What Are Preferences?
And If So, How Many?

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Etymology and Definitions

- Etymology
  - "Prefer" comes from the Latin words for "carry" and "in front of"
- Dictionary Definitions
  - Collins: "to like better or value more highly"
  - Cambridge On-Line:
    - "to prefer": "to like, choose or want one thing rather than another"
    - "preference": "when you like something or someone more than another person or thing"

How is the Term Used in RecSys? (1)

- What kinds of things do preferences concern?
  - On the object level
    - Items from the domain that are to be recommended
  - On the recommender system level
    - Preferences for particular systems or aspects of systems
      - See, e.g., Knijnenburg, Reijmer, & Willemsen, "Each to His Own: …" at RecSys 2011
      - For example, knowledgeable users preferred the hybrid recommender
- Focus in this talk:
  - On the object level; though many of the same points apply on the recommender system level

Knijnenburg, B. P., Reijmer, N. J., & Willemsen, M. C. (2011). Each to his own: How different users call for different interaction methods in recommender systems. In D. Jannach, G. Adomavicius, B. Mobasher, & R. Burke (Eds.), *Proceedings of the Fifth ACM Conference on Recommender Systems*. New York: ACM.

How Is the Term Used in RecSys? (2)

- Examples of precise, formal uses
  - Evaluations of individual items
    - "*r(U, I)* = the degree of interest, rating, or preference of a user *U* for an item *I*"
  - General evaluations of levels* of particular attributes
    - "*R(U, Aj)* = evaluation by a user *U* of a given level *j* of an attribute *A*"
- Question:
  - What sort of psychological reality underlies these precise uses?

We use the following terminology

Level of an attribute: a particular value that an attribute can take

"Price = $29"

Evaluation of a level of an attributeL how a given person evaluates the possession of a given level of an attribute

"A price of $29 for an iPhone dictionary is very undesirable / worth 2 points on a scale of 10 / ..."

Sometimes, the term *value of an attribute* is used, but this term makes it harder to distinguish between the above two concepts

How Is the Term Used in RecSys? (3)

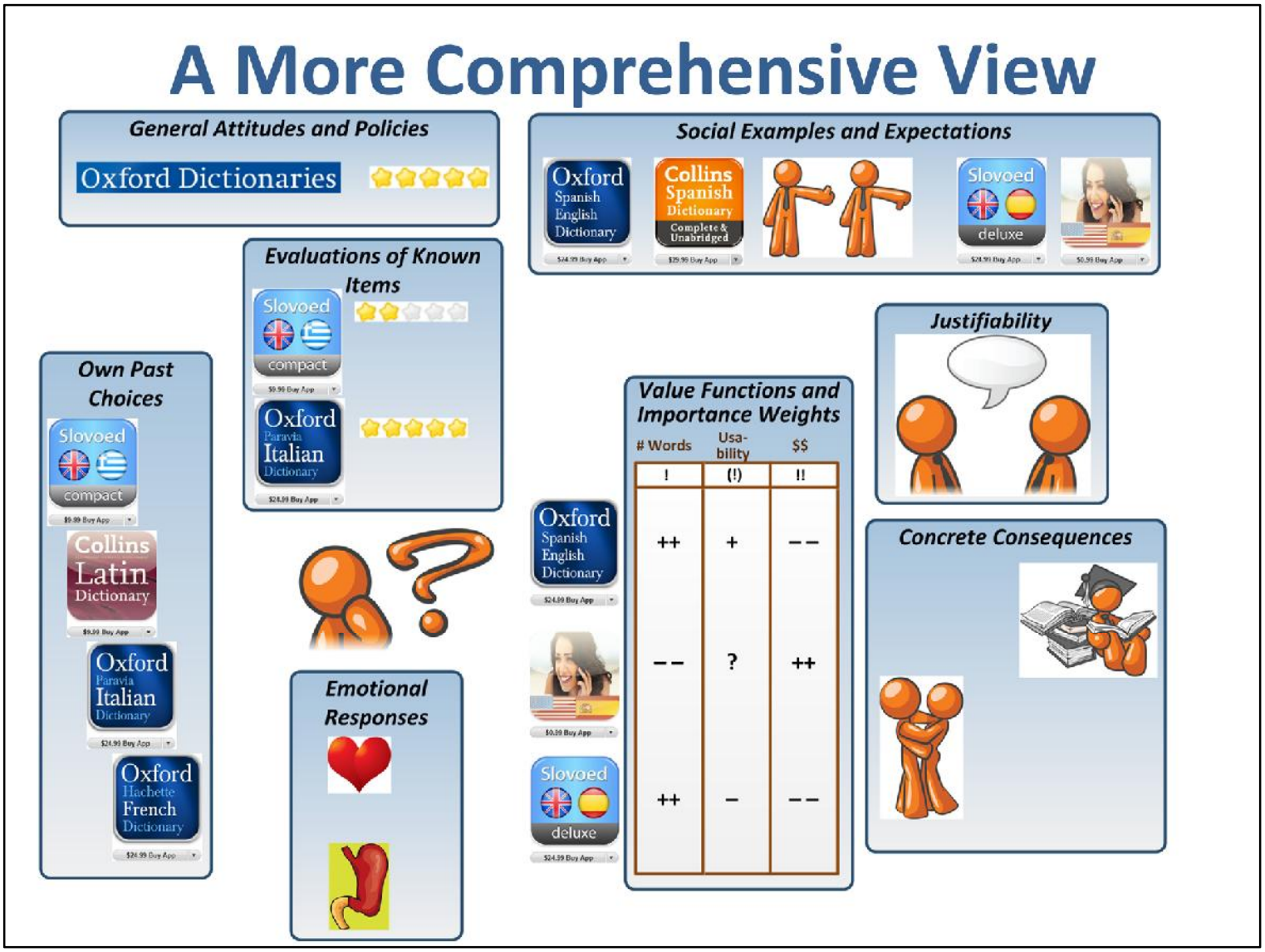
- Global use of the term
  - Whatever in the user's head determines what the user will like / choose / ...
    - "The items presented to the user should depend on the user's preferences."
- Question:
  - What are these things in the user's head?

