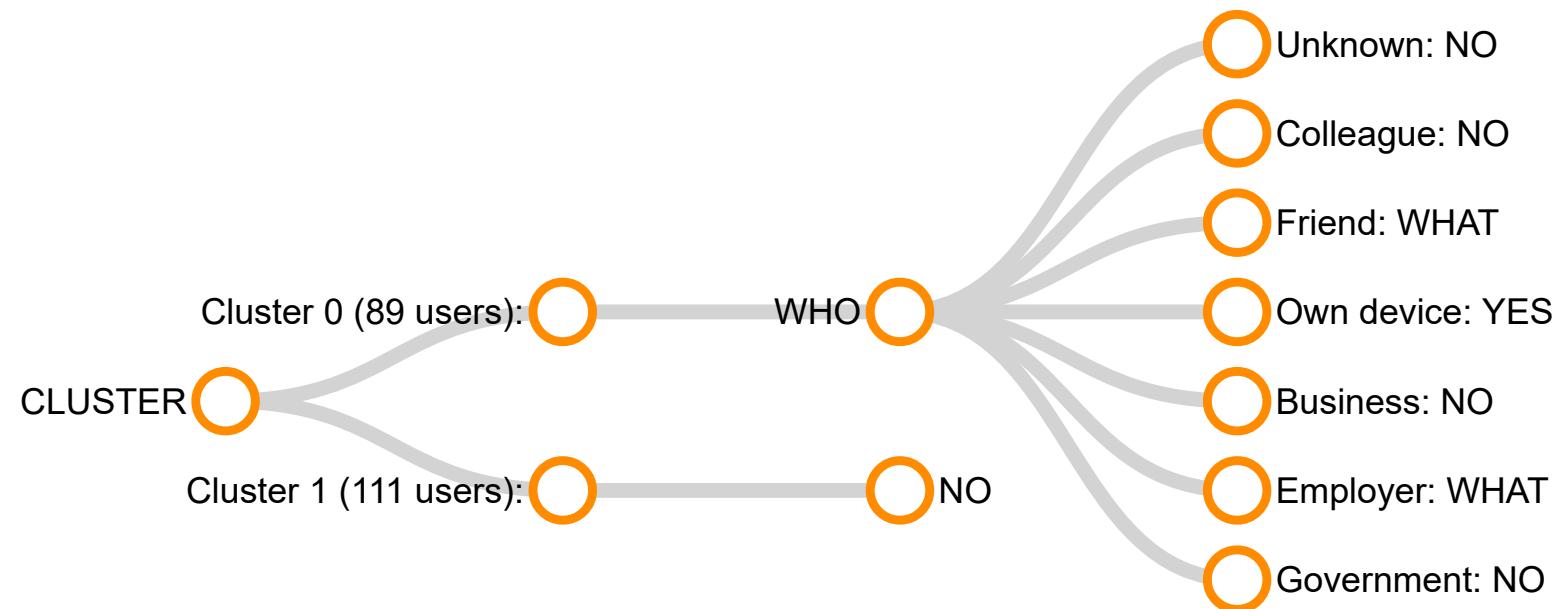




Results

Divide participants based on overall attitudes?

Two **profiles**: Correct 77% of the time!