Background Overview: Considerations That Influence Choices and Decisions

A Classical View of Decision Making

Value Functions and Importance Weights

# Words	Usa-bility	$$
!	(!)	!!
++	+	– –
– –	?	++
++	–	– –



As background for the discussion of the concept of “preferences”, this slide presents a broad overview of the qualitatively different types of consideration that can influence a choice or decision.

It is intended as a compact, high-level synthesis of ideas and results from many complementary lines of research relevant to choice and decision making – each of which typically focuses on a small subset of these types of consideration.

This slide, which was built up and discussed one part at a time in the workshop presentation, is a slightly expanded version of a slide from the following talk:

> Jameson, A. (2011). What should recommender systems people know about the psychology of choice and decision making? Invited talk at *DEMRA 2011, the First Workshop on Decision Making and Recommendation Acceptance Issues in Recommender Systems*, in conjunction with UMAP 2011, User Modeling, Adaptation, and Personalization, Girona, Spain. (Annotated slides available from http://dfki.de/~jameson/pdf/Jameson11DEMRA.pdf)

The slides from that talk include a number of literature references that are relevant to this slide as a whole, as well as a number of sections that discuss the implications of particular parts of this overall picture for recommender systems research – again with literature references.

Further literature and discussion relevant to this slide can be found in the following chapter, though it does not focus on recommender systems:

Jameson, A. (2012). Choices and decisions of computer users. In J. A. Jacko (Ed.), *The human-computer interaction handbook: Fundamentals, evolving technologies and emerging applications* (3rd ed.). Boca Raton, FL: CRC Press. (Available from http://dfki.de/~jameson/abs/Jameson11Handbook.html.)

“Preferences” as Evaluations of Individual Items

Legend

- Here are some results from psychological research

- We're already taking that point into account!

- That suggests a question about recommender systems research …

- That gives me an idea about something that I might do

- Here's what I can read to find out more about this topic
  - In the notes to the slides

Absolute vs. Relative Evaluations

- People don't always choose by evaluating each option and comparing the evaluations

- But they do have a true underlying evaluation of each option, don't they?

- Not necessarily (see the next slides)

- So why do recommender systems focus so much on predicting ratings of individual options?

- It's a useful approximation to enable the recommender to winnow out a candidate set; the user can then choose among the candidates without necessarily evaluating each one

Many phenomena that represent choosing without evaluating are discussed in the following volume:

Lichtenstein, S., & Slovic, P. (Eds.) (2006). *The construction of preference.* Cambridge, UK: Cambridge University Press.

Objection: Rationality Axioms (1)

- Argument
  - If a person's pattern of choices between pairs of items fulfills several reasonable-sounding conditions, then there must exist some number (a *utility*) for each item which allows you to predict their choices in particular cases
  - Example of one of these conditions
    - Transitivity of preference: If you prefer *A* to *B* and *B* to *C*, you will prefer *A* to *C*
  - Anyone whose choices do not meet these conditions is irrational, because they could be used as a *money pump*

An exposition of this argument can be found , for example, in Section 16.2 of:

Russell, S. J., & Norvig, P. (2010). *Artificial intelligence: A modern approach.* Upper Saddle River: Prentice Hall.