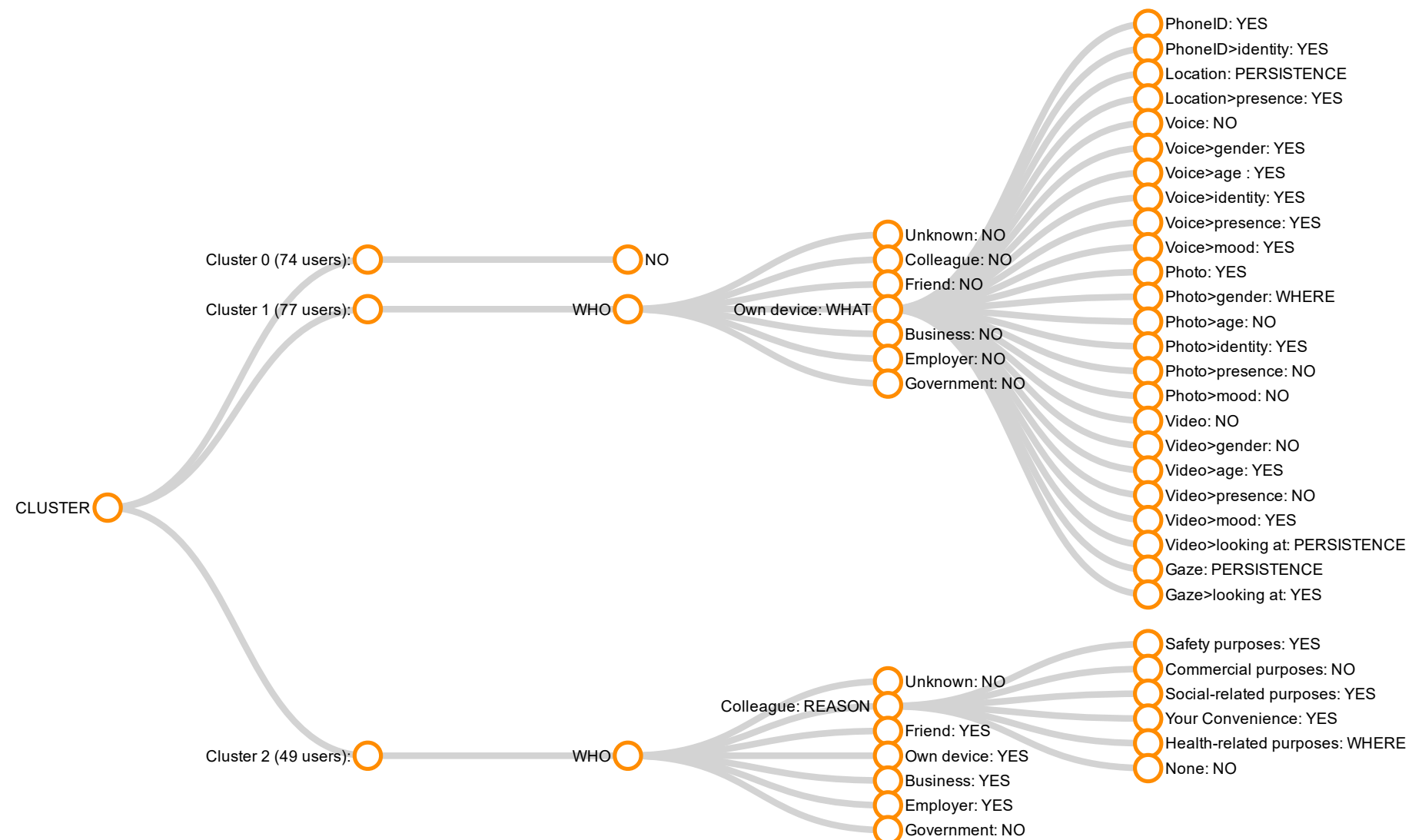




Results

What if we divide participants on the fly?

Three profiles: Correct 82% of the time!



Step 1: choose a profile

Default profiles

Please select a profile
(you can change individual settings on the next screen)

Limited collection

This profile allows the collection of:

- any data by the **your own devices**, your **friends' devices**, your **employer/school's devices**, and **devices of nearby businesses**
- any data by your **colleagues' devices**, but only for **certain reasons**

[learn more...](#)

Limited collection, personal devices only

This profile allows the collection of:

- **certain types** of data by the **your own devices**

No collection

This profile **prevents** the collection of **any** data

next >

IoT Settings

Which **devices** may collect your personal information?

My own devices	☒	more >
Friends' devices	☒	more >
Colleagues' devices	☐	more >
Devices of nearby businesses	☐	more >
My employer's devices	☐	more >
Government devices	☐	more >
Unknown devices	☐	more >

Friends' devices

What **type of data** may your friends' devices collect?

Voice, to determine my...

age	☒	more >
identity	☐	more >
gender	☒	more >
mood	☒	more >
presence	☐	more >
(other)	☐	more >

Photos, to determine my...

age	☐	more >
identity	☐	more >
	☒	more >

Voice - age

For what **purpose** may your friends' devices record your voice to determine your age?

Safety

never	☒
once	☐
continuously	☐

Health

never	☐
once	☒
continuously	☐

Convenience

never	☒
once	☐

Step 2: adjust the default settings



Evaluate for the user

This is what recommender systems typically do!

Mostly attribute-based and socially-based choices

But also trial-and-error (conversational recommenders)
and policy-based choices (a “wizard”)

Big question: Should we even let the system do this for us?

If we can't get any help with the other steps: sure...

But if we can, then maybe we prefer to do this part
ourselves!



Before we adjourn

Groups!

▼ Group 1

3 students



⋮ Mitali Shrikant Bhosekar ⋮

⋮ Pranita Camasamudram ⋮

⋮ Jushawn J Macon ⋮

▼ Group 2

4 students



⋮ Stephanie Ashley Damas ⋮

⋮ Elizabeth Stephanie Gil...

⋮ Allyson I Hauptman ⋮

⋮ Rohit Mallick ⋮

▼ Group 3

3 students



⋮ Chris Kalahiki ⋮

⋮ Jordan D Payne ⋮

⋮ Jacky F Wong ⋮

▼ Group 4

4 students



⋮ Jeffrey T Black ⋮

⋮ Ishitha Michael ⋮

⋮ Dan Roberts ⋮

⋮ Brodrick Lamont Stigall ⋮

▼ Group 5

3 students



⋮ ATIK ENAM ⋮

⋮ Maithili Mishra ⋮

⋮ Swapnil Srivastava ⋮



Select a topic

Proposed topics (I can help more with these)

- Career / school choice for middle+high school kids

- Career choice for undergrads

- Volunteering opportunities for undergrads

- Volunteering opportunities for retirees

I already have participants lined up for the latter!

If you pick a different topic, you will be responsible for finding participants



Send me an email

Proposed topic: “[decision domain] for [user group]”

Why is this topic interesting to you?

How can ADSS help here?

How will you recruit participants?

Scheduled weekly meeting time

Whether you want to submit an IRB

Required for potential publication, otherwise not

Do this by Monday Sep 19



Questions...