Objection: Rationality Axioms (2)

- Response to this objection
  - People's patterns of choice do not in fact conform consistently to such axioms
  - They do, for example, sometimes exhibit intransitivities
    - And if a person shows an intransitive pattern on one occasion, they are not obliged to show it consistently enough to be exploited as a money pump
  - So are people irrational?
    - Only if you define rationality terms of conformity to such normative conditions (as opposed to *ecological rationality*)

On *ecological rationality*, see, e.g., Gigerenzer, G., & Todd, P. M. (Eds.) (1999). *Simple heuristics that make us smart.* New York: Oxford.

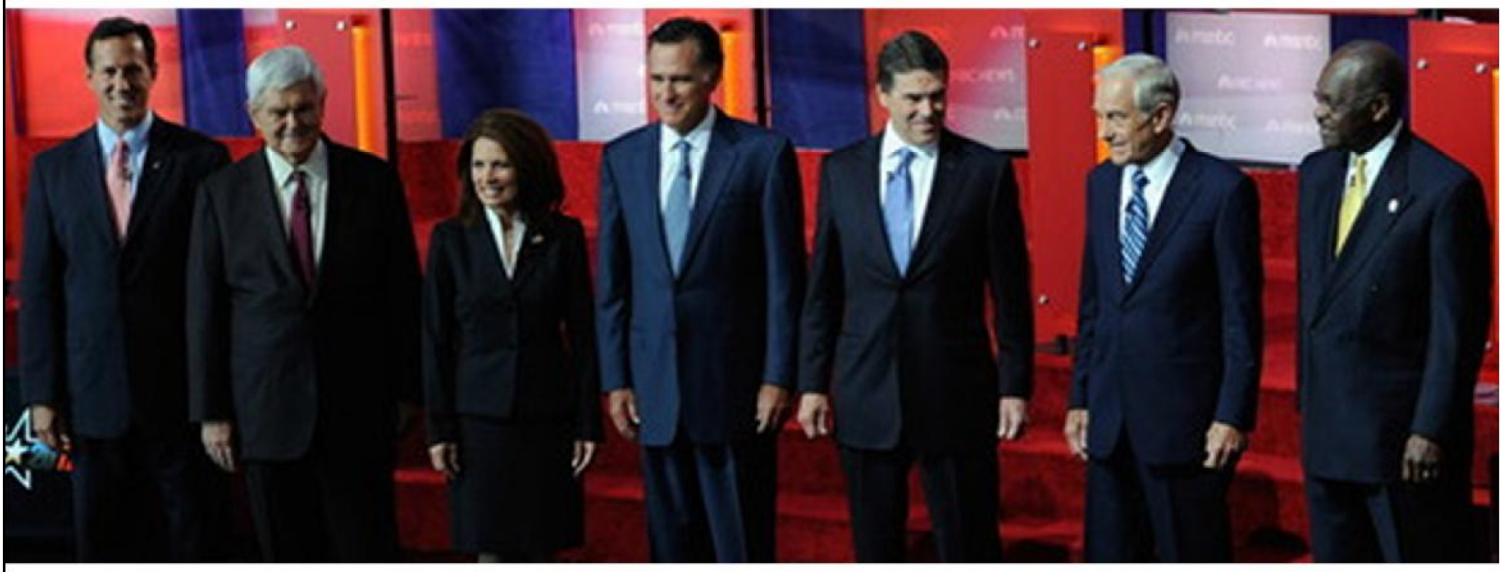
Use of Evaluations of Known Items

- The chooser may consider their evaluations of some relevant known items:
  - Any options that are already known
  - Known items that are similar to the options

- Many recommendation methods likewise use evaluations of known items as input

- What *is* an evaluation of a known item, actually? Is it some stable internal state that can be called a "preference"?

Example Recommendation Domain



Republican candidates for U.S. presidential election of 2012

Constructing an Evaluation

Question

How do you rate Jon Huntsman as a candidate?

The following slides visualize some recurrent ideas from recent psychological theories of the nature of attitudes which are especially relevant to the understanding of "preferences" in recommender systems research. The articles listed below provide detailed discussion.

1. The following article summarizes Fazio's well-known theory which includes the claim that evaluations are sometimes stored in memory and sometimes constructed on the fly; this position is represented in the slides:

Fazio, R. H. (2007). Attitudes as object-evaluation associations of varying strength. *Social Cognition, 25*(5), 603–637.

2. These articles focus on the construction of evaluations:

Gawronski, B., & Bodenhausen, G. V. (2007). Unraveling the processes underlying evaluation: Attitudes from the perspective of the APE model. *Social Cognition, 25*(5), 687–717.

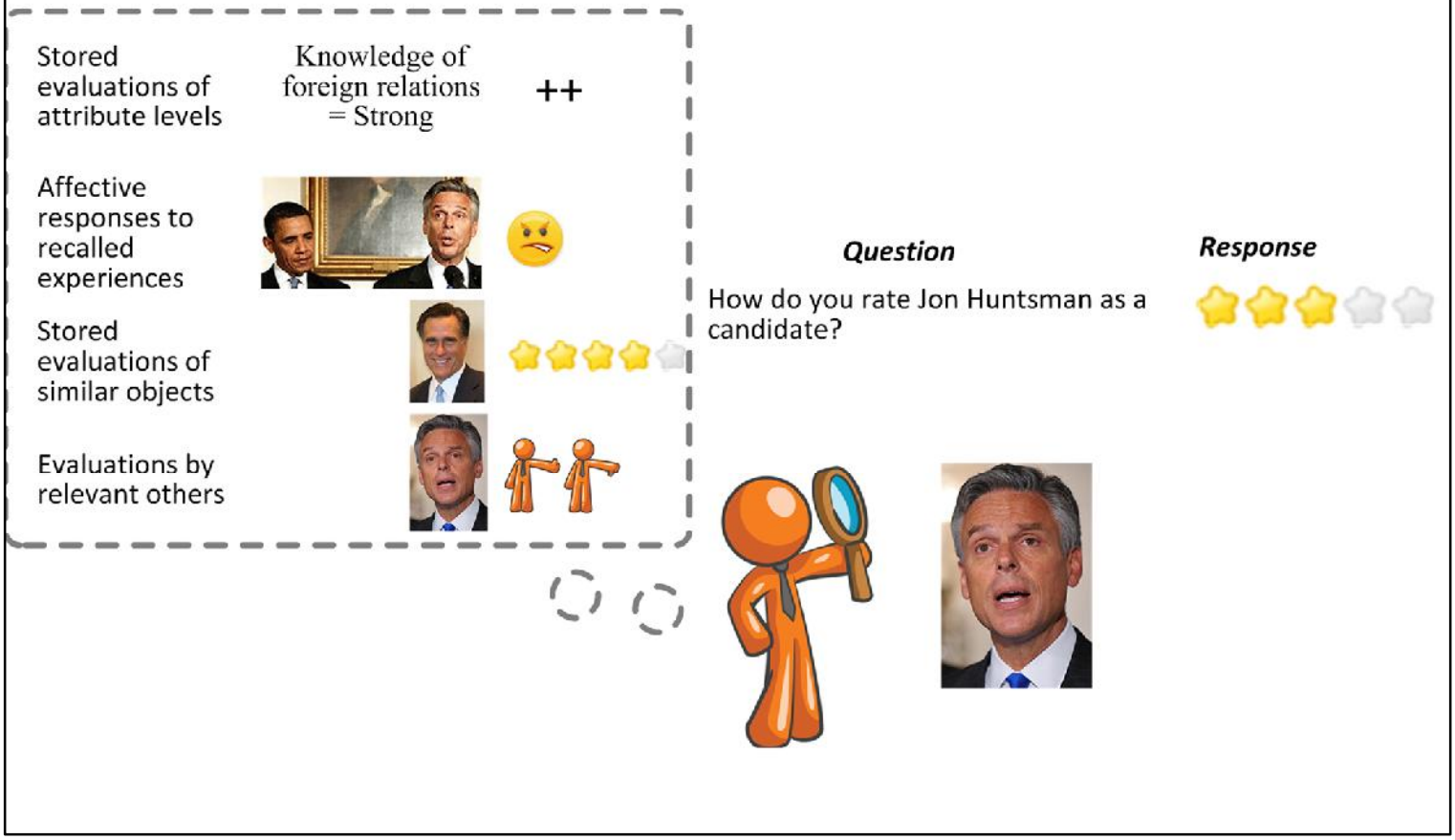
Bassili, J. N., & Brown, R. D. (2008). Implicit and explicit attitudes: Research, challenges, and theory. In D. Albarracín, B. T. Johnson, & M. P. Zanna (Eds.), *The handbook of attitudes*. Mahwah, NJ: Erlbaum.

3. These articles provide general surveys of attitudes and their measurement, respectively, with an emphasis on the construction of attitudes:

Bohner, G., & Dickel, N. (2011). Attitudes and attitude change. *Annual Review of Psychology, 62,* 391–417.

Schwarz, N. (2008). Attitude measurement. In W. D. Crano & R. Prislin (Eds.), *Attitudes and attitude change* (pp. 41–60). New York: Psychology Press.

Constructing an Evaluation



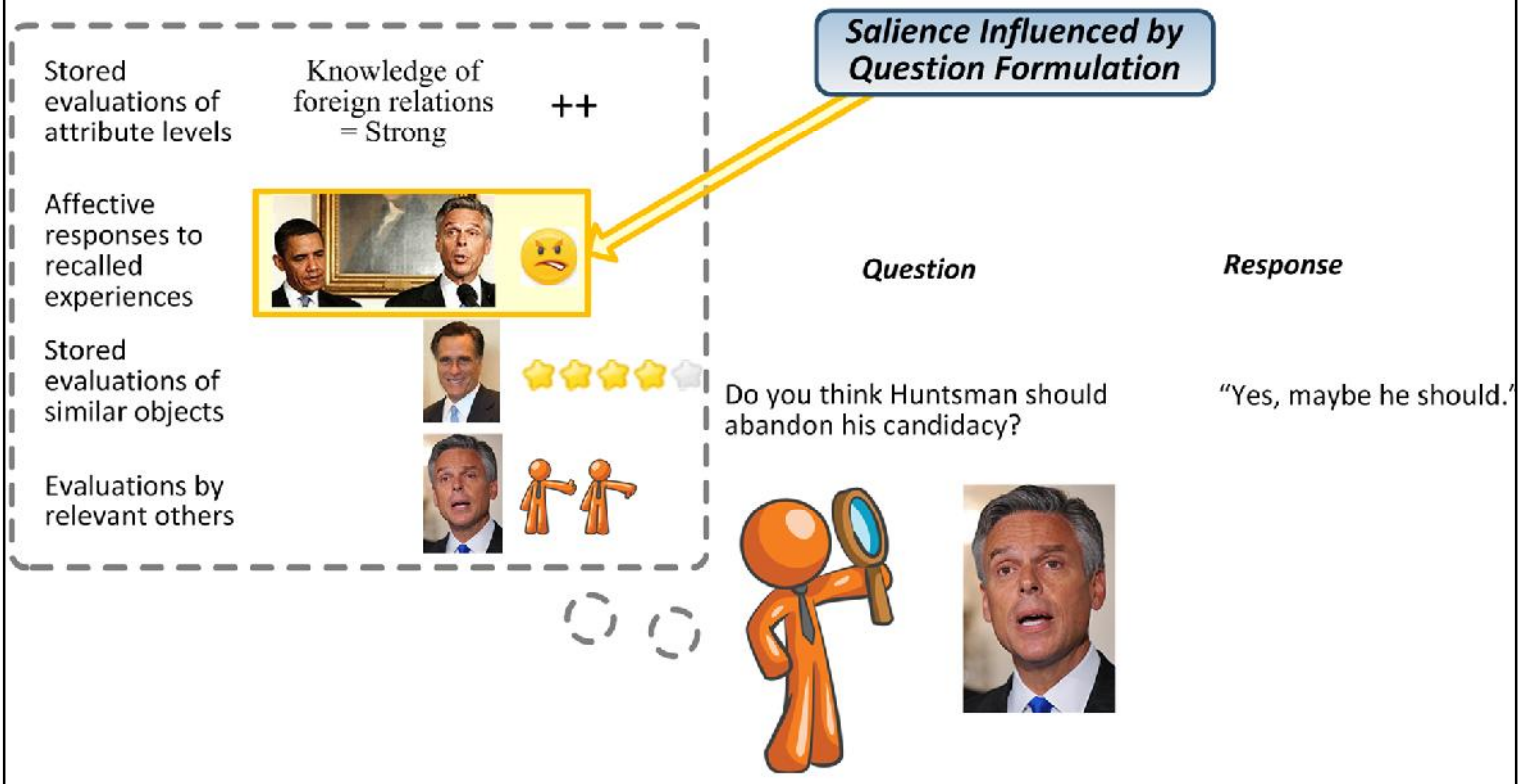
When evaluating an object for the first time, a person samples associations of various sorts, which in different ways suggest positive or negative evaluations.

Like the various considerations shown in the earlier slide about the "more comprehensive view" of decision making, these associations are qualitatively different, and there is no normatively correct way of integrating them to arrive at an overall evaluation.

Moreover, the sampling process can in general not be exhaustive; and the sample that is recruited depends on factors such as the current availability of particular items in memory (which can depend, for example, on the recency of their latest activation).

The sampling process can therefore lead to different overall evaluations in different situations.

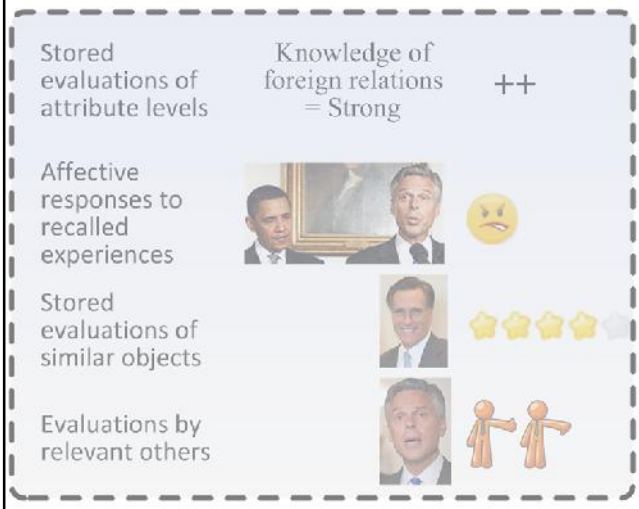
Constructing an Evaluation

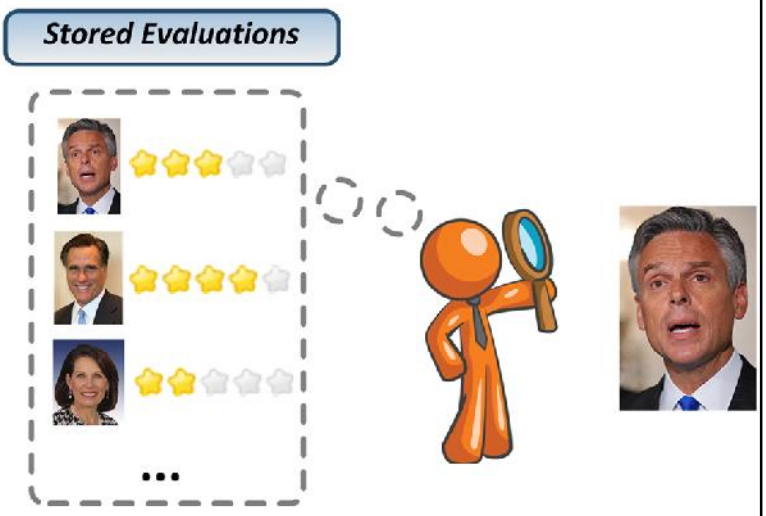


One factor that can influence the sampling of evaluation-relevant associations is the formulation of a question.

The question in this example tends to bring to mind negative associations.

Stored Evaluations



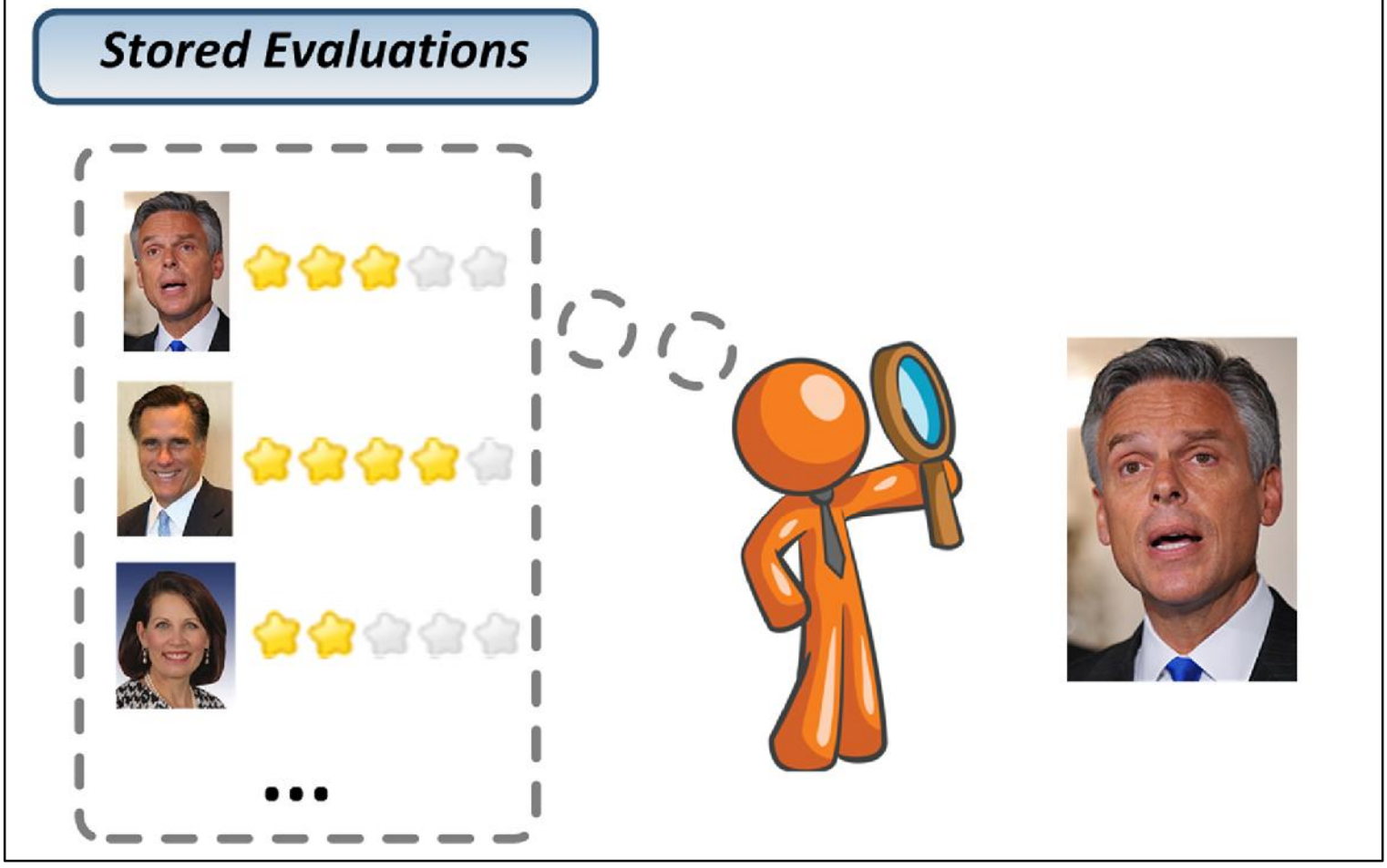


Once a person has evaluated an object one or more times, the resulting evaluation is likely to be stored in memory, much like any other knowledge about the object (see, e.g., Fazio, 2007).

Such stored evaluations can be retrieved quickly and automatically.

They are therefore less susceptible to contextual factors than freshly constructed evaluations – though some on-the-fly construction can still take place, as when new experiences with the object occur.

Stored Evaluations



Preferences as Evaluations of Individual Objects

- A "preference" as an evaluation of a specific object has a fairly clear psychological counterpart in cases where a person has acquired a stored evaluation of the object in question
- Where there is no stored evaluation, a "preference" in this sense must be constructed on the basis of a sample of various types of association that the object in question evokes
- Hence the preference does not exist until the person has some reason to construct it

Preferences as Evaluations of Attribute Levels

- The process of evaluating an individual object seldom matches the classical schema of constructing a weighted average of preexisting evaluations of its levels on various attributes:

1. Even when a person has stored evaluations of levels of attributes, other evaluative associations of various types may influence the overall evaluation of the object (see the slides "Constructing an Evaluation")
2. Often, a person does not have any stored evaluation of an attribute level exhibited by an object.
   - E.g., "How good is it if a presidential candidate has an excellent knowledge of foreign languages?"
   - In such cases, if the person does want to evaluate the attribute level (either on request or as part of the natural process of evaluating an object) he or she will have to construct the evaluation, on the basis of a potentially wide variety of considerations similar to those shown in the slide "Constructing an Evaluation"
   - In particular, when asked to construct evaluations of several different levels of the given attribute, a person may aim to produce a coherent pattern of evaluations (e.g., "The more knowledge of foreign languages, the better"; cf. Ariely's concept of *arbitrary coherence*)

Ariely, D., Loewenstein, G., & Prelec, D. (2003). Coherent arbitrariness: Stable demand curves without stable preferences. *The Quarterly Journal of Economics, 118,* 73–105. Reprinted in Lichtenstein & Slovic (2006).

Ariely, D. (2008). *Predictably irrational.* New York: HarperCollins. (Chapter 2)

Some Other Choice Phenomena That Illustrate the Multifaceted Nature of "Preferences"

More detailed discussion of these phenomena and the issues that they raise for recommender systems will be found in the slides for the DEMRA 2011 workshop talk mentioned earlier.

Framing Effects

- How options are formulated can influence choices, even where essentially the same information is presented

"Includes 95% of words needed by tourists"

"Omits 5% of words needed by tourists"

- People tend to prefer the first option; but do they have a "preference" for it?

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 47*(2), 263–295.

Hastie, R., & Dawes, R. M. (2010). *Rational choice in an uncertain world.* Thousand Oaks, CA: Sage. (Section 12.2)

Dependence on Option Set

- The choice between Options *A* and *B* can be affected by the presence of an Option *C*
  - Waiter: "Fruit salad or ice cream?"
  - Diner: "Ice cream"
  - Waiter: "We also have chocolate cake"
  - Diner: "Then I'll take the fruit salad"

- What "preferences" underlie this pattern of choices?

The following articles describe not only some of the phenomena in question but also ways of modeling them computationally in a parsimonious way:

Roe, R. M., Busemeyer, J. R., & Townsend, J. T. (2001). Multialternative decision field theory: A dynamic connectionist model of decision making. *Psychological Review, 108*(2), 370–392.

Busemeyer, J. R., & Johnson, J. G. (2004). Computational models of decision making. In D. J. Koehler & N. Harvey (Eds.), *Blackwell handbook of judgment and decision making*. Malden, MA: Blackwell.

Hyperbolic Time Discounting

- When choosing between a ***smaller/sooner*** benefit and a ***larger/later*** people often ...
- ... initially plan to choose the larger/later one
- ... then change their minds when the smaller/sooner one is about to become available

- So which one did they really "prefer"?

Read, D. (2004). Intertemporal choice. In D. J. Koehler & N. Harvey (Eds.), *Blackwell handbook of judgment and decision making*. Malden, MA: Blackwell.

Rachlin, H. (2000). *The science of self-control.* Cambridge, MA: Harvard.

Collections of Articles About Temporal Aspects of Choice

Loewenstein, G., & Elster, J. (Eds.) (1992). *Choice over time.* New York: Sage.

Loewenstein, G., Read, D., & Baumeister, R. (Eds.) (2003). *Time and decision.* New York: Sage.

Choosing Based on Social Influence

- When people choose on the basis of ***social examples or expectations***, they may not arrive at any (absolute or relative) evaluation of the options

- Can we say that they have "preferences" in these cases?

Fishbein, M., & Ajzen, I. (2010). *Predicting and changing behavior: The reasoned action approach.* New York: Taylor & Francis. (Chapter 4)

March, J. G. (1994). *A primer on decision making: How decisions happen.* New York: The Free Press.

Repetition of Previous Choices

- For various reasons, people often just choose the ***same option*** they have chosen in similar choice situations in the past
  - For example, they may have formed a ***habit***, which may have been acquired long ago and be triggered now by features of the choice situation

- In these cases, in what sense is the choice due to the chooser's "preferences"?

Habits

Wood, W., & Neal, D. T. (2007). A new look at habits and the habit-goal interface. *Psychological Review, 114*(4), 843–863.

Verplanken, B., Myrbakk, V., & Rudi, E. (2005). The measurement of habit. In T. Betsch & S. Haberstroh (Eds.), *The routines of decision making*. Mahwah, NJ: Erlbaum.

Johnson, J. G., & Busemeyer, J. R. (2005). Rule-based decision field theory: A dynamic computational model of transitions among decision-making strategies. In T. Betsch & S. Haberstroh (Eds.), *The routines of decision making*. Mahwah, NJ: Erlbaum.

Summary and Conclusions

Summary and Conclusions

- People's evaluations and choices are influenced by a variety of qualitatively different considerations
- Each of the approaches to modeling "preferences" that have been developed in the recommender systems field takes into account some small subset of these considerations
- An attempt to take all of them into account would require a hybrid approach to recommendation more complex than anything produced so far; but there is no clear reason to aim for this goal
- Each existing way of modeling preferences can best be seen as a simplified projection which is justifiable in terms of its success in making useful predictions and recommendations, not in terms of its reflection of psychological reality
- But consideration of the psychological phenomena underlying the term "preferences" can yield new ideas about how recommenders can help people make choices.*
- It can also help with the formulation of realistic approaches to complex forms of recommendation such as recommendation to groups and context-aware recommendation

*A number of ideas of this sort are offered in slides for the DEMRA 2011 talk mentioned earlier.

Recommendation to groups

Jameson, A., & Smyth, B. (2007). Recommendation to groups. In P. Brusilovsky, A. Kobsa, & W. Nejdl (Eds.), *The adaptive web: Methods and strategies of web personalization* (pp. 596–627). Berlin: Springer.

Masthoff, J. (2010). Group recommender systems: Combining individual models. In F. Ricci, L. Rokach, B. Shapira, & P. B. Kantor (Eds.), *Recommender systems handbook* (pp. 677–702). Berlin: Springer.

Context-aware recommendation

Adomavicius, G., & Tuzhilin, A. (2010). Context-aware recommender systems. In F. Ricci, L. Rokach, B. Shapira, & P. B. Kantor (Eds.), *Recommender systems handbook* (pp. 217–253). Berlin: Springer.